DOCUMENT RESUME

ED 111 147 95 EC 073 521

AUTHOR Tetley, Pamela Anne
TITLE Continuous Description, Measurement and Modification of Teacher and TMR Pupil Behaviors through the Use of Precision Teaching and Interaction Analysis. Final Report 38.3.
INSTITUTION Indiana Univ., Bloomington. Center for Innovation in Teaching the Handicapped.
SPONS AGENCY Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.
PUB DATE Dec 74
GRANT OEG-9-242178-4149-032
NOTE 142p.; Page 143 of the original document is copyrighted and therefore not available. It is not included in the pagination

EDRS PRICE MF-$0.76 HC-$6.97 Plus Postage
DESCRIPTORS Exceptional Child Research; Feedback; *Interaction Process Analysis; Mentally Handicapped; Observation; *Performance Factors; *Precision Teaching; Teacher Education; *Trainable Mentally Handicapped

ABSTRACT

Investigated was the effect of training in precision teaching and interaction analysis on the performance of eight moderately retarded 10- to 20-year-old pupils. Seven hypotheses were formulated regarding two questions: Do rates of teacher-selected teacher and pupil behavior differ before, during, and after feedback conditions? Do rates of three questioning patterns differ before, during, and after feedback conditions? Interaction analysis data were gathered for 30 teaching sessions under three conditions: tutoring before training and feedback, training and subsequent feedback regarding verbal interactions, and removal of feedback. Results suggested seven conclusions, including lack of correlation between selected pupil and teacher categories when amount of change was not specified, and the ability of the moderately retarded to produce broad responses. Five appendixes, including a description of the coding system, are provided. (CL)

CONTINUOUS DESCRIPTION, MEASUREMENT AND MODIFICATION OF TEACHER AND TMR PUPIL BEHAVIORS THROUGH THE USE OF PRECISION TEACHING AND INTERACTION ANALYSIS[1]

Pamela Anne Tetley

December, 1974

Center for Innovation in Teaching the Handicapped

Indiana University

Final Report 38.3

[1]This research was partially supported by Grant #OEG-9-242178-4149-032 from the U. S. Office of Education, Bureau of Education for the Handicapped to the Center for Innovation in Teaching the Handicapped. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

CONTENTS

Page

LIST OF TABLES v

LIST OF FIGURES vi

Chapter I 1

INTRODUCTION 1

Interaction Analysis 1
Precision Teaching 2
Statement of the Problem 3
Definition of Terms 4
Pupil Category 4
Teacher Category 4
Objectives Attained Per Session 5
Pattern 5
Rate 5
Feedback 5
Baseline 5
Modification 5
Post-Modification 5
Hypotheses 6
Summary of Hypotheses 11
Summary 12

Chapter II 13

RELATED LITERATURE 13

TMR Efficacy Studies 13
The Use of Interaction Analysis in Classrooms for the Retarded Pupils 18
The Use of Precision Teaching with Retarded Pupils 25
Summary 27

Page

Chapter III 29

METHOD 29

Subjects 29
Teachers 29
Pupils 30
Materials 31
Instruments for Data Collection 31
Training of Coders 31
Precision Teaching Tools 31
Lesson Plans 32
Diagnostic Test 33
Procedures 33
Orientation 34
Baseline 34
Training Sessions 34
Modification 35
Post-Modification 35
Collection of Data 35
Summary 37

Chapter IV 38

RESULTS 38

Hypothesis 1 38
Hypothesis 2 40
Hypothesis 3 42
Hypothesis 4 44
Hypothesis 5 44
Hypothesis 6 47
Hypothesis 7 48
Summary 50

Chapter V 51

CASE STUDIES 51

Dyad A 51
Dyad B 54
Dyad C 59
Dyad D 63
Dyad E 67
Dyad F 69
Dyad G 73
Dyad H 77
Summary 77

Page

Chapter VI 80

DISCUSSION 80

Summary of Study 80
Conclusions 86
Implications for Further Research 87
Implications for Teacher Education 89
Implications for Classroom Teachers 90

REFERENCES 92

APPENDICES 97

A. Teacher Pre-Post Test 97

B. Coding System 99

C. Precision Teaching Tools 107

D. Diagnostic Test and Lesson Plans 110

E. Lindsley Mid-median Test of Exact Probability 127

TABLES

Page

1. Scores of Teachers 29

2. IQ and CA of Pupils 30

3. p Values for Pupil Category H:1 40

4. p Values for Teacher Category H:2 41

5. Pearson Product Moment Correlations H:3 43

6. p Values for Drill Pattern H:5 45

7. p Values for Clarification Pattern H:6 47

8. p Values for Broad Question Pattern H:7 49

9. Summary of Results 81

FIGURES

		Page
1.	Pattern Examples	5
2.	Five Phases of the Workshop	33
3.	Levels of Significance for H:1	39
4.	Levels of Significance for H:2	40
5.	Levels of Significance for H:5	44
6.	Levels of Significance for H:6	46
7.	Levels of Significance for H:7	48
8.	Dyad A Pupil and Teacher Categories	53
9.	Dyad A Patterns	55
10.	Dyad B Pupil and Teacher Categories	57
11.	Dyad B Patterns	58
12.	Dyad C Pupil and Teacher Categories	60
13.	Dyad C Patterns	62
14.	Dyad D Pupil and Teacher Categories	64
15.	Dyad D Patterns	66
16.	Dyad E Pupil and Teacher Categories	68
17.	Dyad E Patterns	70
18.	Dyad F Pupil and Teacher Categories	71
19.	Dyad F Patterns	72
20.	Dyad G Pupil and Teacher Categories	75
21.	Dyad G Patterns	76
22.	Dyad H Patterns	78

Chapter I

Introduction

Efforts to evaluate the effectiveness of special classes for the trainable or moderately mentally retarded (TMR) have been made several times (Goldstein, 1956; Guenther, 1956; Johnson & Capobianco 1957; Peck & Sexton, 1958; Hottel, 1958; Cain & Levine, 1961). Various standardized tests which purport to measure intelligence and of social competence have been used to describe the effect of special classes on pupils. However, by employing these measures, little information has been obtained about what behaviors teachers and moderately mentally retarded pupils exhibit, and what effect teacher behaviors have on pupil behaviors and pupil academic growth.

Interaction Analysis

The area of teacher education has recently experienced an increase in the amount of research activity focusing on the quantification of verbal teaching behaviors. The underlying goal which prompted this type of research was to determine the specific nature of verbal interaction between teachers and pupils and, based on that information, to manipulate interaction variables and measure the effect in terms of pupil performance.

Interaction analysis (Amidon and Flanders, 1967) is a shorthand method of describing teacher-pupil verbal, and sometimes nonverbal, behaviors in a classroom or instructional setting. Teacher and pupil behaviors are coded such that data reveal sequence. Perhaps the most well-known and extensively used interaction analysis observation system is Flanders' Interaction Analysis (FIA) which divides classroom interaction into ten distinct categories (Flanders, 1967)--four indirect

teacher categories: Accepts Feelings, Praises or Encourages, Accepts or Uses Ideas of Students, Asks Questions; three direct teacher categories: Lectures, Gives Directions, Criticizes or Justifies Authority; two student categories: Student Talk-Response, Student Talk-Initiation; and a tenth category, Silence or Confusion. FIA gave rise to modifications of the system and development of other coding systems, each devised for specific research problems or teacher observation needs (Simon & Boyer 1967).

People who are trained to use a given coding system, those who have memorized which numbers represent which categories, observe a teacher and pupil(s) for a specified period of time and write a number representing the category of behavior which is occurring every three seconds, as in FIA, or every time the behavior or category changes, as in some other systems. This provides continuous objective data about what is occurring between teacher and pupil(s). No value judgment is implied in the naming or numbering of the categories. The data obtained are purely descriptive. Interpretations may vary widely from one set of data to another as they are relevant to different purposes for collecting such data.

Precision Teaching

A system of objective and precise measurement of behavior was developed by Lindsley (1968) and his colleagues and students. It has evolved over the last few years at the University of Kansas Medical Center and is still a dynamic, evolving process.

Precision Teaching (Haughton, 1969) is a precise measurement system designed to facilitate the acquisition of continuous, objective data about specific behaviors. It is not a method of teaching, but a measurement system. Typically, these steps are followed: (a) pinpoint,

(b) record-chart, (c) take aim-set goal, (d) change, (e) try, try, try, and (f) restore (Caldwell, 1968). For example, a teacher noted that Joe was giving short, clipped responses without elaboration on anything he said. He felt that Joe should have more to say. He pinpointed (Step 1) short responses and recorded (Step 2) that behavior of Joe for a while so that he could see a graphic representation of Joe's short responses across time. At the same time, he decided to get a rate on broad, more elaborate responses. He found from the graphs that the rate of short responses was relatively high, and the rate of broad responses was relatively low. His goal (Step 3) became to accelerate the rate of broad responses, and decelerate the rate of short responses. After thinking about his own behavior in time proximity to Joe's pinpointed behaviors, he decided to ask more broad questions (Step 4). After he had done this for a while, he noted from the graphs that the goal was being reached--that short responses were decelerating and broad responses were accelerating. In the event that his goal was not being reached, he would try another approach (Step 5) while still recording the original pupil behaviors. When Joe's short responses had decreased to what the teacher felt was optimum, he restored (Step 6) his own behavior as closely as possible to the original. That is, he no longer concentrated on asking many broad questions. Again, a look at the data will reveal whether Joe's behavior remained at the optimum level it had reached during the change phase. The point is, decisions are made based on objective data gathered across time.

Statement of the Problem

Two systems for describing and measuring behavior have been discussed. Precision Teaching is a measurement system. Interaction

analysis is a descriptive system. By recording rate (from Precision Teaching) of selected or even all categories in a coding system (from interaction analysis), quantitative data are obtained. These data are obtained not only about a specific pinpointed behavior but also about other events which occur in the same situation at the same time. In this study, the processes of interaction analysis and Precision Teaching were combined to provide appropriate data to answer the research questions posed. This study will attempt to provide answers for the following questions:

1. Do rates of teacher-selected teacher and pupil categories of behavior differ before, during, and after feedback conditions?

2. Do rates of three questioning patterns differ before, during, and after feedback conditions?

Both Precision Teaching and interaction analysis are considered feedback systems. Rate, rather than frequency or percent, is used because percent has a ceiling and does allow for genuine comparison. Frequency allows no basis for comparison where time is not constant. Rate, or frequency divided by time, overcomes these problems (Caldwell, 1966). Selected categories of a coding system were plotted on graphs over a particular period of time in order to assist the teachers in making decisions about teacher-pupil interaction strategies. Computing and plotting rate of selected categories in a coding system provides a way of quantifying descriptive data.

Definition of Terms

Pupil Category. Pupil category is defined as any category of behavior in the coding system which is exhibited by the pupil.

Teacher Category. Teacher category is defined as any category of behavior in the coding system which is exhibited by the teacher.

Objectives Attained per Session. Objectives attained per session refers to the movement of pupils through the curriculum which was designed for this study. Rates of objectives reached per session were computed.

Pattern. Pattern is defined as at least one teacher category and one pupil category occurring in sequence, either order.

Rate. Rate equals frequency divided by time.

Feedback. Feedback refers to interaction analysis tally sheets for each session for each teacher in addition to teacher-prepared graphs of selected categories.

Baseline. Baseline refers to the first ten teaching sessions during which teachers received NO FEEDBACK from coders.

Modification. Modification refers to the second ten teaching sessions. Teachers received FEEDBACK in the form of interaction analysis in raw data from coders after each session.

Post-Modification. Post-modification refers to the third ten teaching sessions during which teachers received NO FEEDBACK from coders.

Drill Pattern Example			Tally Sheet	
			T*	P
Teacher:	What color is this?	Narrow Question	2_2*	
Pupil:	Red	Narrow Response		5_2
Teacher:	Yes	Binary Response	1	

Clarification Pattern Example			T	P
Teacher:	What color is this?	Narrow Question	2_2	
Pupil:	What?	Request for Clarification		2_4
Teacher:	What color is this cup?	Clarification	5_4	

Broad Question Pattern Example				
Teacher:	What could you use this cup for?	Broad Question	2_3	
Pupil:	To put sand in.	Broad Response		5_3

*T = Teacher, P = Pupil

**See Coding System--Appendix B

Figure 1. Pattern Examples

Hypotheses

Since it is the firm belief of the investigator that each child's needs differ and each teacher's response to those needs differs, this study addresses itself to each of eight teacher-pupil dyads as a separate entity. That is, each hypothesis was tested eight times, once for each dyad. Each teacher was allowed to identify his own and his pupil's category of behavior which he believed needed to be changed. Since each dyad was treated separately, and since it was not known what categories each teacher would select, the hypotheses were stated in null form.

1. There is no significant difference in rate of a teacher-selected pupil category:
   a) between baseline and modification, or
   b) between modification and post-modification.
2. There is no significant difference in rate of a teacher-selected teacher category:
   a) between baseline and modification, or
   b) between modification and post-modification.
3. There is no significant difference in correlation between rates of teacher-selected pupil category and teacher-selected teacher category:
   a) between baseline and modification, or
   b) between modification and post-modification.

A related and important question follows from the first three hypotheses: How does the intended category change affect the academic behavior of the pupil?

4. There is no significant difference in rate of objectives attained per session:
   a) between baseline and modification, or
   b) between modification and post-modification.

Relative to the second research question, three types of teacher-pupil interaction patterns--a drill pattern, a clarification pattern, and a broad question pattern--seem relevant to interaction between a teacher and a moderately mentally retarded child.

The drill pattern appears relevant because many elementary teachers do exhibit this pattern for a relatively large percentage of time, at least in some grade levels (Furst & Amidon, 1967). The

clarification pattern seems particularly relevant for the type of pupil used in this study because of the language problem some moderately mentally retarded pupils have. The broad question pattern appears to be appropriate for several reasons: (a) to determine whether teachers will think to ask broad questions of a moderately mentally retarded pupil, and (b) to determine if a moderately mentally retarded pupil can respond, as can EMRs (Schmitt, 1969), with broad responses. If so, it may be that this type of question should be asked more often of TMRs to foster types of thinking other than factual recall.

The question-answer pattern has been investigated by Flanders and others (Amidon & Hough, 1967). Teacher questioning in general has been dealt with rather extensively over the years (Gall, 1970). It is not surprising to discover such a large quantity of research on questioning since the asking of questions is one of the most important aspects of teaching methodology. Teachers ask questions for a large number of reasons to get students to think, to ascertain the extent of pupils' knowledge about something, to raise more questions, or perhaps to encourage a multiplicity of responses in a problem-solving situation. Therefore, when one begins to investigate what it is that teachers and pupils do in a classroom, the nature of questioning emerges as one of the most significant problems with which to deal.

In FIA (Amidon & Flanders, 1967) all questions were put into a single category. Subsequent modifications of his system divided the questioning category into narrow questions and broad questions, as in the verbal Interaction Coding System (VICS) (Amidon & Hunter, 1966), then into binary, narrow, broad, and request for clarification as the present study. Based on the assumption that different kinds of

questions invoke different kinds of responses, three distinct patterns can be defined.

A drill pattern involves a teacher ordinary or narrow question, or in cases where a nonverbal physical response is required, a direction followed by a pupil binary response or narrow response, or a nonverbal physical response, sometimes followed by teacher repetition of rephrasing or positive reinforcement, or any combination of the above. Thus, a pattern may be referred to as a drill pattern when the teacher asks or tells the pupil to do something which is predictable by the very nature of the request or question. The pupil gives what he thinks is the predictable response, which may be correct or incorrect. The teacher may or may not respond by providing knowledge of results or reinforcement.

Interaction analysis literature reveals some form or extent of this pattern being used by most teachers (Furst & Amidon, 1967). The question is how much will a pattern be used by a teacher and TMR child in a 1:1 tutorial, and how will it vary under and after feedback conditions. Interaction analysis as a feedback system does affect teacher behavior (Amidon & Hough, 1967). What happened to a drill pattern in each dyad depended upon how the teacher perceived the feedback, and what specific pupil and teacher categories each selected to change. Since each dyad was treated separately and since it was not known what behaviors each teacher would select, the hypothesis is stated in null form.

5. There is no significant difference in rate of a drill pattern:
   a) between baseline and modification, or
   b) between modification and post-modification.

A clarification pattern involves a request for clarification

by either teacher or pupil, followed by a clarification by either teacher or pupil. That is, the teacher may ask the question and the pupil may clarify, or the pupil may ask the question and the teacher may clarify. This pattern may involve a direction, question, or response which apparently was not understood by the one to whom it was directed, thus eliciting a request for clarification.

Since the request for clarification and clarification categories are not found in coding system, no data-based predictions can be made. However, considering the fact the teacher and child in each dyad had not met before, and since the speech of the moderately mentally retarded pupil is often not clear, it seems reasonable to assume that a clarification pattern will be exhibited at least to a small extent by some of the dyads. Since each dyad was treated separately, and since it was not known what categories each teacher would select, the hypothesis is stated in null form.

6. There is no significant difference in rate of a clarification pattern:

   a) between baseline and modification, or

   b) between modification and post-modification.

A broad question pattern involves the use of a broad question or an open-ended statement by the teacher and a broad response by the pupil. The pupil broad response may or may not be followed by more pupil talk.

Broad questions are probably seldom used by teachers of retarded children because retardates are seldom perceived as being capable of responding to broad questions. It has been demonstrated that educable mentally retarded (EMR) children do respond to broad questions (Schmitt, 1969). EMRs are perceived as being more intelligent (IQ 80-60) than TMRs (IQ 60-35). Can TMRs also respond appropriately with a broad response

to a broad question? Does feedback change the teacher's use of the broad question category? Since each dyad was treated separately, and since it was not known what categories each teacher would select, the hypothesis is stated in null form.

7. There is no significant difference in rate of a broad question pattern:
   a) between baseline and modification, or
   b) between modification and post-modification.

Summary of Hypotheses

For each dyad:

1. There is no significant difference in rate of a teacher-selected pupil category:
   a) between baseline and modification, or
   b) between modification and post-modification.
2. There is no significant difference in rate of a teacher-selected teacher category:
   a) between baseline and modification, or
   b) between modification and post-modification.
3. There is no significant difference in correlation between rates of teacher-selected pupil category and teacher-selected teacher category:
   a) between baseline and modification, or
   b) between modification and post-modification.
4. There is no significant difference in rate of objectives attained per session:
   a) between baseline and modification, or
   b) between modification and post-modification.

5. There is no significant difference in rate of a drill pattern:
   a) between baseline and modification, or
   b) between modification and post-modification.
6. There is no significant difference in rate of a clarification pattern:
   a) between baseline and modification, or
   b) between modification and post-modification.
7. There is no significant difference in rate of a broad question pattern:
   a) between baseline and modification, or
   b) between modification and post-modification.

Summary

This chapter provides an introduction and explanation of the processes, interaction analysis and Precision Teaching, leading to a statement of the problem. Terms are defined, and a rationale for each of the seven hypotheses is included.

Chapter II

Related Literature

Literature relevant to the education of moderately mentally retarded pupils indicates that few attempts have been made to objectively measure teacher and pupil behavior. Studies which utilized interaction analysis to record the behavior of teachers of retarded pupils and pupils themselves have been included to show ways in which this process has been used to gather objective data about the interaction between teachers and retarded pupils. Data on teachers of and/or mentally retarded pupils which were gathered via the Precision Teaching process have been discussed to indicate how direct and continuous measurement of the behavior of retarded pupils can assist the teacher in making decisions with regard to behavior and curriculum.

TMR Efficacy Studies

The following studies are cited as examples of attempts (with the exception of the Wayne County Study) to provide justification for the continued existence of classes for the moderately mentally retarded. These efforts are useful in that they provide a moderate amount of direction for further research.

The most extensive and methodologically sound of the controlled TMR studies, Cain and Levine (1961) found some relationship between teacher and pupil behaviors. The general conclusion was that TMRs who lived at home, regardless of whether they attended school, gained in social competency measured by the Cain-Levine Social Competency Scale (Cain, Levine & Elzey, 1963), whereas those who resided in institutions, regardless of whether they attended school, received significantly lower

scores on the Cain-Levine Social Competency Scale. In terms of teacher behavior, results indicated that less than half of the time in school was considered instructional--half of that instructional-social competence, and half of that high adequacy. This amounts to approximately 12-13 percent of the time being spent in high adequacy social competency type instruction in the public school classes. A discussion of social competency scores for the pupils of each teacher individually rather than discussing means of 31 teachers would have provided more meaningful information about relationships between a teacher's behavior and the social competency behavior of his students.

In examining Cain and Levine's criterion for high adequacy--high degree of teacher supervision, materials easily accessible, differentiation among ability levels, distraction handled by teacher with a minimum of interference with the on-going activity, etc., it would seem that value judgments were made based on some preconceived notions of what is "good" in teaching and what is "not good." The fact that inter-observer reliability was high simply means that the observers agreed on their preconceived value judgments. A more meaningful definition of high and low adequacy would involve subsequent behavior of the pupils who were subjected to the teacher's behavior. That is, a teacher behavior is "good" or "effective" if, and only if, it produces a measurable, desirable change in the behavior of the pupil.

Peck and Sexton (1959) observed teachers of moderately mentally retarded pupils. Each of three teachers was observed by three observers who used four sections of the Sanders Descriptive Schedule (Sanders, 1958): Schedule B, Provision for Individual Differences; Schedule D, Social Organization and Classroom Psychological Climate; Schedule E, Efficiency

and Orderliness of Classroom Activities; and Schedule F, Order Maintaining Techniques . Level one described the least desirable procedure and level five described the most desireable. It was agreed that the teaching procedures of group A (Public School Group) and B (Opportunity Center Group) were at about the same level--within the three highest levels of efficiency. And it was agreed that the procedures of Group C (State School Group) teachers were at a slightly lower level. Each teacher was given lesson plans and each pupil was rated six times in two years on nine scales: social adjustment, self-care, language development, arts and crafts, economic usefulness, music, physical development of muscles with and without equipment, and physical development of small muscles. Trend analysis indicated that the trainable mentally retarded children participating in the three experimental groups, as a whole, made significantly greater progress on the nine scales than those in the control group who received no special training program. The three experimental groups did not differ significantly from each other on the nine scales.

In this study, teachers were observed only six times in two years. In the Cain and Levine study, there were only three teacher observations in the same period of time. Even though the investigators in both studies attempted to generally identify teacher behaviors and classroom procedures which may have an identifiable effect on specified pupil achievements (usually test scores), three to six observations in two years are hardly sufficient data to allow one to come to any worthwhile conclusions about the effect of any teacher behaviors on any pupil behaviors.

Hudson (1960) conducted a study to determine amount of emphasis placed on 15 different areas of curriculum in TMR classrooms and to gather enough observational data to develop a much needed inventory

of teacher competencies. She developed a teacher competency checklist based on 200 minutes of observational data on teachers of trainable children in 29 classrooms. She constructed seven major categories: Individual and Group Control; Getting Children Started on Work and Keeping Them Going; Building a Feeling of Personal Worth in the Children; Structuring or Guiding the Learning; Encouraging Cooperative Interpersonal Interactions; Providing for a Mind-Set or Attention; and Drawing from the Children--each with nine or ten subcategories, identified as instructional techniques. Subjective value judgments were built into the checklist.

This is one of the most important steps in identifying teacher behaviors relevant to the progress of teachers and the progress of trainable moderately mentally retarded children. One limitation of Hudson's work is that value judgments are attached to categories of behavior. The wording of the categories implies interpretation rather than simple objective description of the teacher-pupil interaction which is being observed.

The Wayne County Study (England, 1969) was an exploratory study concerned with the relationship between the training, experience, and selected characteristics of teachers and the progress of trainable mentally handicapped children. Eighty-six teachers and 979 TMR pupils were involved. With regard to teacher and pupil variables in general, results indicated that 23 variables of 38 studied failed to show differences related to pupil growth.

Multivariate discriminant analysis was employed to determine what combination of teacher and pupil variables could best indicate which TMRs would gain most and least on the Cain-Levine Social Competency Scale. It was found that only four pupil variables out of 16 applied

to grouping 67% of 300 pupils into a high-gain group. The four pupil variables were number of years a child had been in the program (more years); Cain-Levine self-help score (higher); number of older siblings (more), and age of father (younger). None of the nine teacher variables was related to pupil grouping just mentioned.

Multiple linear regressions of teacher and pupil variables were performed to determine if there were differences between means of pupil growth scores of teacher and child groups on personality and professional characteristics, and to determine if specific teacher and child variables could be used to predict teacher success. Results indicated no differences for the first case; and for the second case, differences were found on two subtests of the Edwards Personality Scale.

Thus, it was concluded by the investigators that "the results of the statistical procedures employed in this study indicated that the vast majority of training, experience, and selected personality characteristics of teachers were unrelated to pupil growth of TMR as measured by the CL (p. 327)." England further stated, "It seems apparent from the Wayne County Study that what occurs between the teacher and the child is the primary factor in the progress of the TMR (p. 329)."

This study was clearly an attempt to gather as much data as possible on a given population and run it through every kind of analysis a computer could perform. Such an approach is useful in that the goal, rather than being merely to obtain highly significant results, was to determine in an exploratory manner what patterns and relationships currently existed and to begin to raise questions and suggest hypotheses for subsequent study. In this way, the study makes a significant contribution.

In summary, the four studies discussed in this section (Cain & Levine, 1961; Peck & Sexton, 1959; Hudson, 1960; and the Wayne County Study, 1969) have shown inconclusive evidence for justification of special classes for the moderately mentally retarded. Several explanations have been submitted for such results in these studies. For example, it was pointed out that an extremely small number of observations were made in both the Cain and Levine (1961) and the Peck and Sexton (1959) studies. Also, the data gathered on teacher and pupil behaviors were not objective, except in some substudies of the Wayne County Study (England, 1969). Hudson's (1960) was the only study of those discussed to make an attempt to categorize behavior; however, value judgments were attached, thus making the observations subjective rather than objective. It was strongly suggested in the Wayne County Study (England, 1969), however, that interaction between pupil and teacher seems a most important factor in the progress of the moderately mentally retarded child.

The Use of Interaction Analysis in Classrooms for the Mentally Retarded

In the following studies some kind of interaction analysis coding system has been used with teachers and either educable or mildly retarded pupils (EMR) or trainable or moderately mentally retarded pupils (TMR). Several other variables are considered in relation to teacher-pupil interaction.

Semmel, Herzog, Kreider and Charves (1969) explored the possibility that teacher verbal behavior via Flanders' Interaction Analysis coding system (FIA) could be predicted form scores on the Minnesota Teacher Attitude Inventory (MTAI) (Cook, Leeds & Callis, 1951). The FIA system was used to gather verbal interaction data on both low and high MTAI

teachers and pupils who were labeled trainable mentally retarded (TMR). It was hypothesized that high MTAI teachers would use more indirect verbal techniques. That is, high MTAI teachers would use more statements that would accept student's feelings, give students praise, accept student ideas, and ask questions more than low MTAI teachers. It was also predicted that low MTAI teachers would be more direct. That is, low MTAI teachers would make more use of lecture, giving directions, and criticism than the high MTAI group. There were seven teachers in each group. The data failed to support the predictions.

It would seem that the N of teachers was probably too small to expect differences based on a measure of attitude. In addition, though the use of an interaction analysis coding system is applauded, two one-hour observations per teacher are hardly a sufficient sample of total classroom behavior. Classroom behavior may differ widely for both teacher and pupil from time to time during the day or from one type of activity to another. A problem with the use of Flanders' basic ten categories in regard to the present investigation is that all questions are in one category, thus no comparison can be made between the England study and the study under investigation.

Semmel and Kreider (1970) explored the relationship between TMR pupil gain in communications skill, as measured by a Cain-Levine Social Competency Scale (CL) subscale, and pupil-teacher verbal interaction, as measured by Flanders' Interaction Analysis coding system. Six teachers whose TMR pupils scored high on the CL communications subscale (referred to as high-gain teachers or HGT) and six teachers whose TMR pupils scored low on the CL communications subscale (referred to as low-gain teachers or LGT) were used. The prediction that the two groups of

teachers would differ was supported by the trend data, allowing for methodological problems. The HGT i/d (indirect/direct) ratio was higher than the LGT i/d ratio. That is, the HGT were less restrictive in their teaching style than the LGT. The authors noted as an aside, in reviewing the characteristics of the teachers, that the LGT on the average were five years older, had three more years of total experience, and had more teaching experience with TMRs than the HGT. It was suggested that as TMR teachers grow older and have more experience they tend to be more restrictive, thus limiting the communications skills of their pupils.

The findings suggest further avenues to explore. No generalizations can be made with an N of six plus six, but the notion of relating verbal interaction with pupil growth is an important one. As in several other studies reviewed here, two one-hour observations are not sufficient as a sample of classroom behavior.

The preceding studies in this section made use of interaction analysis techniques with trainable or moderately mentally retarded pupils (TMR). The following studies made use of interaction analysis with educable or mildly mentally retarded pupils (EMR). The first three studies (Schmitt, 1969; Kreider, 1969; Weaver, 1969) are intervention studies, while the last three (Semmel, Herzog, & Jorgensen, 1965; Fine, Allen, & Medvene, 1968; Stuck & Wyne, 1971) are comparison studies which compare verbal interaction in EMR and regular classrooms.

Three studies made use of a Computer-Assisted Teacher Training System (CATTS) to train teachers of EMRs. CATTS provides immediate <u>in situ</u> feedback via computer and closed circuit television screen. Schmitt (1969) used CATTS to train teachers in the use of broad questions for social studies and arithmetic. She found that while teachers who

received immediate in situ feedback spent a higher percentage of time asking questions than those teachers who did not receive such feedback, the pupils of the teachers who asked more broad questions did not give more broad response, though the trend was in that direction. It would be reasonable to assume that while this was the case with some teachers, others were able to invoke a significantly greater amount of broad responses from their pupils. Kreider (1969) reported that student-initiated talk was greater with teachers who received no CATTS feedback. He also found that use of pupil ideas and student-initiated talk was greater in social studies than in arithmetic lessons. Weaver (1969) found that during baseline, teachers with higher expectancies of TMRs spend more time in teacher use of student ideas than those teachers with lower expectancy. However, the low expectancy teachers spent more time with student ideas during training, contrary, to the direction hypothesized. Also, no significant difference in use of student ideas was found for delayed or immediate CATTS feedback.

These three studies sought to test a system, and results were not uniform. This may indicate that all teachers given the same treatment (in this case CATTS feedback) do not respond with the same degree of appropriateness. Perhaps teacher educators should think about using combinations of different systems of training, almost all of which are effective with some people, until all of the trainees respond appropriately. It may well be that no one method is the "best" method for college teaching any more than any one is for elementary teaching. Each method is effective for some trainees, and for each trainee there is a method or combination of methods to which he will respond appropriately.

Semmel, Herzog and Jorgensen (1965) conducted a brief pilot study in ten regular and ten special (EMR) classrooms. Five of each were primary and the other five intermediate. They used the basic Flanders' system (Flanders, 1963) to compare verbal interaction in regular and EMR classes. Results indicated that in the special classes the following categories were used a significantly greater percentage of the time: praise and encouragement, accepting and using student ideas, and student-initiated response. In the regular class it was found that the category, giving direction, was used more.

As the authors indicated, this was a small preliminary study conducted to suggest areas for further, more extensive research. A few comparison studies have been done since 1965, but many more are needed.

In Fine, Allen and Medvene (1967) the Verbal Interaction Category System (VICS) (Amidon & Hunter, (1966) was used to compare verbal interaction patterns in EMR (educable mentally retarded) and regular classrooms. Directional hypotheses were not made for the reason that little information existed with regard to differences in interaction between the two groups under study. Twelve classes were observed: four upper elementary EMR classes, four regular classes of similar CA (grades five and six), and four regular classes of similar MA (grades two and three). Each class was observed for three separate 20-minute periods including both morning and afternoon sessions. Results indicated that essentially interaction patterns were about the same for all groups, with a slightly greater correlation between EMR and lower class regular groups. Trends indicated that "all" teachers were primarily directive in a didactic role. That is, the teachers talked and initiated activity more than the students did.

As the authors stated, the study leaves something to be desired in terms of scope and design. The trends found are not surprising when one considers the findings of Furst and Amidon (1967), who gathered a large amount of interaction analysis data in the regular grades. Using FIA in 25 classrooms in each of the elementary grade levels, Furst and Amidon found and/or concluded that:

1. Primary grade teachers use more question-answer techniques, whereas intermediate grade teachers use more lecture.

2. Student talk is encouraged more in the primary grades, with the exception of the third grade where the least amount of student-to-student talk is found. However, more student-initiated talk is found in the upper grades accompanied by less praise and encouragement by the teacher.

3. In the upper grades the highest category was lecture, with the silence or confusion category being second highest. It was suggested that teachers in the upper grades feel that independent work is important.

4. Generally, extended indirect influence is found more than direct influence in all grades except third grade.

5. Subject matter to some extent dictates verbal interaction patterns. More indirect influence is found in social studies than in reading or arithmetic. However, even though they are more indirect during social studies, it appears that first, fifth, and sixth-grade teachers consider teacher talk more effective or more important than student independent activity in social studies.

6. The third grade is by far the most fascinating since it does not seem to follow what might be predicted from looking at behavior in the other grades: (a) teacher talk and giving direction begin to increase;

(b) praise, student-initiated response, and acceptance of student ideas is lowest; (c) thus, extended indirect influence is lowest and extended direct influence is highest.

Stuck and Wyne (1971) used Flanders' Interaction Analysis coding system (FIA) to compare pupils-teachers in 27 public school classrooms: nine intermediate EMR (educable mentally retarded), nine intermediate intellectually average, and nine primary intellectually average. Three one-hour observations were made in each classroom. Multivariate analysis of variance was used to analyze the results which indicated that there were no significant differences among the three types of classrooms. Only one significant finding was reported of two multivariate and 18 univariate analyses, and that was that questions asked by special class teachers may go unanswered until the teacher directs the pupil to respond.

It was suggested by Stuck and Wyne that the failure of efficacy studies to find gain in academic achievement for pupils in special classes may be due, at least partially, to the similarity of verbal behavior in special and regular classes. This is an interesting notion and definitely should be explored. They further suggested that the non-significant results may be due to the fact that Flanders' system does not take into account nonverbal behavior which may logically be different in special classes. This is an important point. There are coding systems which purport to measure nonverbal behavior (Simon & Boyer, 1968), and these could easily be employed or adapted for special classes. A third explanation stated, relative to nonsignificant findings, was that perhaps the teacher's performance was not typical (Hawthorne effect) because he was being observed. Some attempt was made to control for this by having the observers interact informally with the teachers prior to data

collection. However, three one-hour observations are not a sufficient sample of behavior to come to any significant conclusions or to make generalizations. This methodological limitation was cited regarding almost all of the interaction analysis studies cited in this review. Stuck and Wyne, as well as Fine et al., also failed to take note of the Furst and Amidon (1967) results in their discussion.

In summary, the studies reviewed in this section made use of interaction analysis techniques in connection with the following variables: the Minnesota Teacher Attitude Inventory, the Communications Skills subscale of the Cain and Levine Social Competency Scale, feedback from a Computer-Assisted Teacher Training System, and similar verbal interaction data from regular class teachers and pupils. In the present study, interaction analysis techniques were used in connection with behavioral objectives as a measure of pupil growth (though this measure could not be used for reasons explained later in the paper), and a measurement system called Precision Teaching (Haughton, 1969). The major objection cited in the studies discussed in this section was that although the use of some kind of coding system is highly desirable, the number of observations was far too small to provide meaningful data. In the present study it is hoped that this objective was overcome by the integration of interaction analysis techniques and a measurement system called Precision Teaching, as all 30 teaching sessions were coded in their entirety.

The Use of Precision Teaching with Retarded Pupils

The process of Precision Teaching (Haughton, 1969) has been used with almost all types of exceptional children. Two studies which made use of the technique with retarded children are reviewed to show application of the process to a whole class of children and to an individual over a relatively long period of time. Very little has been published

with regard to Precision Teaching to date, but it is hoped that this state of affairs will soon be altered.

Fink (1968) compared selection and performance rates of emotionally disturbed and mentally retarded preschoolers in a Montessori classroom. Precision Teaching techniques were used by the regular teacher and assistant for a complete school year for the following purposes: to evaluate the selection (of toys and equipment) rates of each child; to compare differences in performance between the two classes; to determine the effects of synthetic consequation upon performance and selection rates; to contrast the performance and selection rates of classes for each Montessori task; to decelerate and accelerate specific teacher and pupil behaviors; to prepare reports for parents and the school on each pupil; and to compare the results with Montessori's statement about performance and selection rate for each piece of equipment. She found that the mentally retarded preschoolers had lower selection and performance rates on the educational toys than the emotionally disturbed preschoolers, although the retarded children worked faster with the Montessori materials. An interesting finding of this study was while emotionally disturbed pupils appeared to choose most frequently the activities they could do most quickly, the retarded pupils chose least frequently the materials they could do most quickly.

Milbury (1969) conducted a longitudinal study of one 17-year-old boy labeled trainable mentally retarded. The stated objective was to determine whether the boy's verbal capacities could be increased via the process of Precision Teaching. Thirteen categories of verbal behavior were recorded for a school year. Highly significant changes took place for all 13 categories during systematic, direct, and continuous data gathering.

The Milbury study is an investigation of the process of Precision Teaching as applied to one individual; therefore, generalizations cannot be made.

A limitation of the Milbury study as it relates to the present study is that the 13 categories of the verbal behavior were recorded in isolation. That is, no sequence data among the categories were obtained. That technique might have yielded additional meaningful information about the general verbal capabilities of the boy.

In summary, the two studies discussed in this section (Fink, 1968; Milbury, 1969) serve as examples of the utilization of Precision Teaching techniques in two quite different enviornments. The major emphasis is that the data are specific and are gathered daily over a period of time which is consistent with stated goals.

Summary

Three general areas of literature have been reviewed in this chapter: studies in which the efficacy of special classes was dealt with; studies in which interaction analysis was used with retarded pupils; and studies in which the process of Precision Teaching was employed with retarded pupils. The present study was designed to overcome the limitations cited in studies reviewed by integrating the processes of interaction analysis and Precision Teaching. The major objection that too few observations were made was eliminated by the coding of all 30 teaching sessions in their entirety. By doing so, the notion of continuous recording from Precision Teaching is incorporated into the categorization of many behaviors from interaction analysis. Selected categories of raw data from the coding sheets were plotted on graphs for further clarification of quantitative trends from session to session.

Some inconsistencies of philosophy exist in combining the two processes as they were in this study. For the proponent of Precision Teaching, categories of behavior are far too general. That is, it is hardly believable that "all" behavior can be reduced to "only" ten categories. And for the proponent of interaction analysis, coding all sessions in their entirety is hardly practical. The investigator, originally being a proponent of Precision Teaching, arrived at the present marriage of the two systems for the following reasons: (a) although specific pinpointing of single behaviors is all important for objective and consistent recording, sequencing of various verbal and nonverbal behaviors is also considered all important. Therefore, specificity was sacrificed for categorization to get sequencing. Thus, it was emphasized that categories, not behaviors, were graphed. (b) The interaction analysis matrix into which raw data from the coding sheets are usually placed is objectionable because merely reading numbers does not present any sort of picture of day-to-day or lesson-to-lesson quantitative progress. Therefore, instead of moving raw data to a matrix, the raw data of selecting categories were moved to six cycle log graphs such as those used for Precision Teaching data. (c) The notion of continuous recording, that is recording every time the behavior can possibly occur, was taken from Precision Teaching and applied to coding from interaction analysis. Thus, coding was done for all sessions rather than samples of sessions.

Chapter III

Method

The processes of interaction analysis and Precision Teaching were utilized to determine whether selected categories of behavior and three interaction patterns would differ after training and under feedback conditions. The methodology employed in the study is explained in this chapter.

Subjects

Teachers. Eight preservice or inservice teachers were selected on the basis that they had no previous knowledge of interaction analysis or Precision Teaching. These teachers were selected from all those who wished to enroll in an Intersession Workshop (June 2-17, 1970) entitled, Analysis and Practice of Teacher-Pupil Interaction Skills, directed by

Table 1
Test Scores of Teachers

Dyad	Pretest Score	Posttest Score
A	0	6
B	0	7
C	0	0
D	0	7
E	0	7
F	1	7
G	0	7
H	3	7

Dr. Jean Elder, held at Indiana University. A short test was administered (Appendix A) before and after the workshop to determine understandings of interaction analysis and Precision Teaching. Scores are shown in Table 1. A perfect score was seven.

Pupils. Eight moderately mentally retarded children were selected from among seven classes for TMRs, conducted by Stone Belt Association for Retarded Children, Bloomington, Indiana in cooperation with the Monroe County Community School Corporation, on the following basis: geographic

Table 2

IQ and CA for Pupils

Dyad	IQ Score	CA
A	54	12
B	48	16
C	48	13
D	58	12
E	39	17
F	44	16
G	50	14
H	52	16

location, willingness to attend all sessions, enrollment in a special class for TMRs, IQ 35-60, and CA 10-20. Table 2 provides descriptive data on the TMR pupils who were in the study.

Materials

Instrument for Data Collection. A modification of Flanders' original system of interaction analysis (Amidon and Flanders, 1967) was used to code the verbal behavior of teachers and TMR pupils. Each category in the system used in this study has a corollary in the Flanders' system, with the exception of nonverbal categories. A detailed description of the observation schedule used and its Flanders' corollary is found in Appendix B. The modified Flanders' system was developed by viewing videotapes of a teacher and a moderately mentally retarded pupil in a 1:1 tutorial. Thus, the situations from which the system was designed were identical to the situations in which the system was used.

Training of Coders. Three coders were trained on the coding system. Reliability checks were made at the beginning, middle, and end of the experimental period. The Scott Reliability Coefficient (Gregory, 1970) was used to determine the reliability of the three coders. The Scott Reliability Coefficients for the three verbal checks alone were .8, .8, and .8 respectively. Videotapes showing a teacher and a TMR pupil in a 1:1 tutorial were used to train coders. There was no transfer problem for coders moving from these videotapes to viewing a teacher and a pupil in a small observation room through a one-way mirror.

Precision Teaching Tools. A rate computation sheet and six cycle log graph paper (Appendix C) were used by the teachers to compute and plot rate of a teacher-selected pupil category, a selected teacher category, and objectives attained per session. Information on the rate computation sheet includes start and finish time, total time, frequency of the category, and rate for each day or session. The rate computed on this form is then transferred to six cycle log graph paper which

includes position for rates from 0 to 1000 per minute for a period of 140 days or 20 weeks. This graph was designed especially to record behavior. Use of the six cycle log graph al ws a more specific view of changes in behavior. Both forms were developed as Precision Teaching tools by Lindsley (1968) and his colleagues.

Lesson Plans. A sequence of lessons, based on an instructional development (ID) (Briggs, Campeau, Gagne & May, 1967) model including audience analysis, behavioral objectives, entry behavior, strategy, resources, and criterion, was written on telling time. These lessons formed the curriculum for telling time used in this study. Audience analysis is a brief description of the learner, as pertinent to the task at hand. A behavioral objective is one which is stated in observable, measurable terms. Entry behavior is typically noted as a behavioral objective which should already have been achieved before the current behavioral objective is attempted. Strategy is simply a method of teaching the objective. Resources are materials used to implement the strategy; and criterion is a test-like item or situation which stems directly from the behavioral objective.

Each lesson plan (Appendix D), as given to the teachers, included the following items of the ID model: behavioral objective, entry behavior, and criterion. The teachers were instructed to plan their own strategies and develop or select their own resources from materials which were made available to them during the workshop period. Teachers were not provided with strategies and resources. It was felt that these would tend to dictate interaction patterns or categories which the teacher might choose to change in himself or his pupil, thus interfering with the testing of the hypotheses.

Diagnostic Test. A diagnostic test (Appendix D) was developed based on criteria for each behavioral objective in the curriculum. It was used to place children in the curriculum and was administered prior to teacher planning.

A criterion item was written for each behavioral objective in the curriculum for telling time. For example, objective number one was: to be able to name the number 1. The criterion item for that objective was: write the number one. Show it to the pupil. Ask: What number is this? (Write the pupil response in the box.) The test consists of 67 items related to telling time, which require the student to name, demonstrate, count by rote, count by 1:1, point, manipulate, show, and trace with respect to telling time.

Procedures

The ten-day workshop was conducted in five phases: (1) orientation to lesson plans and diagnostic testing, (2) baseline sessions, (3) training in Precision Teaching and interaction analysis, (4) modification

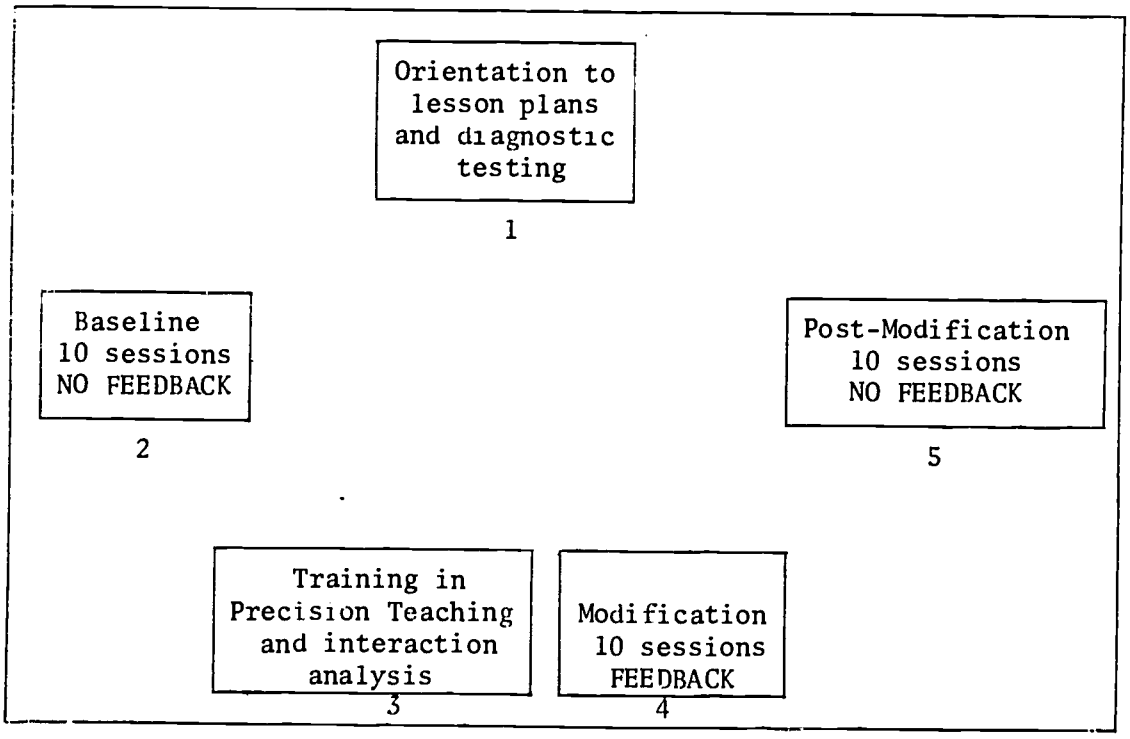


Figure 2. Five Phases of the Workshop

sessions, and (5) post-modification sessions. The five phases are shown in Figure 2.

Orientation. During the first two days of the workshop teachers were oriented to the physical facilities, scheduling, procedures, materials, and objectives of the workshop. They were given lesson plans and the diagnostic test which were discussed with them. The diagnostic test was administered by each teacher to his pupil to determine placement of the child in the sequence of lessons, and to give the teacher and child a chance to become acquainted. When the teacher had determined where his pupil was to begin, he spent the remainder of the two-day orientation planning how to help the child reach the objectives.

Baseline. Ten ten-minute teaching sessions were coded by the trained coders to obtain baseline data. Teachers did not know they were being coded and received no feedback of any kind. Each teacher kept simple frequency data on which objectives and how many were attained for each session. Each teacher taught only ten minutes out of each hour, taking two days to teach ten sessions. They used the time between each teaching session to plan or revise plans for the next lesson.

Training. At this point two days were spent training teachers in interaction analysis and Precision Teaching. They were taught the coding system and were informed that their first ten sessions were coded according to this system by trained coders. After a brief period of time to actually practice coding a videotape of a 1:1 tutorial involving a teacher and a TMR pupil, each teacher was given his data to evaluate. They were given the opportunity to practice coding so that they might better understand the raw data. After a short introduction to Precision Teaching, each teacher was instructed to select a category of pupil

behavior which he felt would, if increased or decreased, help the child learn more efficiently. Each teacher was then instructed to select a category of teacher behavior which he felt would change the selected pupil category in the desired direction. Again, each teacher was free to choose a different category. They were then taught how to complete the rate computation sheet and six cycle log graph and told to plot rate of the pupil category, teacher category, and objectives attained, each on a separate graph for the ten baseline sessions. After evaluating this data, they planned for the next ten sessions for which they received feedback after each ten-minute session.

Modification. A second group of ten-minute teaching sessions was coded by the trained coders to obtain modification data. The same schedule was used during this phase as was used for the baseline sessions. After each ten-minute session, the teacher obtained the interaction analysis raw data from the trained coder and plotted his selected teacher and pupil categories and objectives attained before planning and teaching the next ten-minute session. Thus, feedback was provided.

Post-Modification. A third group of ten-minute teaching sessions was coded by trained coders to obtain post-modification data. The same schedule was used. Teachers received no feedback until all ten sessions were completed. Thus, the baseline, or no feedback condition, was restored to ascertain what would happen under the more normal conditions of no feedback to the selected teacher and pupil cateogries.

Collection of Data. All 30 ten-minute teaching sessions were coded for each dyad. Thus, for each dyad 300 minutes of interaction

analysis raw data were obtained. Three small observation rooms were made available by the Institute for Child Study at Indiana University. One coder sat behind a one-way mirror in each room. One teacher and one TMR pupil occupied each room. During the first ten, or baseline sessions, teachers and pupils were not aware that they were beind coded and received no data. During the second ten or modification sessions, teachers received the interaction analysis raw data immediately following each session. From this, between sessions, teachers plotted the rate of the teacher and pupil categories they had selected during training. Rate of these selected categories had been plotted by the teachers during the training period. During the last ten, or post-modification sessions, teachers knew they were being recorded but were received no data until the end of the thirtieth session. They then plotted rates of their selected teacher and pupil categories for the final ten sessions. Teacher's ratings were later checked by the investigator. Coders were rotated among the three stations during the last 20 of the 30 sessions.

The investigator plotted the patterns for each dyad from all of the raw data after the workshop was completed. Teachers did not view that data as such nor were they aware that patterns would be plotted.

Data on objectives were kept by the teachers throughout and were later checked by the investigator. During the baseline sessions only frequency data were kept. After the training period, rate of objectives was plotted for baseline sessions, thereafter following each session.

Each teacher-pupil dyad was treated statistically as a separate study. For each dyad, statistical data were necessary to test the hypotheses were reported on teacher-selected pupil,category, teacher-selected teacher

category, drill pattern, clarification pattern, and broad question pattern.

The Lindsley Mid-Median Test of Exact Probability[1] (Appendix E) was used to determine the significance of change between phases for teacher and pupil categories and the three patterns. BMD02D, a computer program which computes Pearson Product Moment Correlation, was used to compute correlations between teacher and pupil categories; and a critical ratio formula (McNemar, 1969) was used to determine the significance of change between correlations relative to the third hypothesis. A computer program was used to compute the Scott Reliability Coefficient (Gregory, 1969).

Summary

The third chapter describes the materials and procedures designed to test the hypotheses outlined in Chapter I. Information about the selection of teacher and pupil subjects is included. The training of coders as well as collection and analysis of data is also discussed. The results of the statistical analyses performed to test the hypotheses are presented in Chapter IV and V.

---

[1]The Lindsley Mid-Median Test of Exact Probability describes the exact probability of obtaining the values found in the four-fold table. If one wishes to know the probability of obtaining tables with these frequencies, or more extreme frequencies (i.e., even less likely values), one would have to obtain the exact p for each of the more extreme tables as well and add the p values to those of the given table. Thus, the exact values presented here are underestimates of the p of obtaining value extreme.

Chapter IV

Results

This chapter presents the results and discusses all eight dyads in relation to each hypothesis. That is, pupil category (H:1) will be discussed for all eight dyads, then teacher category (H:2) for all eight dyads, and so on through Broad Question Pattern (H:7).

The Lindsley Mid-Median Test of Exact Probability (Appendix E) was used to determine the significance of change between phases for teacher and pupil categories, and a critical ratio formula (McNemar, 1969) was used to determine the significance of change between correlations relative to the third hypothesis.

Hypothesis 1--Pupil Category. There is no significant difference in rate of a teacher-selected pupil category between baseline and modification (H:1a), or between modification and post-modification (H:1b). Figure 3 shows a comparison of levels of significance of the change for H:1a and H:1b.

H:1a was rejected beyond the .001 level for Dyad B; beyond the .01 level for Dyads A and C; and beyond the .05 level for Dyad G. H:1a for Dyads E and F was not rejected.

H:1b was rejected beyond the .001 level for Dyad F. H:1b for Dyads A, B, C, D, E, and G was not rejected.

In Dyad H, no pupil category was selected.

For four of the dyads (A, B, C, G), a significant change was made in pupil category; and furthermore, that change was maintained after feedback was removed. Thus, the null hypothesis regarding pupil category was rejected for four of seven pupils. For example, in Dyad A the

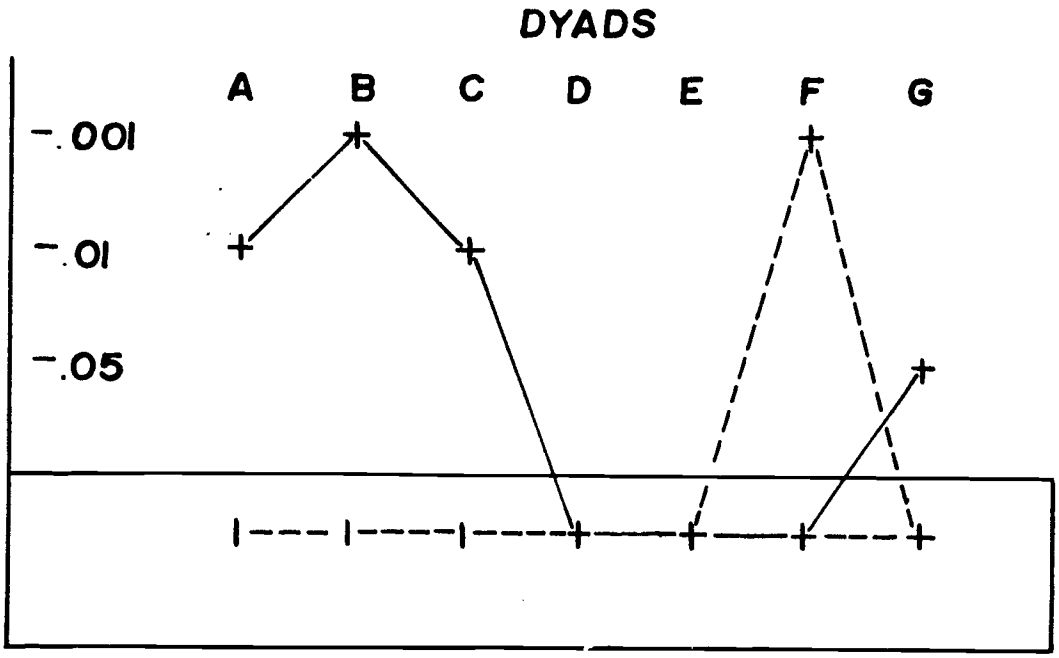


Figure 3. Levels of Significance for Pupil Category. H:1

——— H:1a

- - - - - H:1b

rates of pupil category prior to feedback were significantly higher than they were when feedback was provided. After feedback was removed, the decelerated rates of the feedback phase remained significantly lower. Thus, the significantly changed rates remained changed even when the training device of feedback was removed. This is relevant to goals for teacher training--that what is learned in a controlled environment be applied or continued in a not-so-controlled environment. The pupil categories changed were distracting nonverbal behavior for Dyad A, broad response for Dyads B and C, and pupil statements for Dyad G.

Two of the dyads (D and E) showed no significant change in pupil category for all three phases. The categories were nonverbal response for Dyad D and pupil statements for Dyad E.

And the final dyad (F--pupil statements) did not change during

feedback, but did change significantly in the desired direction after feedback was removed. Perhaps a delayed reaction?

These findings indicate that same treatment of teachers produces differential results in teacher efforts to change pupil behavior. Of course, the teachers did not all use the same treatment of their pupils.

Table 3

p Values for Pupil Category H:1

Phases	Dyads						
	A	B	C	D	E	F	G
Baseline to Modification	* .01D	** .000006A	.002A	.2D	.2D	.3D	.03A
Modification to Post-Modification	.08D	.2A	.1D	*** nc	.2D	.001A	.2D

* Decelerated
** Accelerated
*** Not computed

Hypothesis 2--Teacher Category. There is no significant difference in rate of a teacher-selected teacher category between baseline and modification (H:2a), or between modification and post-modification (H:2b). Figure 4 shows a comparison of levels of significance for H:2a and H:2b.

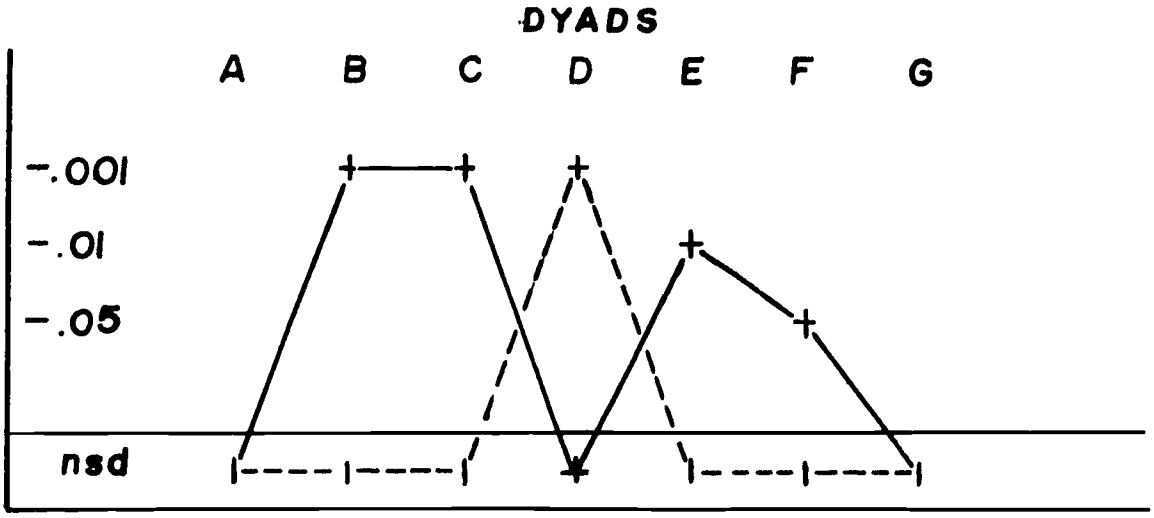


Figure 4. Baseline to Modification Levels of Significance for Teacher Category.

——— H:2a
- - - - H:2b

H:2a was rejected beyond the .001 level for Dyads B and C; beyond the .01 level for Dyad E; and beyond the .05 level for Dyad F. H:2a for Dyads A, D, and G, was not rejected.

H:2b was rejected beyond the .001 level for Dyad D. H:2b for Dyads A, B, C, E, F, and G was not rejected.

In Dyad H, no teacher category was selected.

Again, for four of the dyads (B, C, E, F) a significant change was made, this time for teacher category; and furthermore that change was maintained after feedback was removed. Thus, the null hypothesis regarding teacher category was rejected for four of seven teachers. Teacher category is the category selected by the teacher to facilitate change in a pupil category. However, the four teacher categories which followed this pattern are in only two cases the same dyads as for pupil categories which followed this pattern. Dyads B and C showed the change-maintain pattern for both pupil and teacher categories. For Dyads B and C teacher category was broad questions, and pupil category was broad responses. Correlations were higher for pupil and teacher categories for Dyads B and C than for any other dyad. Teacher category for Dyads E and F was broad question, and pupil category for the same dyad was pupil statements. Although teacher category changed significantly for Dyads E and F, pupil category for Dyad

Table 4

p Values for Teacher Category H:2

Phases	Dyads						
	A	B	C	D	E	F	G
Baseline to Modification	** .08A	.0007A	.002A	.3A	.003A	.03A	*** nc
Modification to Post-Modification	* .2D	.2D	.2D	.0005D	.2D	.08D	nc

* Decelerated
** Accelerated
*** Not computed

E did not change at all; and pupil category for Dyad F did not change significantly until after feedback had been removed in the third phase.

Two of the dyads (A and G) showed no significant change in teacher category for all three phases. The categories were narrow questions for Dyad A and broad questions for Dyad G. It is interesting to note that while teacher categories did not change significantly for these two dyads, pupil category did change significantly , and the change in pupil category was maintained throughout the second and third phases. Correlations were fairly low for pupil and teacher categories for Dyads A and G.

And the final dyad (D--verbatim repetition) did not change during feedback, but did change significantly after feedback was removed. It was noted by the investigator that there seemed to be little face validity in the relationship between the pupil category of nonverbal response and the teacher category of verbatim repetition of verbal response.

Findings for teacher category also indicate that same treatment produces differential results, in this case, in teacher efforts to change their own behavior.

Hypothesis 3--Relationship. There is no significant difference in correlation between rates of teacher-selected pupil category and teacher-selected teacher category between baseline and modification (H:3a), or between modification and post-modification (H:3b).

Only for Dyad B was the correlation between pupil category and teacher category significantly different during the feedback phase. The correlation was 1.0 initially. Since the change was significant between the first and second phase, the correlations were significantly lower in the second phase (.83). The change again was significant between

Table 5

Pearson Product Moment

Correlations Between Pupil and Teacher Category H:3

Phases	Dyads						
	A	B	C	D	E	F	G
Baseline	.65	1.0	#	.06	#	-.41	-.24
Baseline to Modification	nsd	**		nsd		nsd	nsd
Modification	-.09	.83	.76	.15	-.24	.50	-.42
Modification to Post-Modification	nsd	*	nsd	nsd	nsd	nsd	nsd
Post-Modification	.39	.14	.73	-.26	.58	-.12	-.16

not computed by computer
* .05 level of confidence
** .01 level of confidence
*** .001 level of confidence

the second and third phase decreasing from .83 to .14. It should be pointed out that although the correlation in this case decreased significantly, the occurrence of the categories increased significantly; therefore, these findings although statistically significant are probably meaningless.

The largely nonsignificant results of changes in correlations of pupil and teacher categories from one phase to another indicate that some attempt should have been made to dictate to the teacher or allow the teacher to make the decision about a specific and consistent relationship between the selected pupil and teacher categories.

In fact, one of the important steps in the Precision Teaching process is to set a particular goal with regard to baseline records before initiating change. While the direction of the changes was stated in this study (to accelerate or to decelerate), the amount of change was not specified. This is considered a limitation of the study and the results with regard to correlation between pupil and teacher category, where amount of change was not specified, clearly indicate a need for doing so.

Hypothesis 4--Objectives. There is no significant difference in rate of objectives attained per session between baseline and modification (H:4a), or between modification and post-modification (H:4b).

Hypothesis 4 was not treated statistically.

Hypothesis 5--Drill Pattern. There is no significant difference in rate of a drill pattern between baseline and modification (H:5a), or between modification and post-modification (H:5b). Figure 5 shows a comparison of levels of significance for H:5a and H:5b.

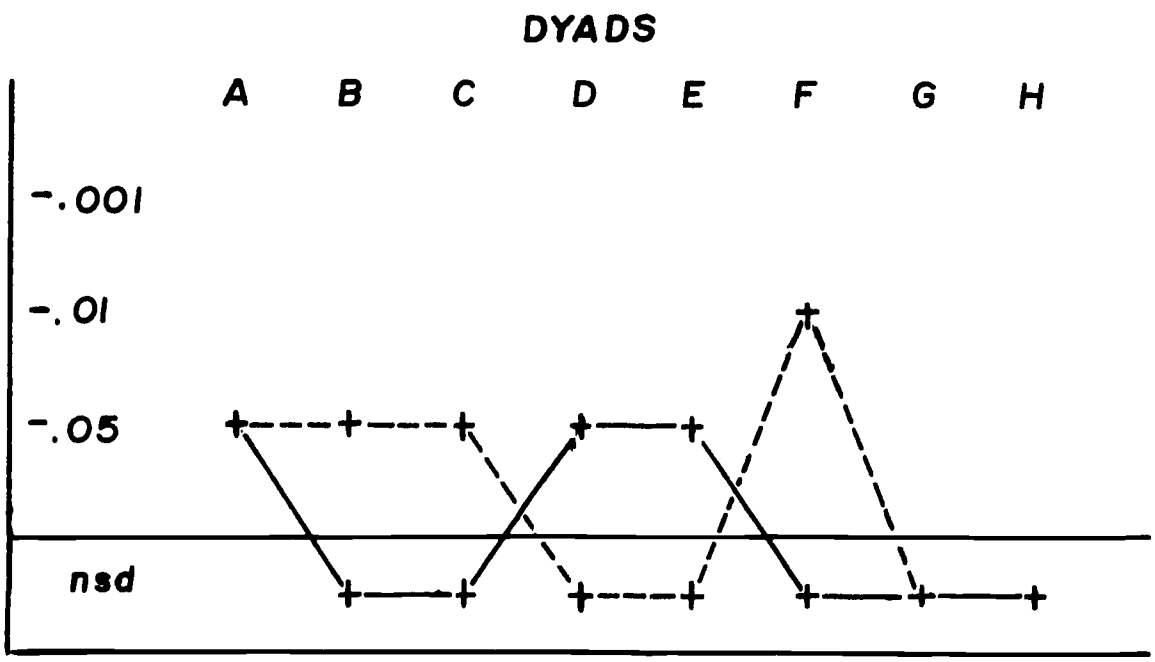


Figure 5. Baseline to Modification Levels of Confidence for Drill Patter. H:5

——— H:5a
- - - - - H:5a

H:5a was rejected beyond the .05 level for Dyads A, D, and E. H:5a for Dyads B, C, F, G, and H was not rejected.

H:5b was rejected beyond the .01 level for Dyad F, and beyond the .05 level for Dyads A, B, and C. H:5b for Dyads D, E, G, and H was not rejected.

The Drill Pattern, while showing significant change in three dyads (A, D, E) during the feedback phase, was consistently higher than the other two patterns and selected pupil and teacher categories. Median rates for the drill pattern for all dyads and all phases were approximately two to four occurrences per minute or 20 to 40 occurrences per session. By comparison, median rates of selected pupil and teacher categories usually ran less than one per minute, more often only two or three per session.

Table 6

p Values for Drill Pattern H:5

Phases	Dyads							
	A	B	C	D	E	F	G	H
Baseline to Modification	** .03A	*** nc	nc	.04D	.03D	.1A	nc	nc
Modification to Post-Modification	* .03D	.04D	.03A	.2D	nc	.003D	.2D	.3A

* Decelerated
** Accelerated
*** Not computed

In all probability, the high occurrence of a drill pattern for all dyads was at least partially accounted for by the nature of the curriculum (Appendix D). Teaching retarded pupils to tell time hardly seems to instigate methods other than a drill pattern. However, it was demonstrated in this study that moderately mentally retarded pupils can respond to questions other than narrow or binary.

Another explanation for the high rates of the Drill Pattern may be that the teachers, none of whom had prior experience with retarded pupils, had preconceived notions about how to deal with such pupils; and furthermore, felt that retarded pupils were not capable of responding to any other kind of treatment. Some of the teachers who chose to work on broad questions and broad responses learned differently, however.

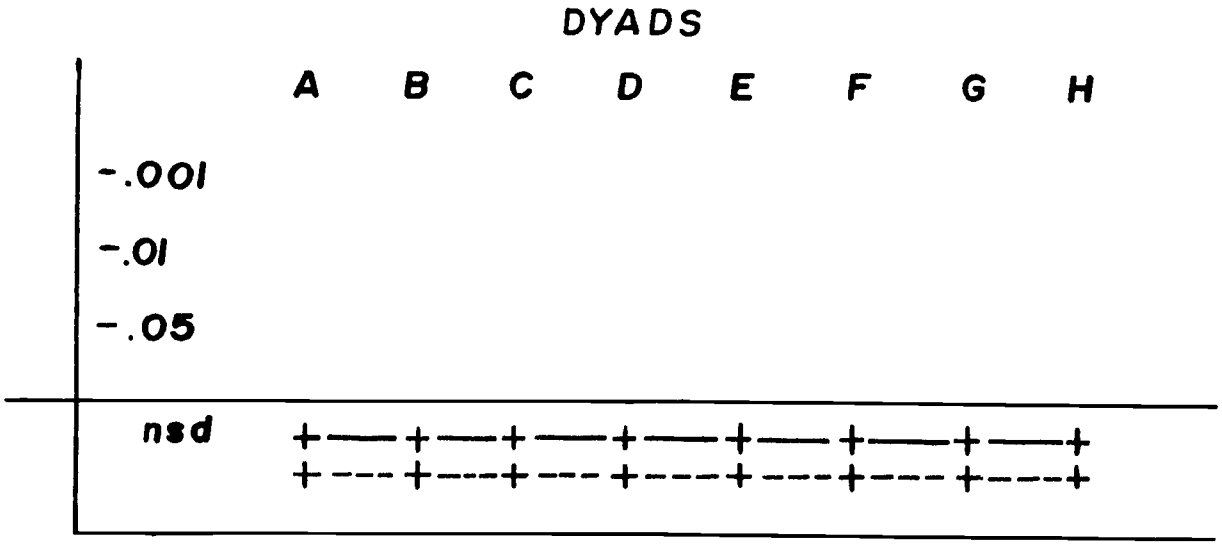


Figure 6. Baseline to Modification Levels of Confidence for Clarification Pattern. H:6

———— H:6a
- - - - - - - - H:6b

Hypothesis 6--Clarification Pattern. There is no significant difference in rate of a clarification pattern between baseline and modification (H:6a), or between modification and post-modification (H:6b). Figure 6 shows a comparison of levels of significance for H:6a and H:6b.

H:6a and H:6b for Dyads A, B, C, D, E, F, G, and H was not rejected.

The clarification pattern was practically nonexistent for all dyads for all phases. The most plausible reason for these findings is that each of the moderately mentally retarded pupils used in the study had sufficient language ability so that they were readily understood by the teachers. Also, apparently all teachers were readily understood by the pupils. At least they did not ask for clarification as indicated by this data. It would seem reasonable to believe, however, that the

Table 7

p Values for Clarification Pattern H:6

Phases	Dyads							
	A	B	C	D	E	F	G	H
Baseline to Modification	.08D	nc	nc	.2D	nc	nc	nc	nc
Modification to Post-Modification	.07A	nc	.2A	nc	nc	nc	nc	nc

* Decelerated
** Accelerated
*** Not computed

the Clarification Pattern would be a useful one to examine with other moderately mentally retarded pupils, whether or not they have adequate language ability. No generalizations can be made here based on an N of eight.

Hypothesis 7--Broad Question Pattern. There is no significant difference in rate of a broad question pattern between baseline and modification (H:7a), or between modification and post-modification (H:7b).

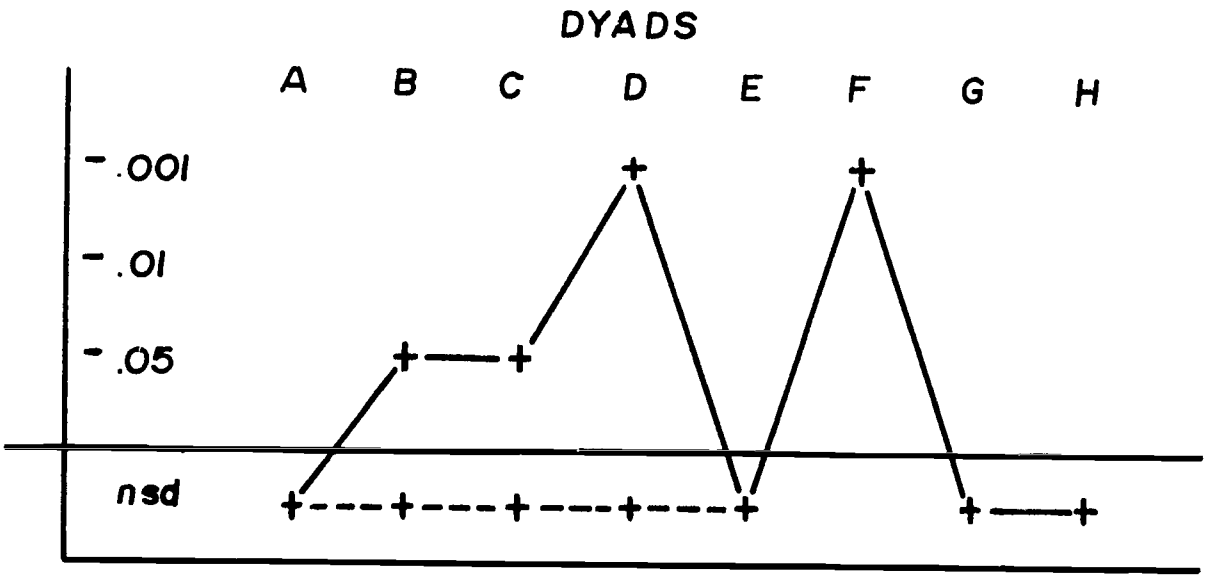


Figure 7. Baseline to Modification Levels of Confidence for Broad Question Pattern.

——— H:7a
- - - - - H:7b

Figure 7 shows a comparison of levels of significance for H:7a and H:7b.

H:7a was rejected beyond the .001 level for Dyads D and F; and beyond the .05 level for Dyads B and C. H:7a for Dyads A, E, G, and H was not rejected.

H:7b was rejected beyond the .001 level for Dyad F. H:7b for Dyads A, B, C, D, E, G, and H was not rejected.

Probably one of the most exciting aspects of this study is that broad responses, which may include productive thinking,by moderately mentally retarded pupils have been documented.

Table 8

p Values for Broad Question Pattern H:7

Phases	Dyads							
	A	B	C	D	E	F	G	H
Baseline to Modification	*** nc	** .04A	.04A	* .0005D	nc	.0007A	nc	nc
Modification to Post-Modification	nc	.2D	nc	nc	nc	.0007D	nc	nc

* Decelerated
** Accelerated
*** Not computed

For four dyads (B, C, D, F) the Broad Question Pattern changed significantly during feedback. For three of these (B, C, D) the change was maintained after feedback was removed. No significant difference from feedback to feedback was shown. For Dyad F the Broad Question Pattern significantly accelerated during feedback and significantly decelerated again after feedback was removed.

For the other four dyads (A, E, G, H) the Broad Question Pattern did not change significantly either during feedback or after feedback was removed.

However, the fact that the pattern existed at all, whether or not it changed, is academically significant. It was interesting to note that in Dyad D the Broad Question Pattern was significantly higher in the first phase than it was during and after feedback. In fact, in the last 20 sessions the pattern showed up only once. Perhaps teacher training in this case interfered with a natural teacher inclination.

Summary

This chapter presents the results of the study in a discussion of individual dyads under each hypothesis. In four of seven dyads pupil and teacher categories changed significantly during feedback, but not for the same dyads. That is, where a significant change was found for a pupil category, the teacher category for that same dyad did not necessarily show a significant change. The Drill Pattern showed consistently higher rates than teacher or pupil categories or the other two patterns and changed significantly for three of eight dyads. The Clarification Pattern was, for all practical purposes, nonexistent. The Broad Question Pattern showed significant changes in four of eight dyads.

Chapter V

Case Studies

This chapter may be most meaningful for those with some understanding and experience with Precision Teaching or similar techniques. In addition, this case study discussion by dyads may also provide useful information for teachers and teacher educators with regard to the interrelationships of changes in several categories and/or patterns for a given teacher and his moderately mentally retarded pupil.

It is hoped that this section, in particular, will raise many questions with the initial phrase reading--"I wonder what would have happened if . . ." It is also hoped that many of the people who ask such questions will implement the ideas stimulated by a reading of this study.

For each dyad then, a brief description of each teacher and pupil is provided in addition to a discussion of each hypothesis for that dyad. Five graphs for each dyad are provided and should be followed closely with the text, which is written directly from the graphs with little regard for statistical significance (Lindsley, 1966). Rate equals frequency divided by time and is used rather than frequency or percentage so that day-to-day data can be compared where time or percentage breakdown differs daily (Caldwell, 1966).

Dyad A

Dyad A involved a female teacher with experience in elementary, but not special education. She earned a pretest score of 0, and a

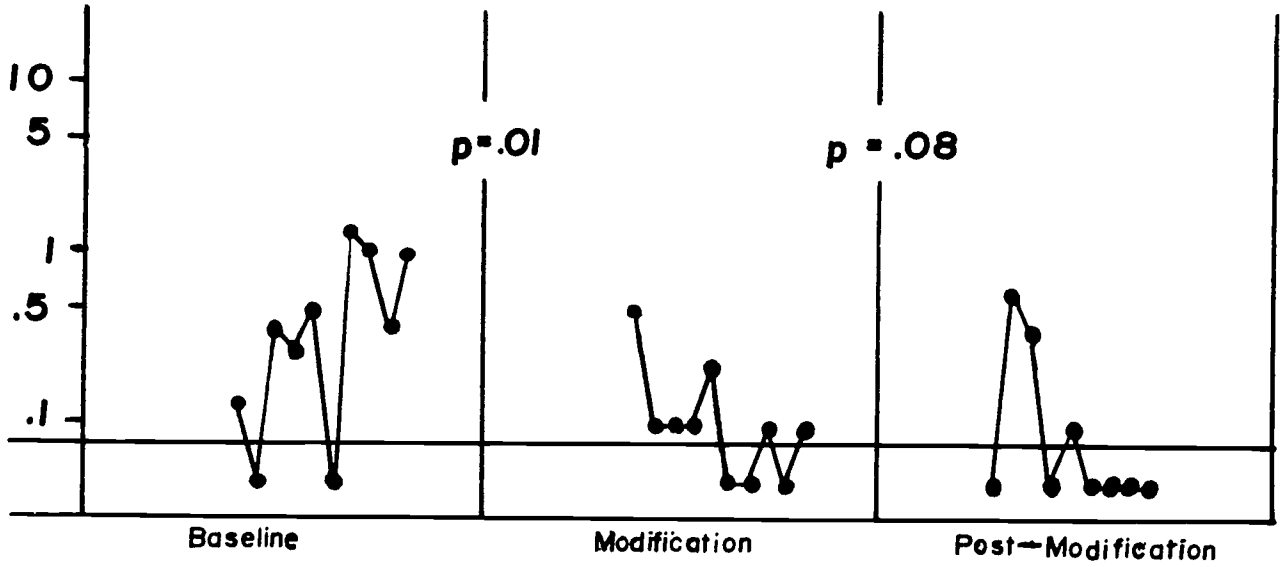
posttest score of 6 from a maximum of 7. The pupil was a 12-year-old male with an IQ score of 54. On the diagnostic test he attempted 60 of 67 items and answered 49 of 60 correctly.

Pupil Category. The teacher chose to decelerate pupil category 14_2, or nonverbal distracting behavior. Median rate of this pupil category for baseline was .3 or 3 in ten minutes. During modification, the pupil category decelerated to a median rate of .1 or 1 in ten minutes ($p = .01$), and during post-modification decelerated to a median rate of 0 ($p = .08$).

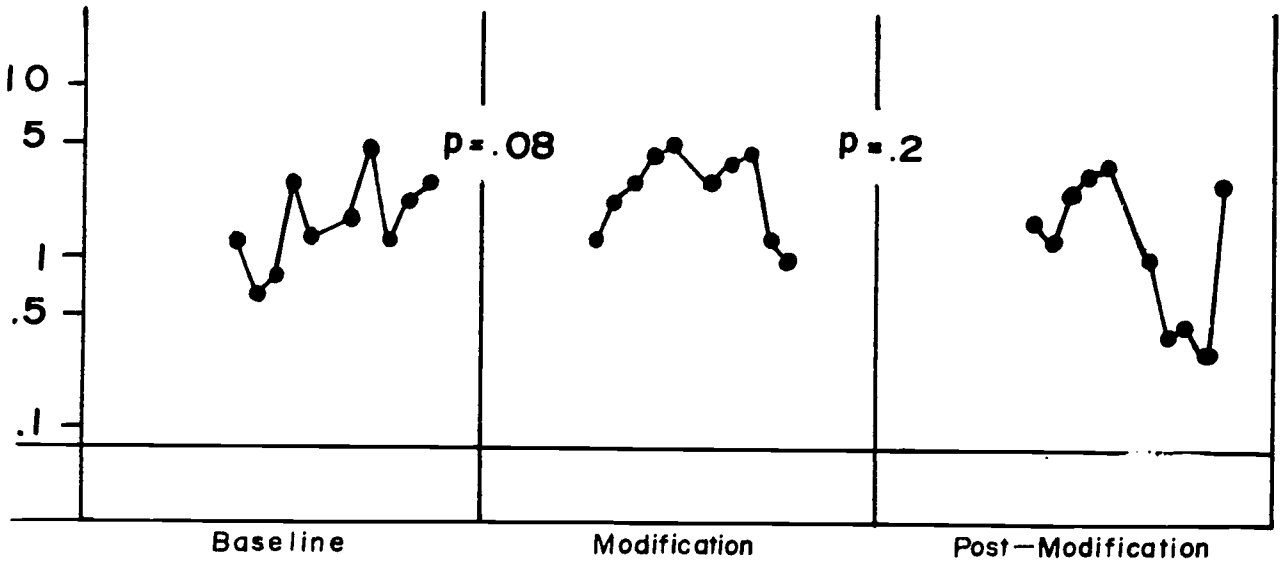
Teacher Category. The teacher elected to accelerate her use of 2_2, or narrow questions, as a way of changing the pupil category in the desired direction. Median rate of narrow questions during baseline was 1.6 per minute. Median rate accelerated to 2.5 per minute during modification ($p = .08$) and decelerated to 1.8 per minute during post-modification ($p = .1$).

Relationship. Correlations for pupil category 14_2 and teacher category 2_2 were .65 during baseline, -.09 during modification, and .39 during post-modification. The difference between $r = .65$ and $r = -.09$ was not significant, nor was the difference between $r = -.09$ and $r = .39$. It is interesting to note that when the teacher accelerated her use of narrow questions, the pupil exhibited less nonverbal distracting behavior, and even though her use of narrow questions decelerated during post-modification, the pupil's distracting behavior continued to decelerate showing up in only three of ten sessions during post-modification.

Objectives. During baseline approximately two objectives per ten-minute session were being attained. During modification and post-modification, about 5 to 7 per session were being attained. Thus,



Dyads A Pupil Category — Distracting Behavior



Dyad A Teacher Category — Narrow Question

Figure 8. Dyad A Pupil and Teacher Category

when the teacher's use of narrow questions accelerated and the pupil's distracting behavior decelerated, more objectives were attained per session.

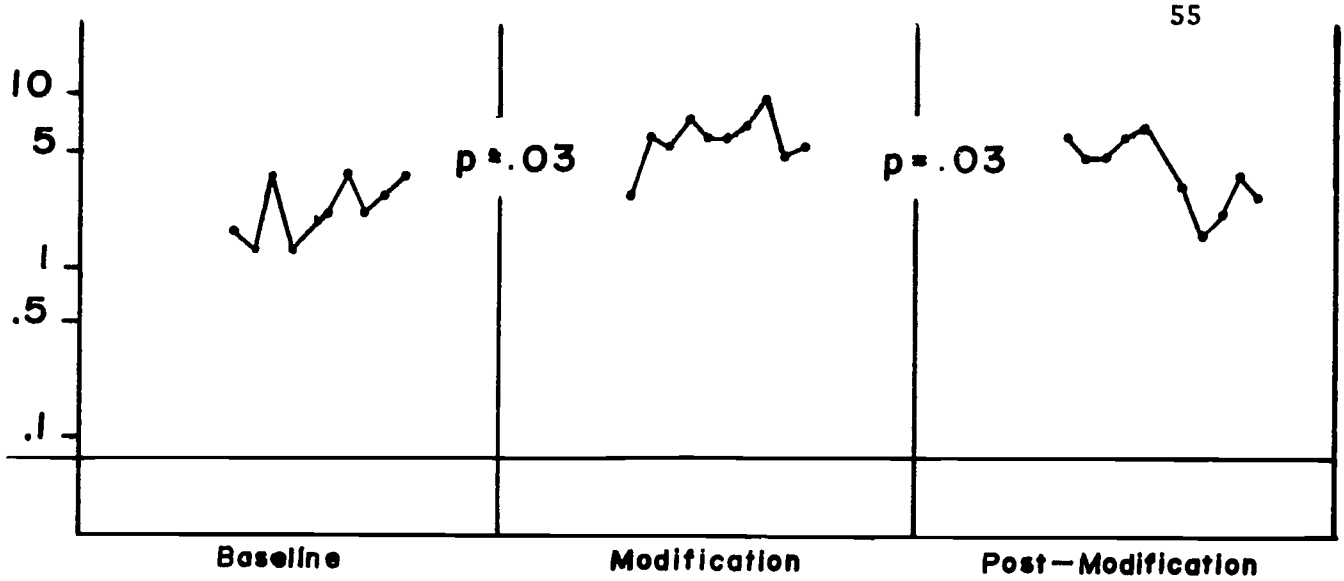
Drill Pattern. Median rate of drill pattern for baseline was 1.3 per minute. During modification it accelerated to 4.8 per minute ($p = .03$) and decelerated during post-modification to 3.5 per minute ($p = .03$). It is not surprising to note that both teacher category 2_2 and drill pattern accelerated during modification since 2_2 is a component of the drill pattern. Rates for drill pattern were noticeably higher than pupil or teacher categories or the other two patterns.

Clarification Pattern. Clarification pattern was exhibited once or twice in most of the baseline sessions with a median rate of .1. During modification median rate was 0 ($p = .08$) and during post-modification accelerated to .25 or 2½ per ten minutes ($p = .07$). Thus, requests for clarification decelerated when teacher use of narrow questions accelerated and pupil distracting behavior decelerated. However, when teacher use of narrow questions decelerated again during post-modification, requests for clarification accelerated.

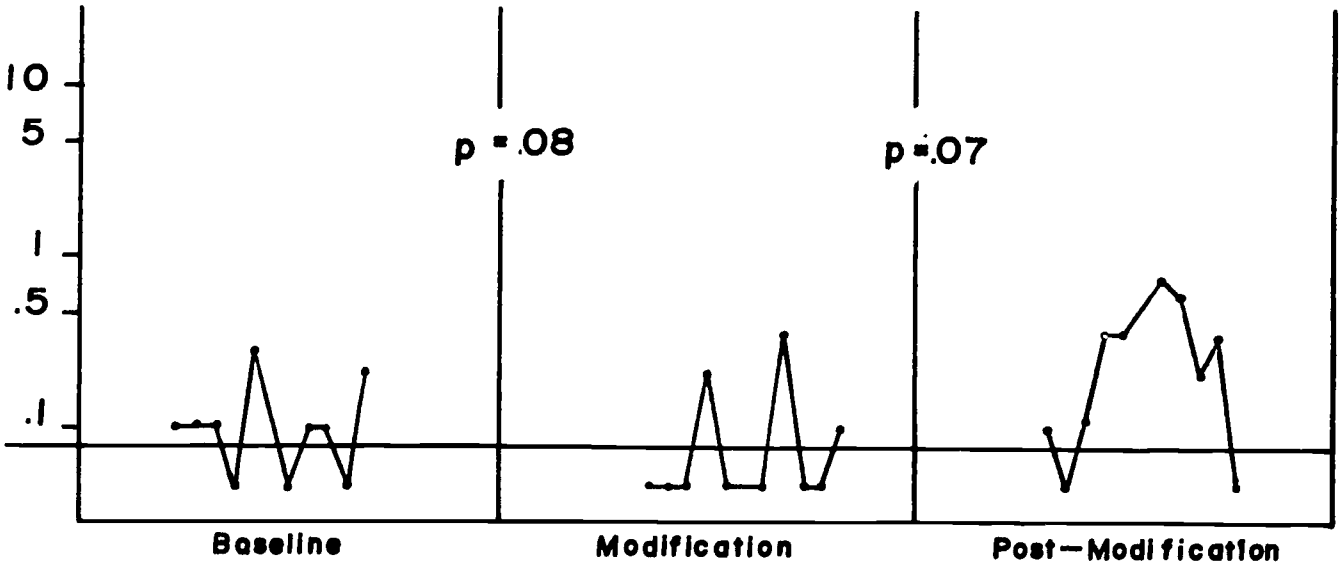
Broad Question Pattern. This pattern was exhibited only two or three times in each phase with median rates of 0 throughout.

Dyad B

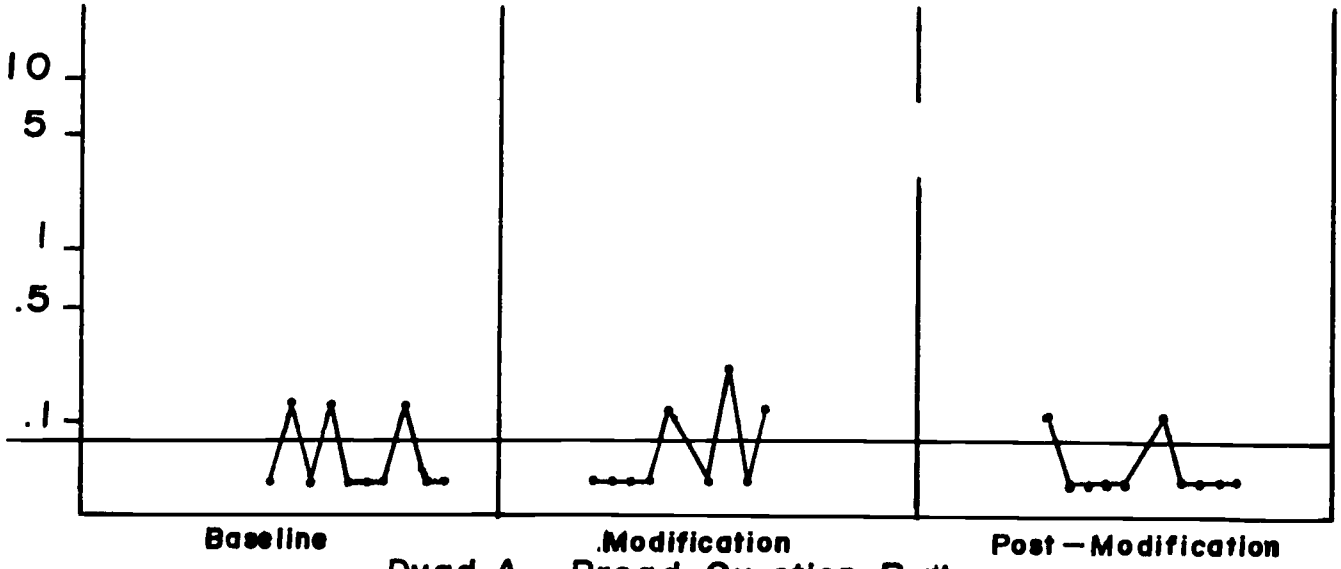
Dyad B involved a female teacher with experience in elementary but not in special education. She earned a pretest score of 0 and a posttest score of 7 from a maximum of 7. The pupil was a 16-year-old female with an IQ score of 48. On the diagnostic test she attempted 67 of 67 items and answered 67 of 67 correctly. Objectives for this pupil were then extended beyond those covered in the diagnostic test.



Dyad A Drill Pattern



Dyad A Clarification Pattern



Dyad A Broad Question Pattern

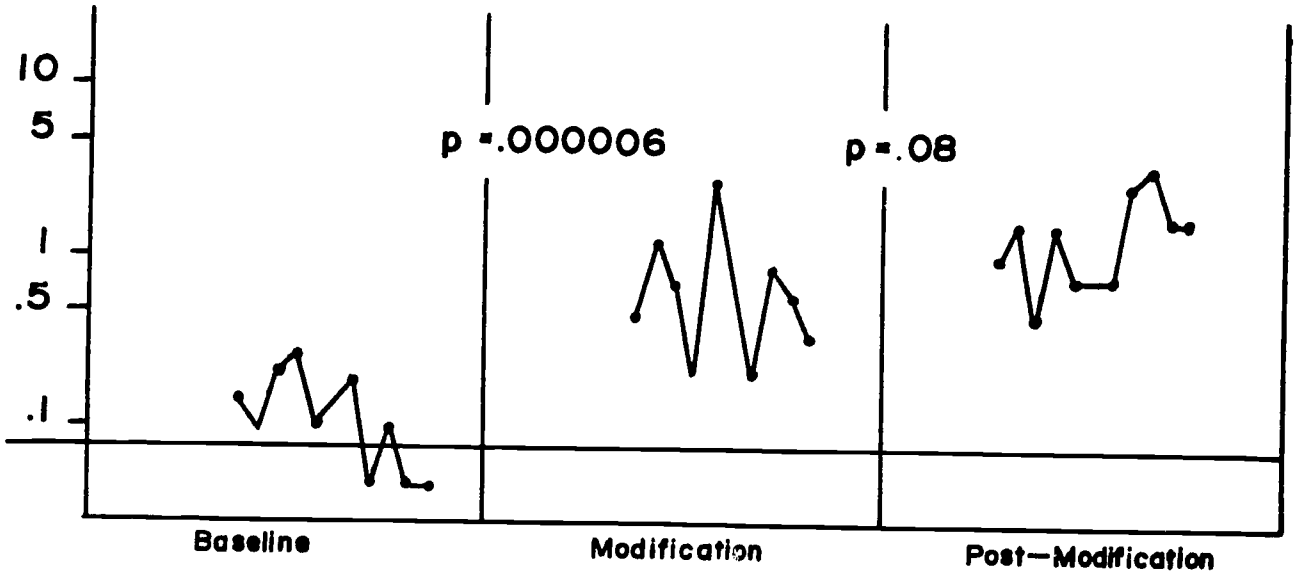
Figure 9. Dyad A Patterns

Pupil Category. The teacher chose to accelerate pupil category 5_3 or broad responses. Median rate of this pupil category was .1 or one in ten minutes during baseline, and accelerated to a median rate of .5 or five in ten minutes during modification (p = .000,0006) and remained about the same during post-modification with a median rate of .6 (p = .2).

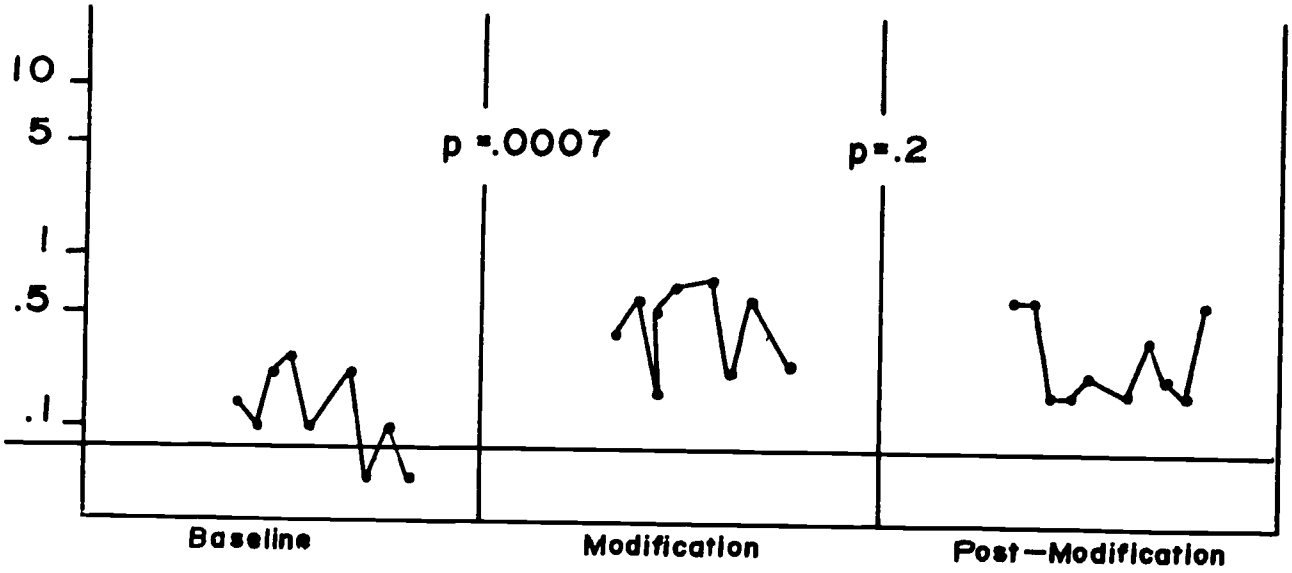
Teacher Category. The teacher elected to accelerate her use of 2_3 or broad questions in order to accelerate pupil category 5_3 or broad responses. Median rate of teacher category 2_3 was .1 or one in ten minutes during baseline and accelerated to .5 or five in ten minutes during modification (p = .0007), decelerating slightly to a median rate of .26 or 2½ in ten minutes during post-modification (p = .2).

Relationship. Correlations for pupil category 5_3 and teacher category 2_3 were 1.0 during baseline, .83 during modification, and .14 during post-modification. The difference between 1.0 and .83 was highly significant (beyond the .001 level) and between .83 and .14 significance was at the .05 level. Although the pattern of one broad question and one broad response was maintained throughout baseline and modification, the instance of broad responses was greater than broad questions during post-modification. That is, the ratio increased from 1:1 to about 1:2 or two responses to every one question.

Objectives. During baseline one or two objectives were attained per session. During modification and post-modification approximately three per session were attained. Since the pupil correctly responded to 100% of the items on the diagnostic test, the teacher, with the assistance of the investigator, wrote objectives which related telling time to television, cooking, and meal planning for the last 15 of the 30 sessions.

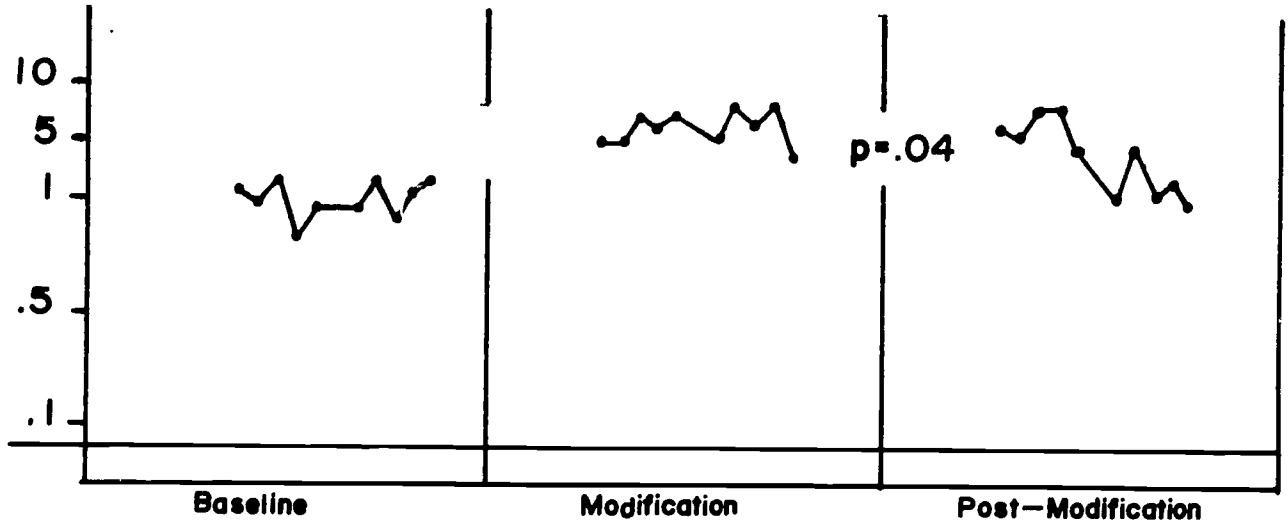


Dyad B Pupil Category—Broad Response

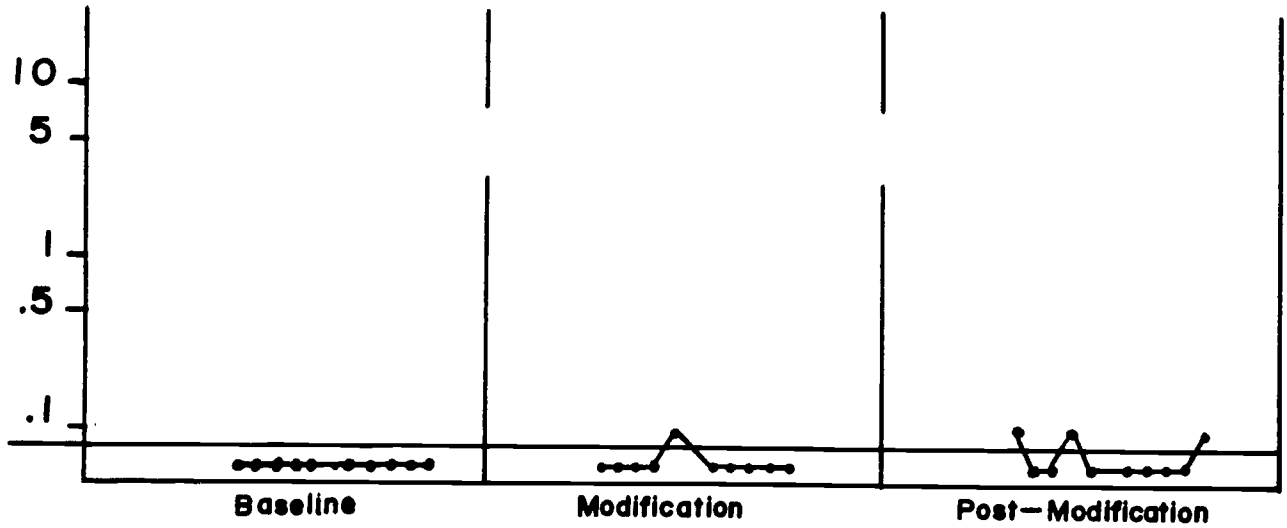


Dyad B Teacher Category — Broad Questions

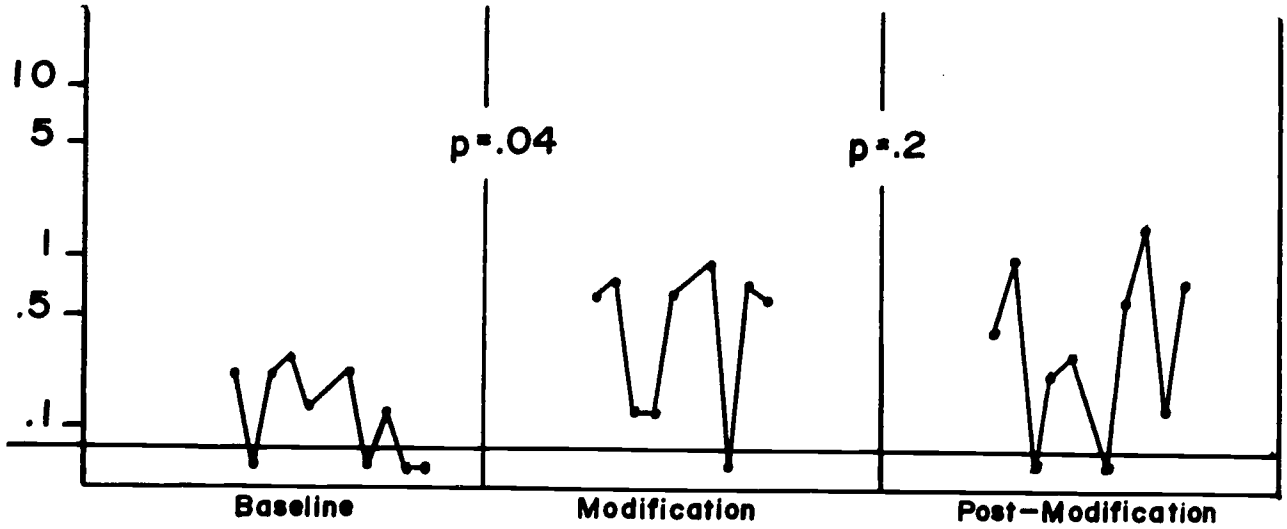
Figure 10. Dyad B Pupil and Teacher Categorie



Dyad B Drill Pattern



Dyad B Clalfication Pattern



Dyad B Broad Question Pattern

Figure 11. Dyad B Patterns

Objectives in the first 15 sessions dealt with an extension of the original curriculum organization, except that they dealt with 15, 5, and 1-minute intervals of time.

Drill Pattern. Drill pattern remained fairly stable throughout with a median rate of 4.1 per minute during baseline and modification ($p = 0$) and a slight deceleration to a median rate of 3.0 per minute during post-modification ($p = .04$). Rates for the drill pattern were noticeably higher than for pupil or teacher categories, or the other two patterns.

Clarification Pattern. This pattern was exhibited only four times in the 30 sessions with a median rate of 0 throughout.

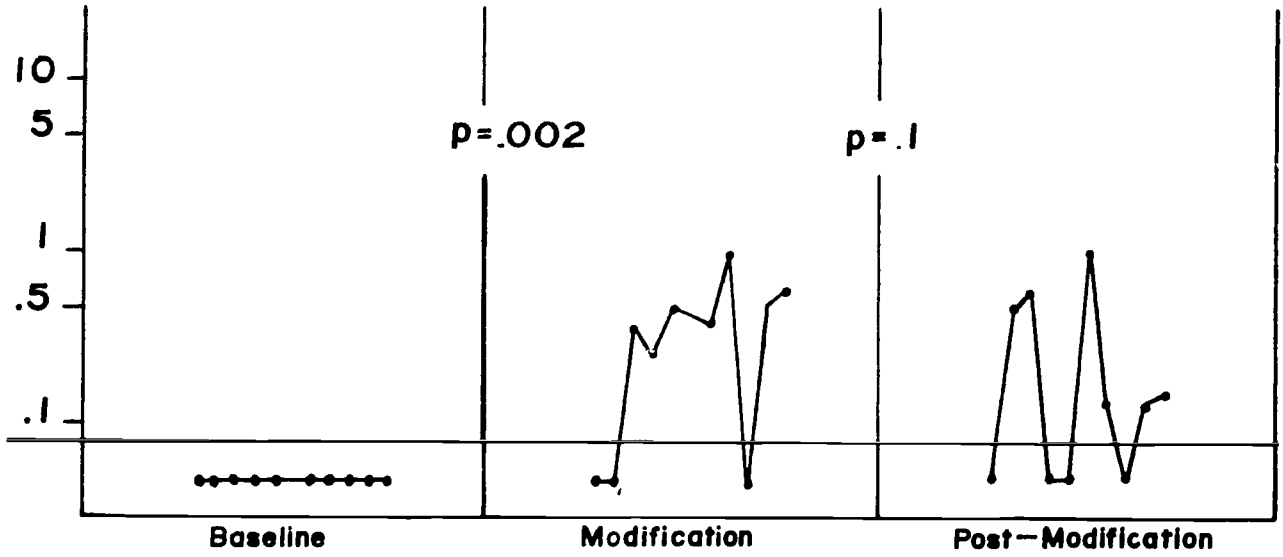
Broad Question Pattern. Median rate for this pattern was .1, or one in ten minutes during baseline, accelerated to .5 or five in ten minutes during modification ($p = .04$), and remained about the same with a median rate of .3 per minute or three in ten minutes ($p = .2$). Thus, the broad question pattern very closely parallels the pupil and teacher categories that are the two components of this pattern.

Dyad C

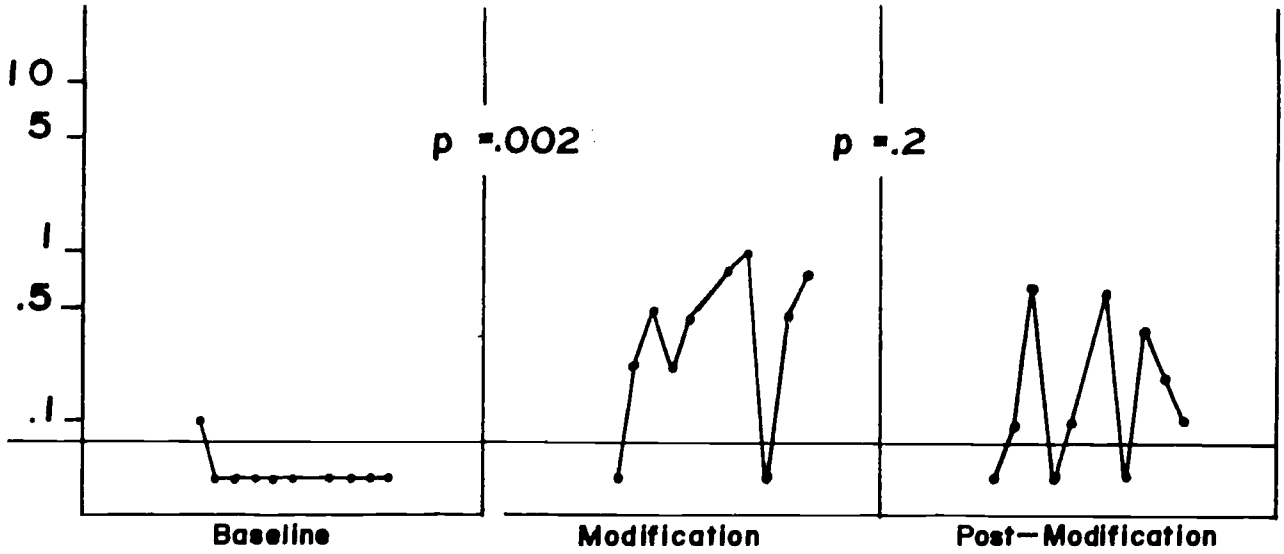
Dyad C involved an inexperienced female teacher. She earned a pretest score of 0 and a posttest score of 0 from a maximum of 7. The pupil was a 13-year-old male with an IQ score of 48. On the diagnostic test he attempted 67 of 67 items, and answered 53 of 67 correctly.

Pupil Category. The teacher chose to accelerate pupil category 5_3, or broad response. Median rate of 5_3 was 0 during baseline, accelerated to .3 per minute or three in ten minutes during modification ($p = .002$) and decelerated slightly to .1 or one in ten minutes during post-modification ($p = .1$).

Teacher Category. The teacher elected to accelerate her use of category 2_3, broad questions, as a means of accelerating pupil category 5_3. Median rate for teacher category 2_3 was 0 for baseline, accelerated to .4 per minute or four in ten minutes during modification (p = .002) and decelerated slightly to .1 or one in ten minutes during post-modification (p = .2).



Dyad C Pupil Category—Broad Response



Dyad C Teacher Category—Broad Questions

Figure 12. Dyad C Pupil and Teacher Categories

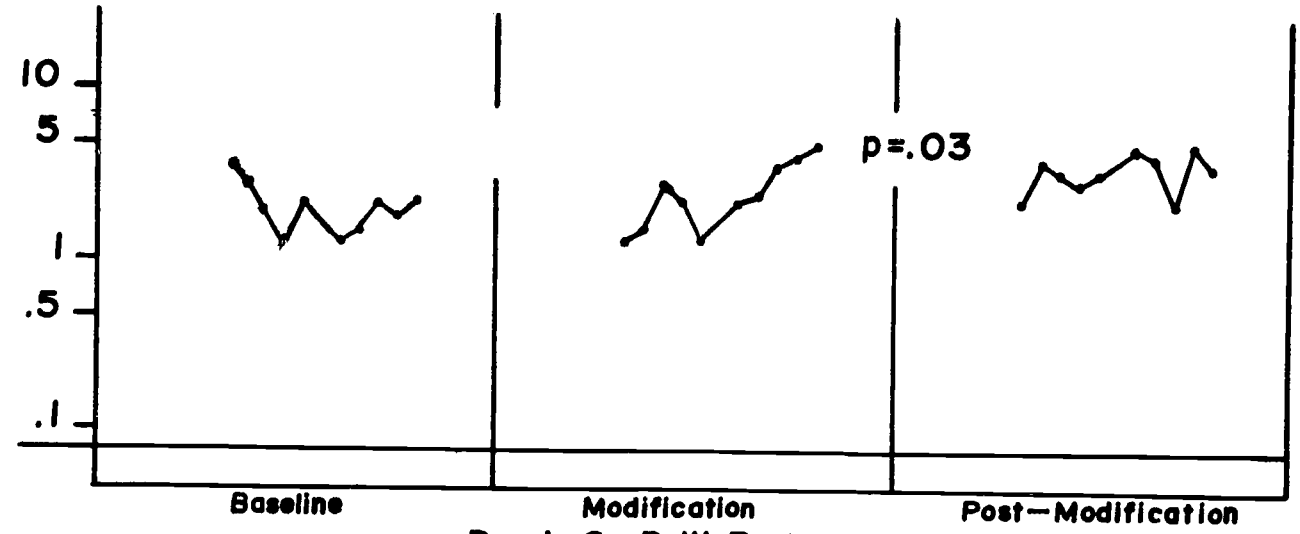
Relationship. Correlations for pupil category 5_3 and teacher category 2_3 were .76 for modification, and .73 during post-modification. Correlations for baseline were not computed by the computer as almost all data points were zero. The difference between .73 and .76 was not significant. In contrast to the same pupil and teacher categories for Dyad B, where the relationship between broad questions and broad responses for Dyad C deviated from a 1:1 rather than broad responses being greater or 1:2 as in Dyad B, they were less or sometimes 1:0. That is, the pupil in Dyad C did not always respond to a broad question with a broad response.

Objectives. Roughly three or four objectives per session were attained. The teacher began with teaching the half hour and continued through the 15, 5, and 1-minute intervals. This was an extension of the original lesson plans.

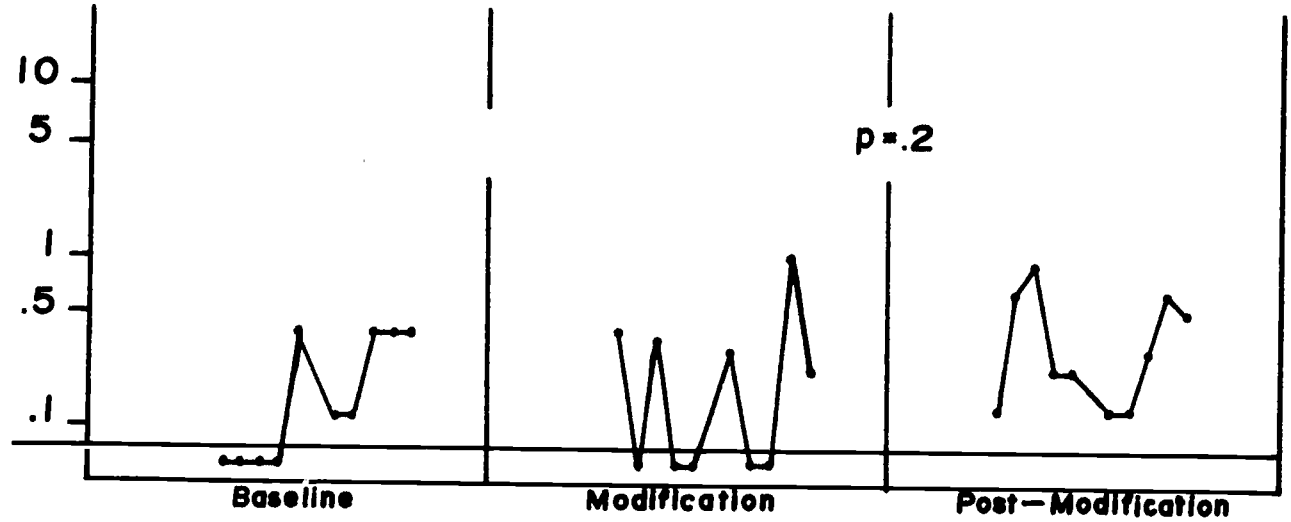
Drill Pattern. Drill pattern remained fairly stable throughout with a median rate of 2.3 per minute during baseline and modification and a slight acceleration to 3.3 per minute during post-modification ($p = .03$). Rates for drill pattern were noticeably higher than for pupil or teacher categories or for the other two patterns.

Clarification Pattern. Median rates for the clarification pattern were .1 per minute or one in ten minutes, .1 and .2 for the three phases. During baseline and modification the pattern was exhibited in only about half the sessions, and then only once or twice. During post-modification, however, it showed up at least once in every session, more typically two or three times. Lack of communication, particularly during the latter part of the workshop, was noted by the teacher herself.

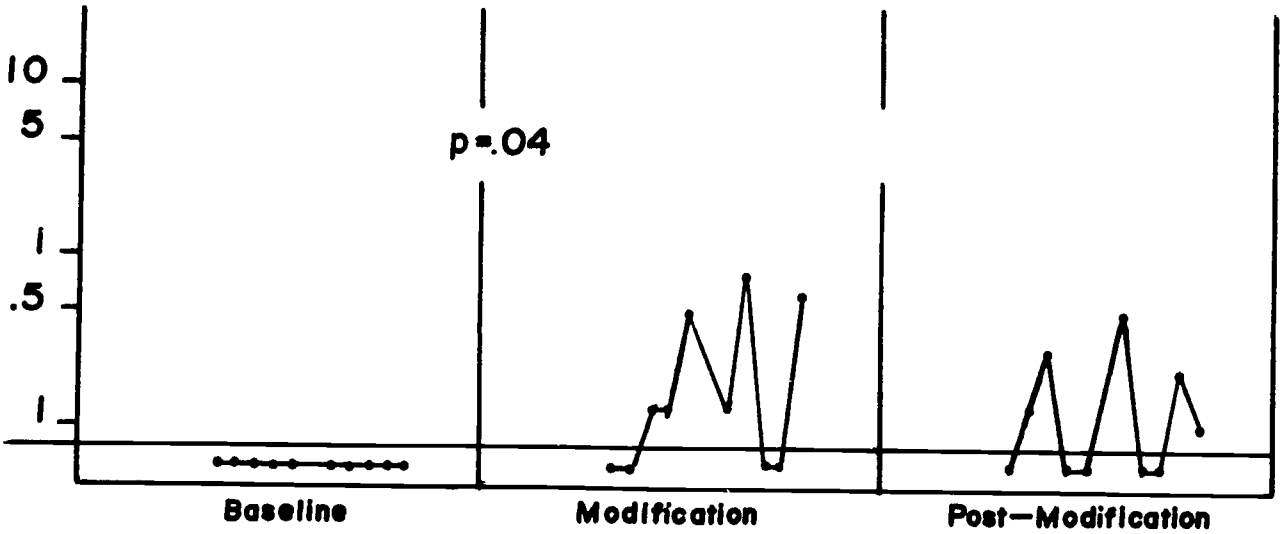
Broad Question Pattern. This pattern was not exhibited at all during baseline. Median rate for modification was .1 or one in



Dyad C Drill Pattern



Dyad C Clarification Pattern



Dyad C Broad Question Pattern

Figure 13. Dyad C Patterns

ten minutes (p = .04) and .1 for post-modification. The pattern was exhibited less than the teacher category as the pupil did not always respond to a broad question with a broad response.

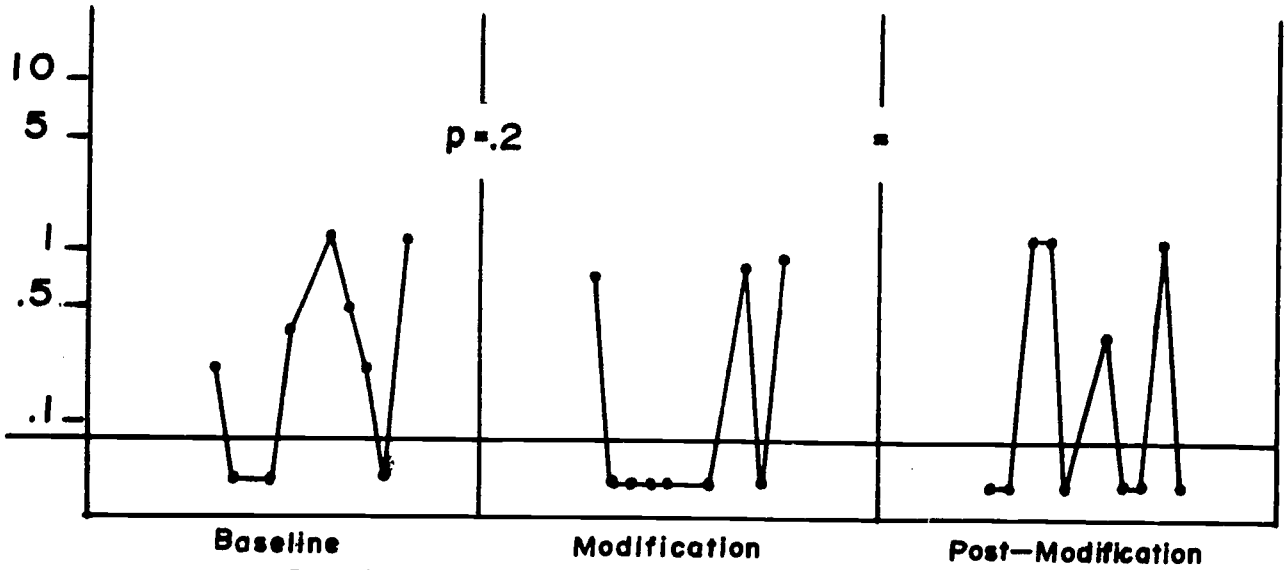
Dyad D

Dyad D involved an inexperienced male teacher. He earned a pretest score of 0 and a posttest score of 7, from a maximum of 7. The pupil was a 12-year-old male with an IQ score of 58. On the diagnostic test he attempted 58 of 67 items and answered 34 of 58 correctly.

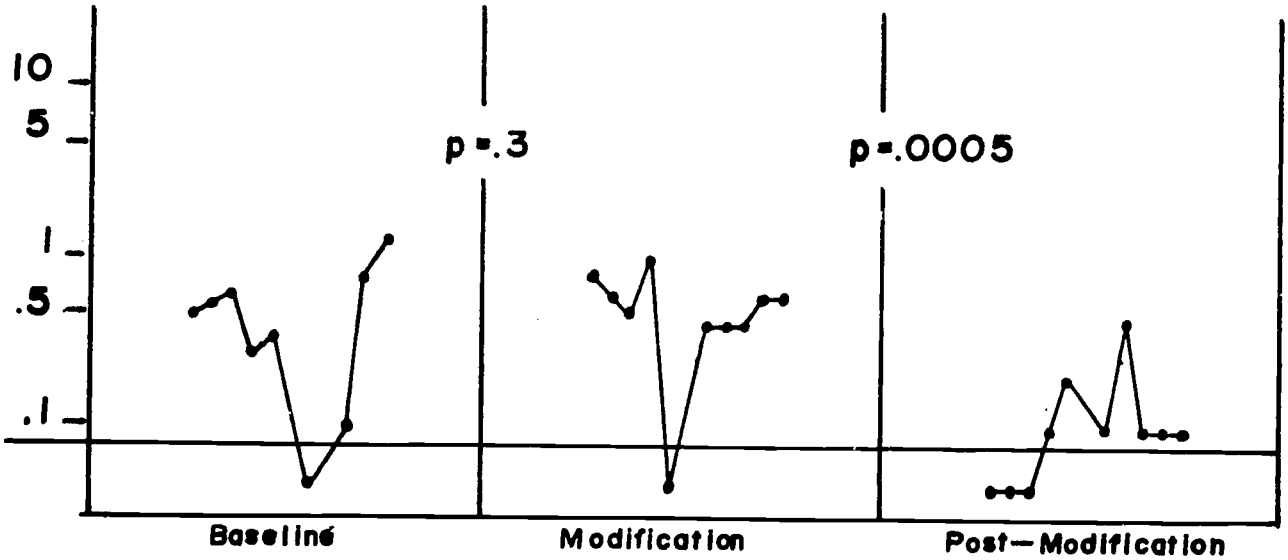
Pupil Category. The teacher chose to accelerate nonverbal responses (13_2) such as putting, pointing, moving hands on a clock, etc., without accompanying them with verbal responses. Median rate during baseline was .2 or two in ten minutes with some sessions showing 0 and others as many as 1 per minute or 10 in ten minutes. During modification the median rate decelerated to 0 (p = .2) with the category being exhibited in only four of 10 sessions. It was noted at the time by the teacher and by others close to the situation that during the first five of the 10 modification sessions, the pupil's behavior was negatively atypical. It is possible that this had some bearing on the data. During post-modification, median rate was 0, the category being exhibited in only four of the 10 sessions.

Teacher Category. The teacher elected to accelerate his use of category 4_1 or verbatim repetition as a way of accelerating pupil non-verbal responses. Median rate of category 4_1 for baseline was .4 per minute, accelerated slightly to .5 per minute during modification (p = .3) and decelerated to .1 per minute during post-modification (p = .0005).

Relationship. Correlations for pupil category 14_1 and teacher category 4_1 were .06 for baseline, .15 for modification, and -.26 for



Dyad D Pupil Category—Nonverbal Response



Dyad D Teacher Category—Verbatim Repetition

Figure 14. Dyad D Pupil and Teacher Categories

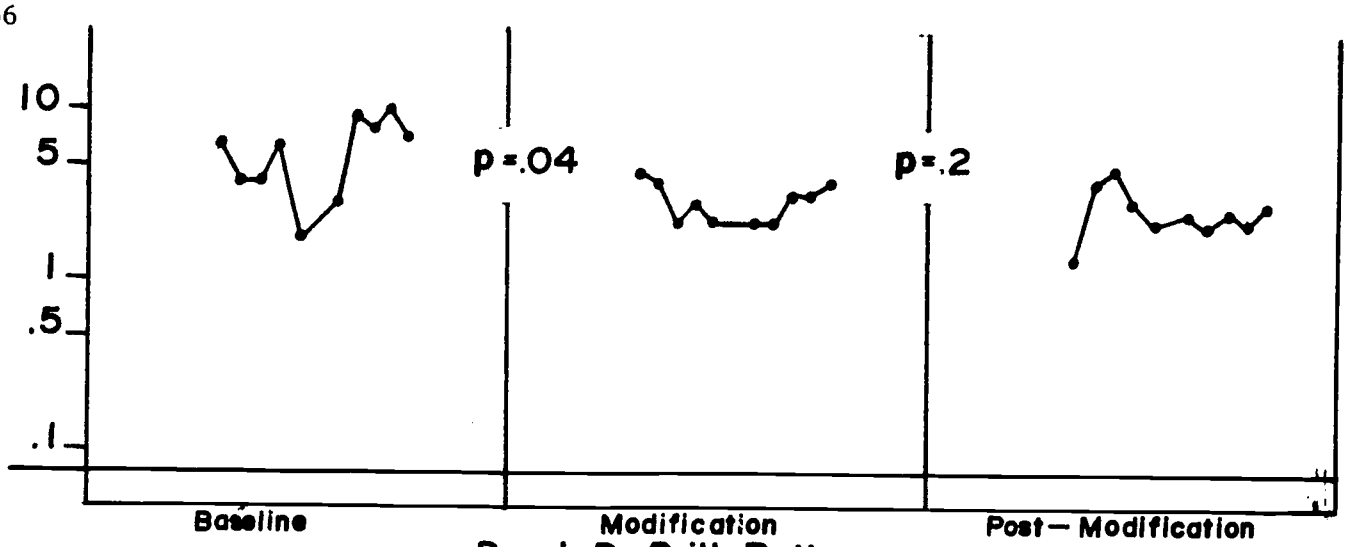
post-modification. Differences between correlations were not significant An analysis of the two categories which this teacher chose would indicate that there is little apparent content relationship between pupil nonverbal response and teacher verbatim repetition. The graph appears to show that a slight acceleration in verbatim repetition is accompanied by a more than slight deceleration in nonverbal responses. This is exactly opposite from what was intended by the teacher. That is, a high rate (.5) of repetition was accompanied by the same low rate (both 0) of nonverbal response as was a low rate (.1) of repetition.

Objectives. A median of two objectives per session was maintained throughout baseline and modification, decelerating slightly to a median of about one per session during post-modification. The original curriculum was extended to include 15 and 5-minute intervals of time.

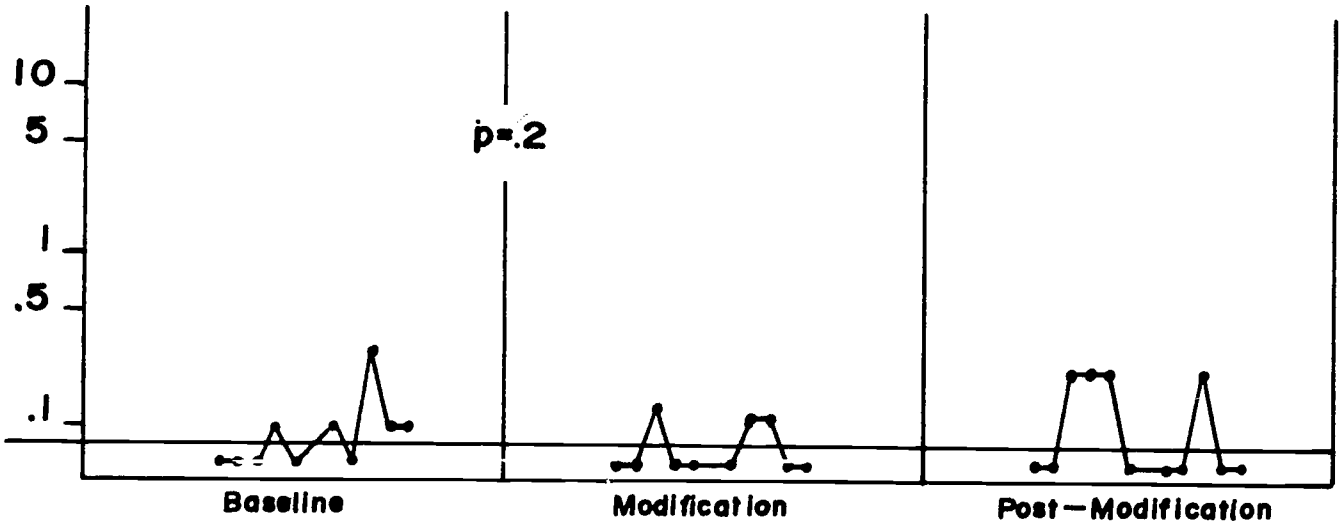
Drill Pattern. Drill pattern decelerated slightly across the three phases, beginning with a median rate of 4.8 per minute during baseline, 3.3 per minute during modification ($p = .04$), and ending with a median rate of 2.7 per minute during post-modification ($p = .2$). This pattern was consistently higher than the teacher and pupil categories or the other two patterns.

Clarification Pattern. Median rates for the clarification pattern were .1, 0, and 0 for the three phases ($p = .2$). The pattern was exhibited about once in half of the baseline sessions and occurred once in less than half of the modification and post-modification sessions.

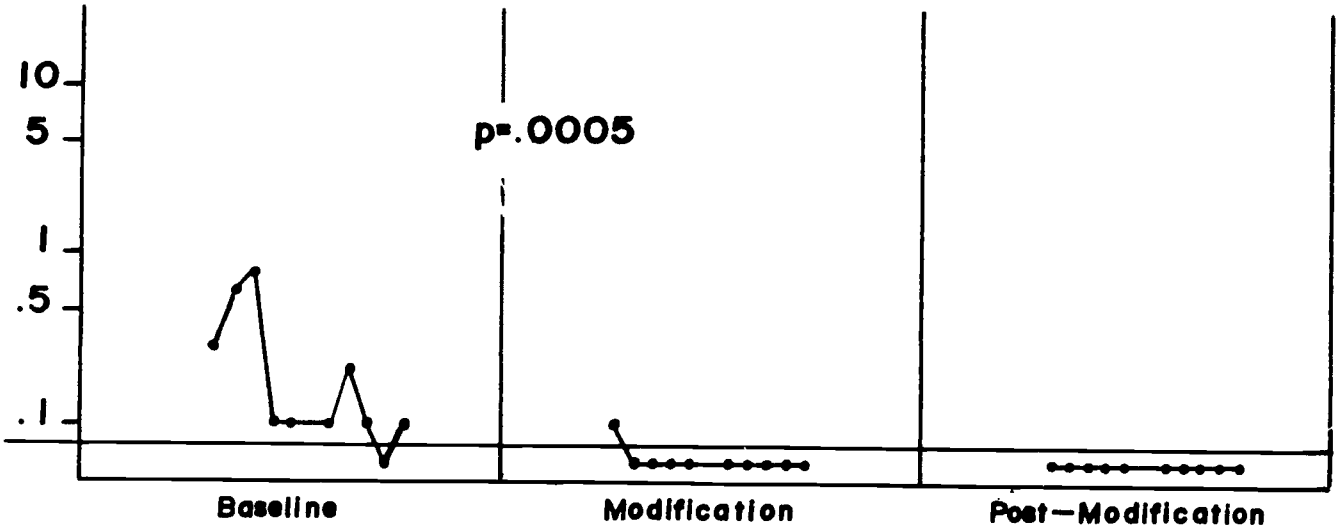
Broad Question Pattern. Broad Question pattern occurred at a median rate of .1 , showing up at least once in 9 of the 10 baseline sessions. During modification the median rate was 0 ($p = .0005$) and remained at 0 through post-modification. The pattern showed up only once in the last 20 sessions.



Dyad D Drill Pattern



Dyad D Clarification Pattern



Dyad D Broad Question Pattern

Figure 15. Dyad D Patterns

Dyad E

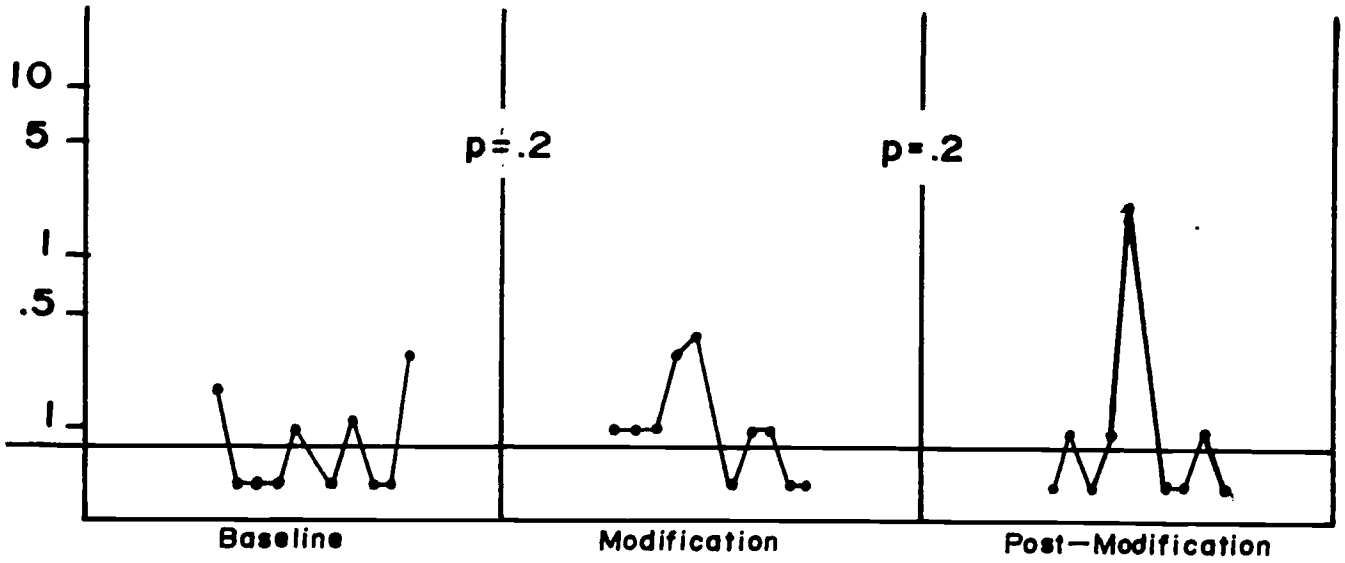
Dyad E involved an experienced female teacher with several years of experience in elementary but not in special education. She earned a pretest score of 0 and a posttest score of 7 out of 7. The pupil was a 17-year-old female with an IQ of 39. On the diagnostic test she attempted 67 of 67 items and answered 51 of 67 correctly.

Pupil Category. The teacher chose to accelerate pupil category 1_1, or statements. Median rate during baseline was 0 and accelerated to .1 during modification (p = .2), showing up in seven of 10 modification sessions. Median rate for post-modification was .05 (p = .2) occurring about once in only half of the sessions.

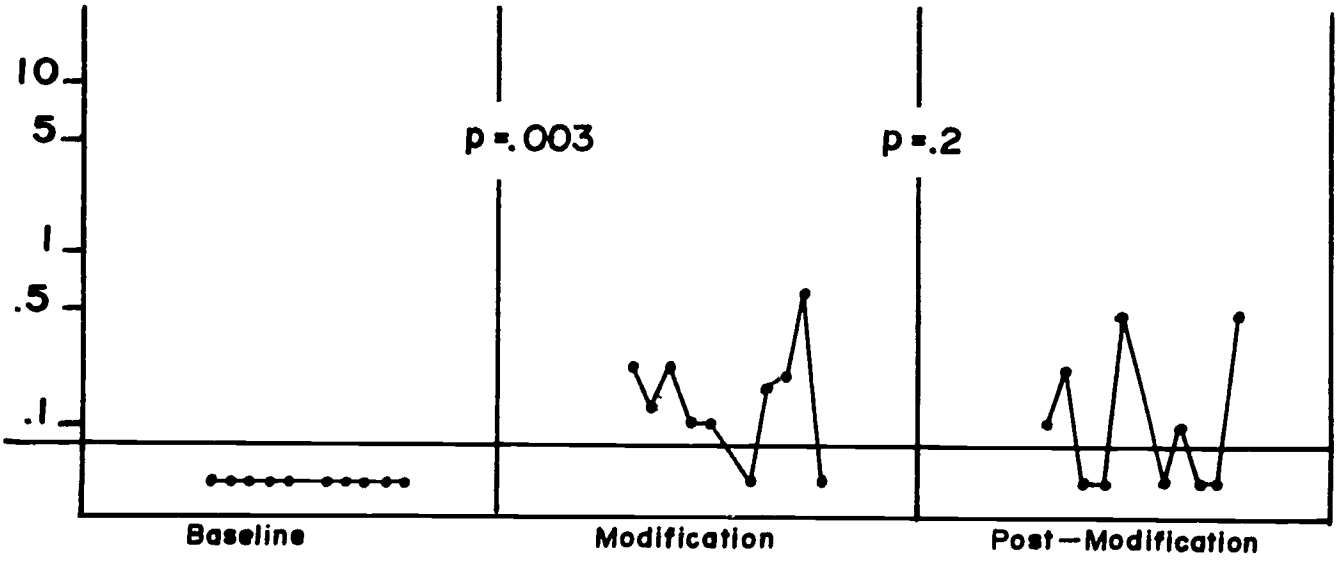
Teacher Category. The teacher elected to accelerate her use of 2_3 or broad questions in order to accelerate statements, or 1_1, by the pupil. Median rate was 0 during baseline, accelerated to .15 during modification (p = .003) and decelerated slightly to .1 (p = .2) during post-modification.

Relationship. Correlations between pupil category 1_1 and teacher category 2_3 were -.24 for modification, and .58 for post-modification. Correlations for baseline were not computed by the computer, as almost all data points were zero. The difference was not significant between -.24 and .58. Pupil category statements, although they did accelerate, did not do so as much as the teacher category broad questions. In fact, from the graph, it may be noted that during the second half of the modification sessions the pupil statements were low while the teacher broad questions were high.

Objectives. Approximately two objectives per session were being attained during baseline. About five or six per session were being



Dyad E Pupil Category—Statements



Dyad E Teacher Category— Broad Questions

Figure 16. Dyad E Pupil and Teacher Category

accomplished during modification and post-modification. The original curriculum was extended to include 15, 5, and 1-minute intervals.

Drill Pattern. The drill pattern remained stable throughout with a median rate of 3 per minute for baseline and 2.8 per minute during modification and post-modification. These rates are noticeably higher than the rates for pupil and teacher categories and the other two patterns.

Clarification Pattern. Clarification pattern occurred only once in 30 sessions.

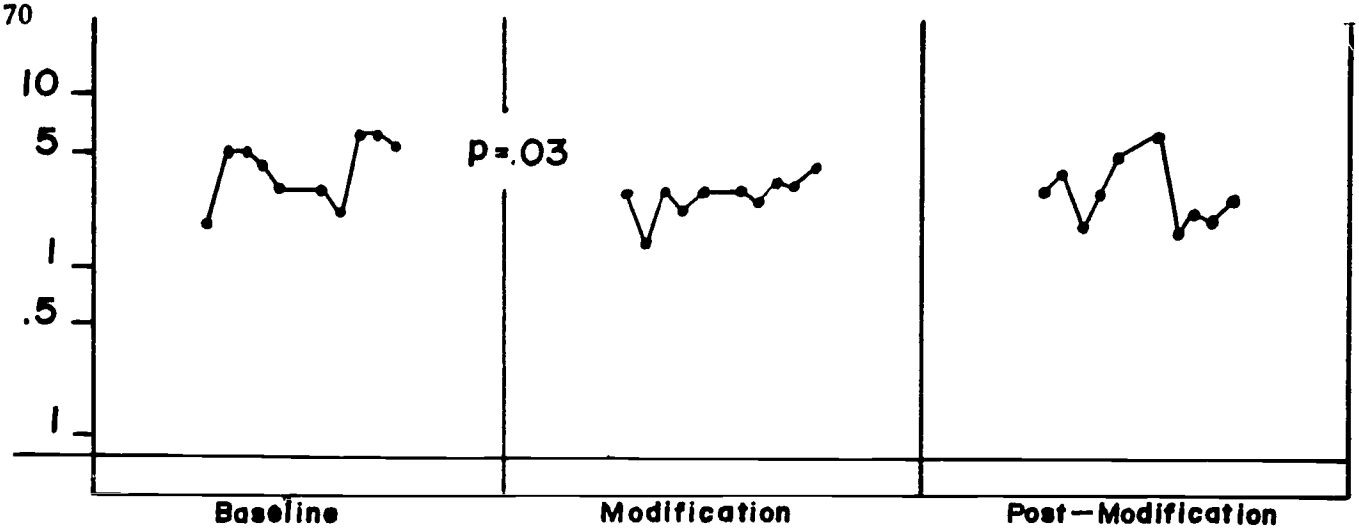
Broad Question Pattern. Broad question pattern maintained median rates of 0 throughout, showing up 0 times during baseline, four times during modification and twice during post-modification.

Dyad F

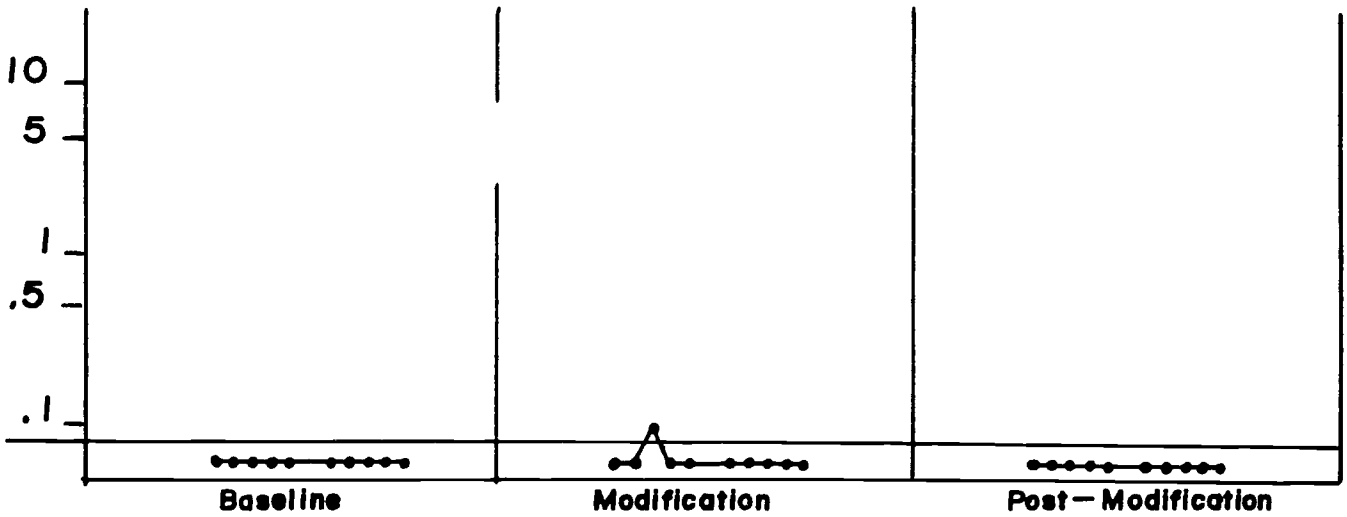
Dyad F involved an inexperienced female teacher. She earned a pretest score of one and a posttest score of 7 out of 7. The pupil was a 16-year-old female with an IQ score of 44. On the diagnostic test she attempted 67 of 67 items and answered 63 correctly. The original curriculum was extended.

Pupil Category. The teacher elected to accelerate pupil category 1_1, or statements. Median rates were .05 during baseline, showing up in only half of the sessions, decelerated to 0 during modification ($p = .3$) showing up in just less than half the sessions, and accelerated to .35 during post-modification ($p = .001$).

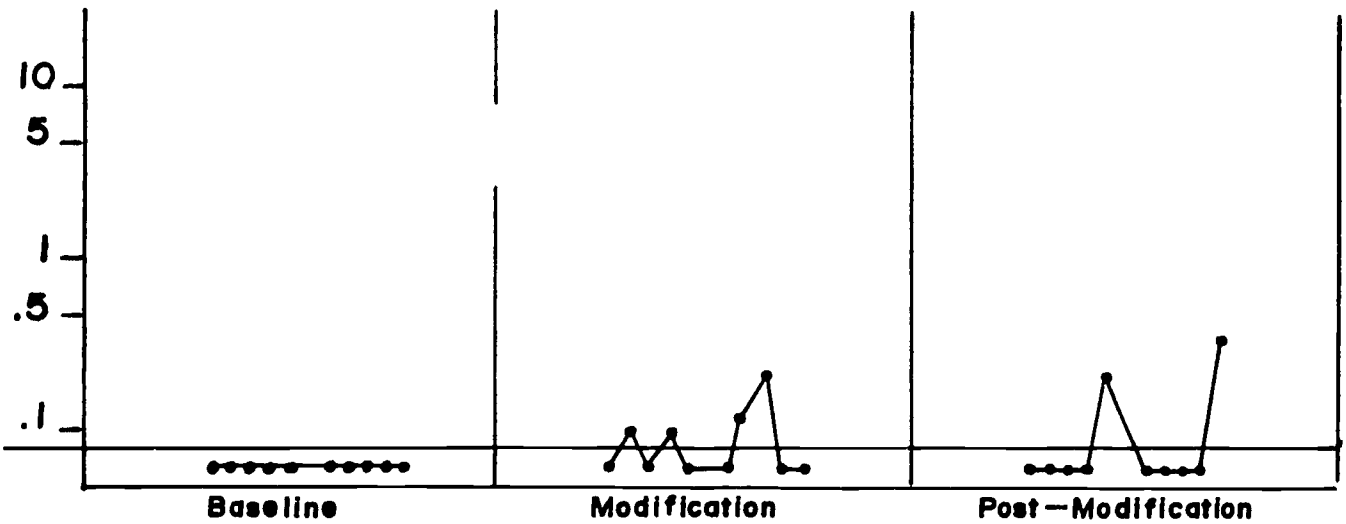
Teacher Category. The teacher elected to accelerate category 2_3, or broad questions, as a way of accelerating pupil statements or 1_1. Median rates were 0 during baseline, accelerated to .3 per minute during modification ($p = .03$) and decelerated to 0 during post-modification ($p = .08$).



Dyad E Drill Pattern

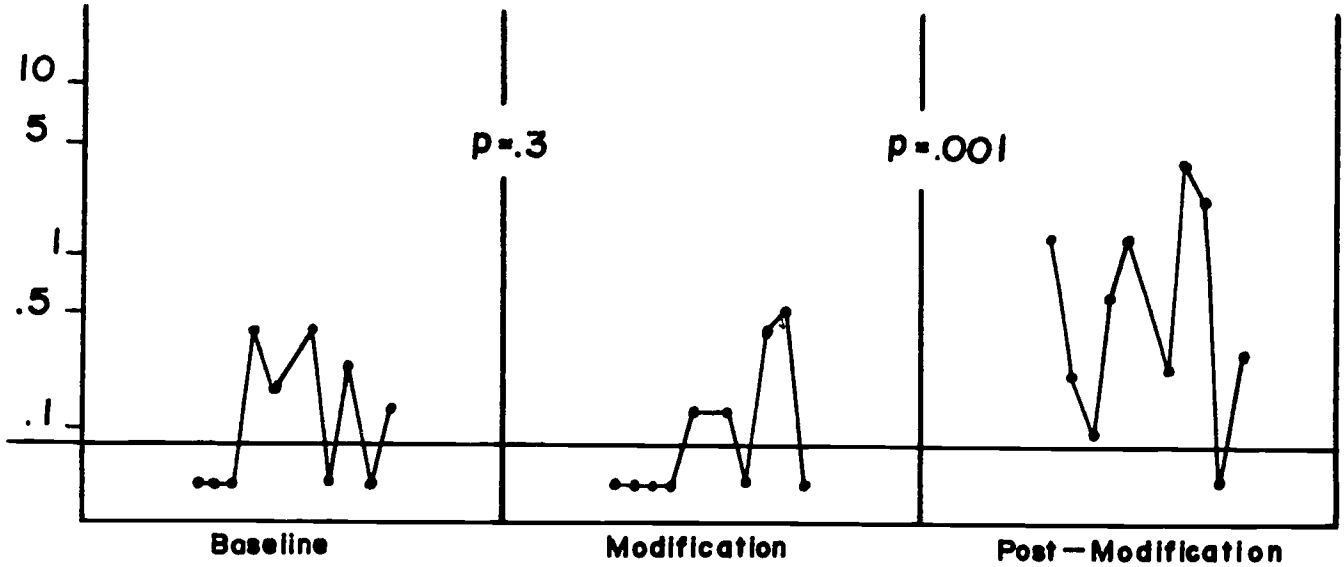


Dyad E Clarification Pattern

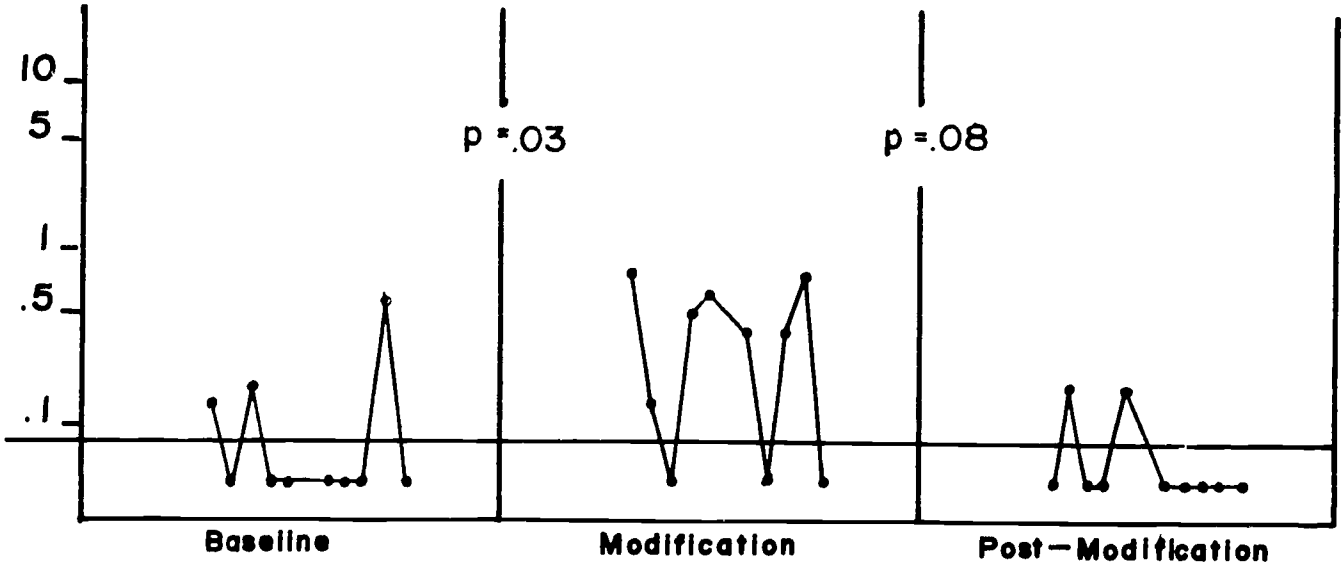


Dyad E Broad Question Pattern

Figure 17. Dyad E Patterns

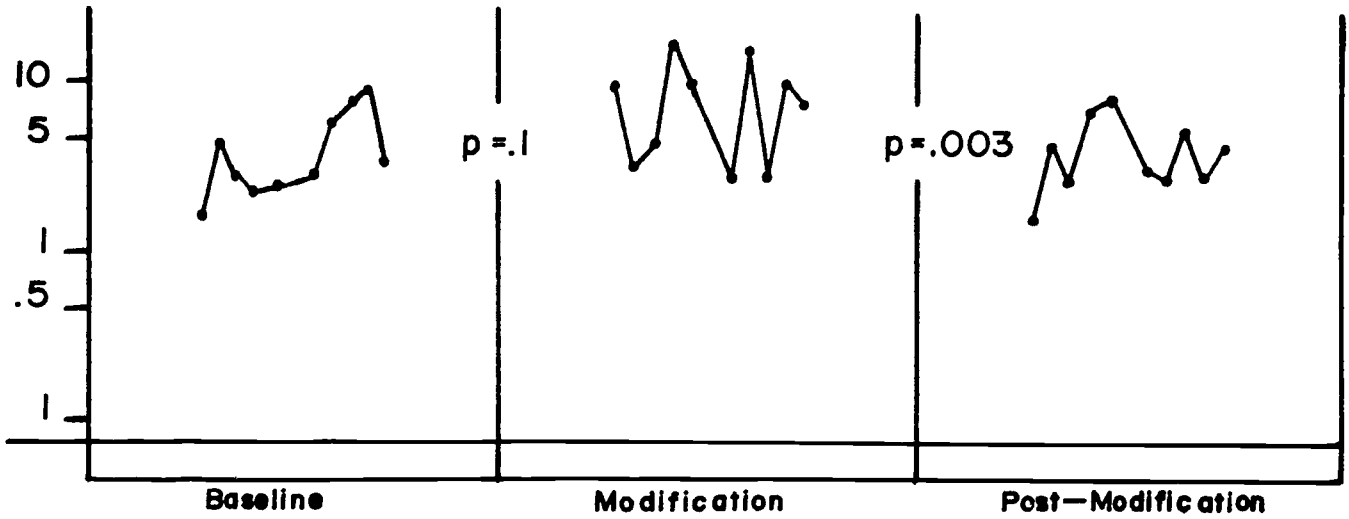


Dyad F Pupil Category—Statements

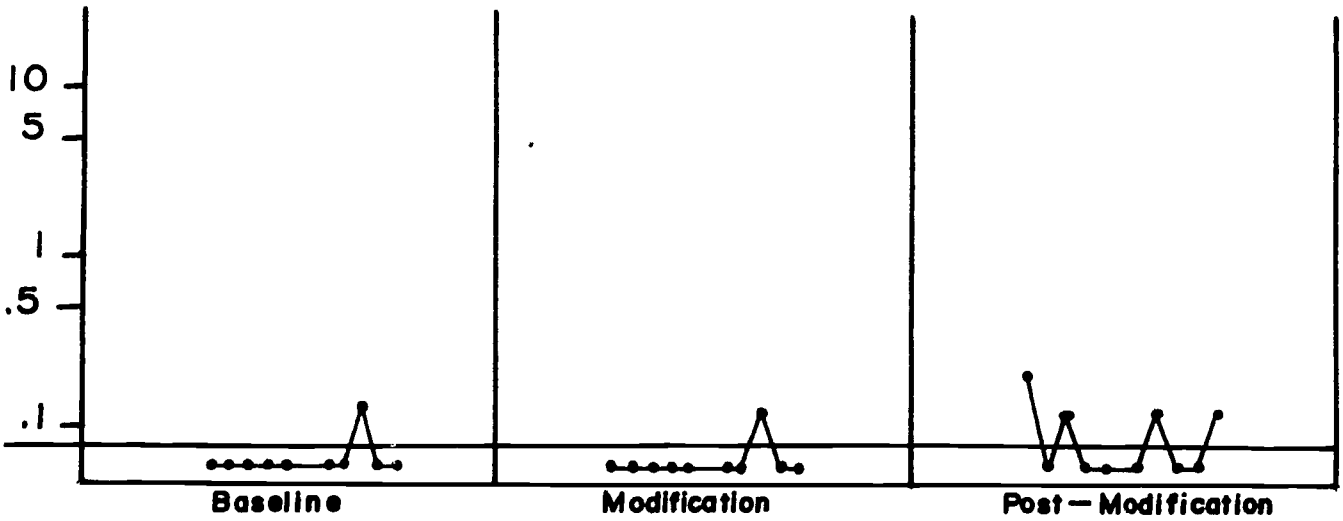


Dyad F Teacher Category—Broad Question

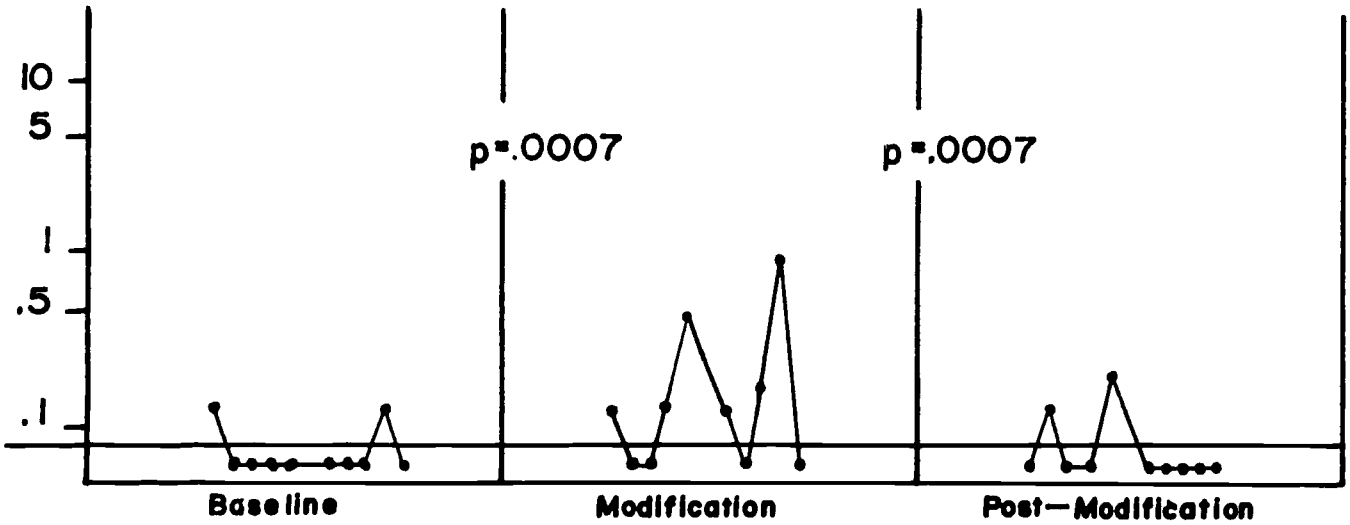
Figure 18. Dyad F Pupil and Teacher Categories



Dyad F Drill Pattern



Dyad F Clarification Pattern



Dyad F. Broad Question Pattern

Figure 19. Dyad F Patterns

Relationship. Correlations for pupil category 1_1 and teacher category 2_3 were -.41 during baseline, .50 during modification, and -.2 during post-modification. Differences between correlations were not significant. As with Dyad E, when teacher broad questions accelerated during modification, pupil statements decelerated. During post-modification, the opposite occurred. That is, teacher broad questions decelerated and pupil statements accelerated.

Objectives. Objectives were extended from the original curriculum to include 15-minute intervals of time. Only three sessions in each phase of nine total showed that objectives had been attained, and in each of the nine of 30 sessions, 12 objectives were recorded as having been attained.

Drill Pattern. Rates of the drill pattern were relatively high with a median of 2.4 per minute during baseline, 3.6 per minute during modification ($p = .1$) and 3.0 per minute during post-modification ($p = .003$).

Clarification Pattern. The clarification pattern was exhibited only once each during baseline and modification, and in four sessions of ten during post-modification.

Broad Question Pattern. Broad question pattern was exhibited in only two sessions during baseline and post-modification. During modification the median rate was .1 ($p = .0007$ in both directions).

Dyad G

Dyad G involved an inexperienced female teacher. She earned a 0 on the pretest and a score of 7 out of 7 on the posttest. The pupil was a 14-year-old female with an IQ score of 50. On the diagnostic test she attempted 60 of 67 and answered 50 of 60 correctly.

Pupil Category. The teacher chose to accelerate pupil category 1_1, or statements. Median rates were .085 for baseline, 14 per minute for modification (p = .03) and .1 per minute for post-modification (p = .2).

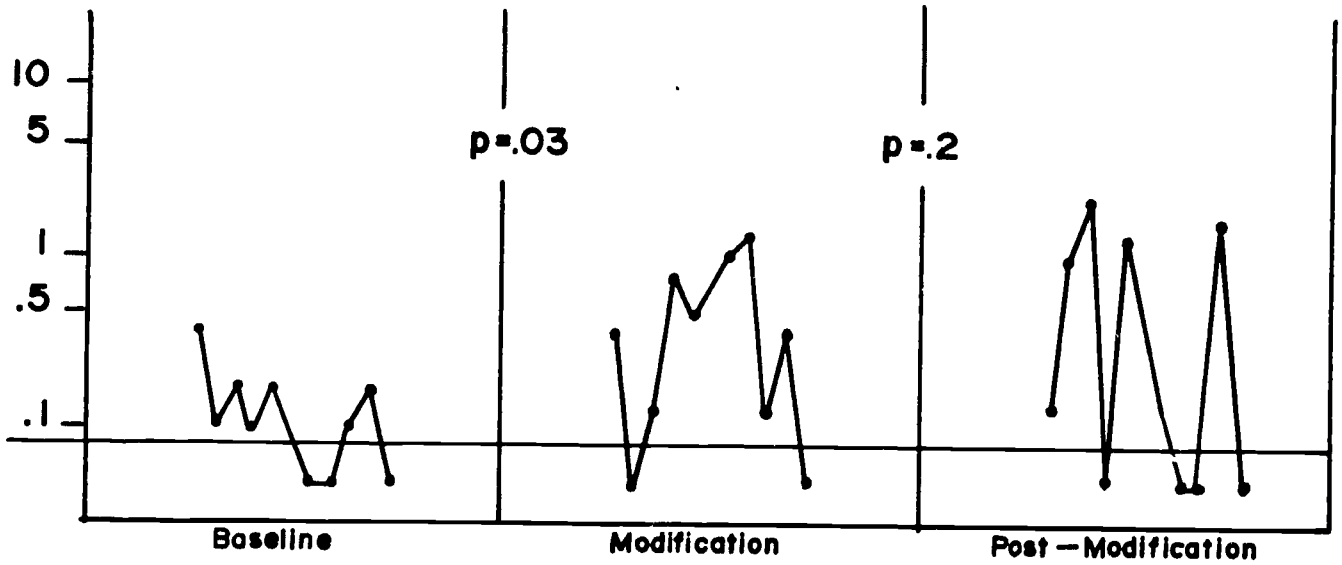
Teacher Category. The teacher elected to accelerate category 2_3, or broad questions, hoping that would accelerate pupil statements, or 1_1. Median rates of teacher category 2_3 were 0 throughout, showing up in 4 of 10 modification sessions, 2 of 10 baseline sessions, and 1 of 10 post-modification sessions.

Relationship. Correlations for pupil category 1_1 and teacher category 2_3 were -.24 for baseline, -.42 for modification, and -.16 for post-modification. Differences between correlations were not significant. It is interesting to note that the rates of pupil category 1_1 accelerated during modification even though the rate of teacher category 2_3 did not accelerate.

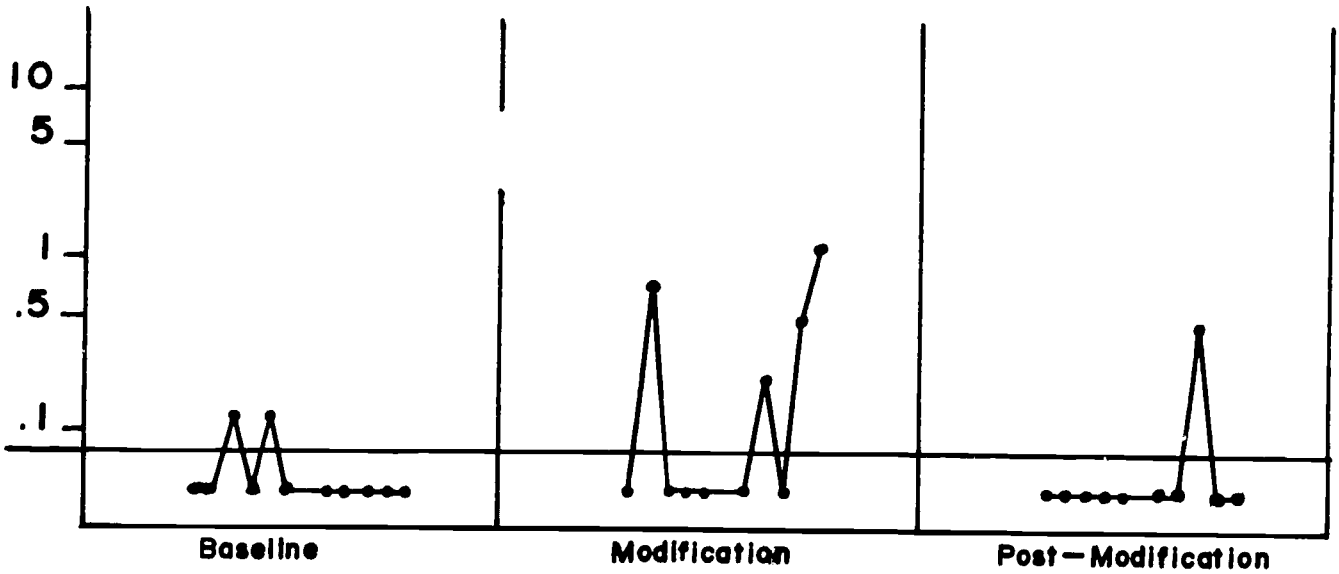
Objectives. During baseline approximately three objectives per session were attained. During modification objectives were recorded as attained in only two of ten sessions. During post-modification in 9 of 10 sessions, 12 objectives were recorded.

Drill Pattern. Rates for drill pattern remained high and stable throughout with a median rate of 4.6 per minute for baseline, 4.3 per minute for modification, and 3.3 per minute during post-modification (p = .2)

Clarification Pattern. Median rates for the clarification pattern were 0 throughout with the pattern showing up in only two or three sessions per phase.

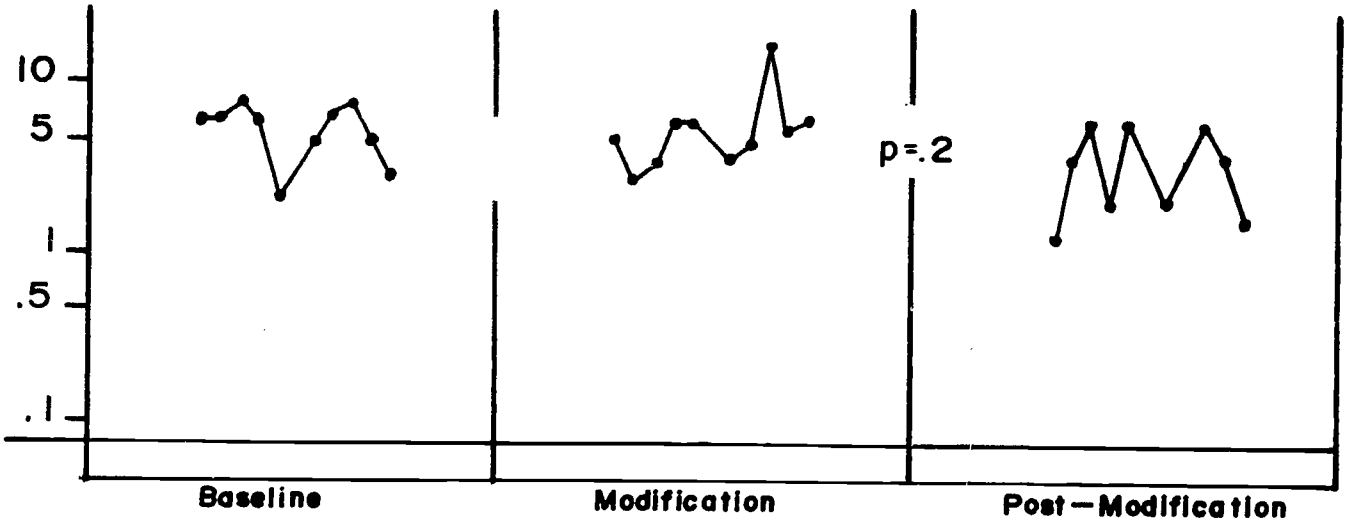


Dyad G Pupil Category—Statements

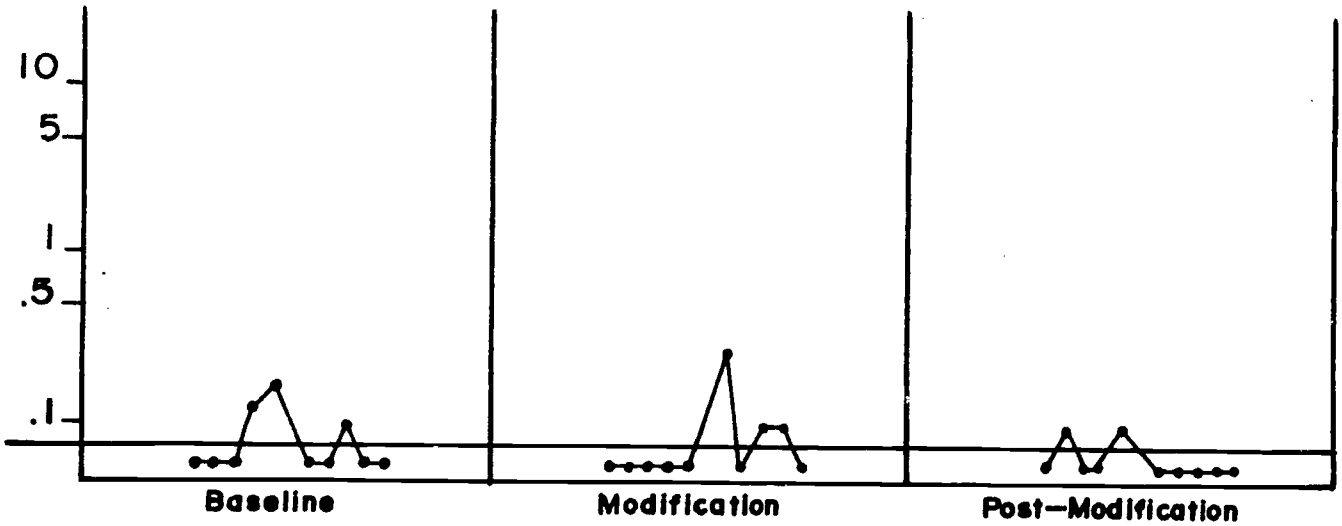


Dyad G Teacher Category—Broad Question

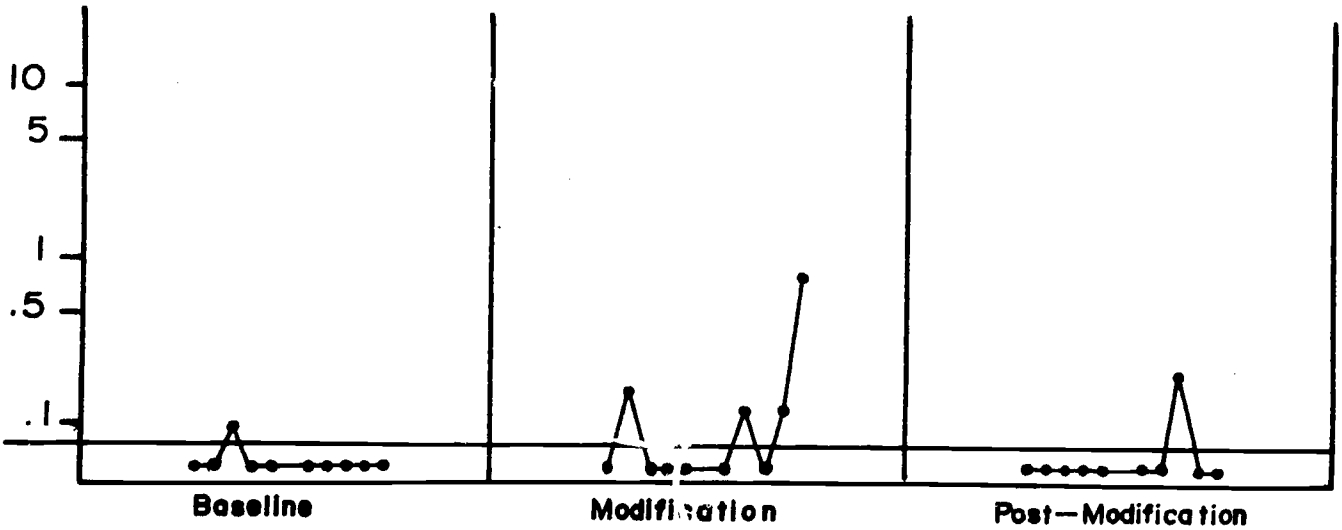
Figure 20. Dyad G Pupil and Teacher Category



Dyad G Drill Pattern



Dyad G Clarification Pattern



Dyad G Broad Question Pattern

Figure 21. Dyad G Patterns

Broad Question Pattern. Median rates for the broad question pattern were 0 throughout, showing up once each in baseline and post-modification and in three sessions during modification.

Dyad H

Dyad H involved a teacher experienced with emotionally disturbed children. She earned a pretest score of 3 and posttest score of 7 out of 7. The pupil was a 16-year-old male with an IQ score of 52. On the diagnostic test he attempted 60 of 67 items and answered 49 of 60 correctly.

This teacher did not elect a pupil and teacher category to change; therefore, only the patterns will be discussed.

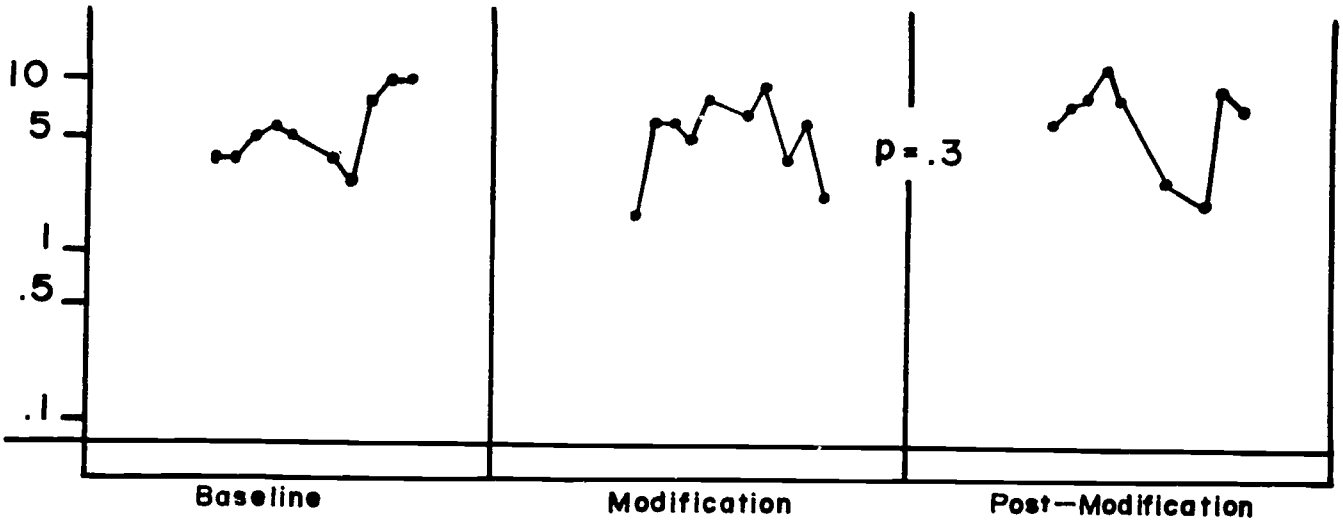
Drill Pattern. The drill pattern was consistently high, median rates being 4.0 per minute for baseline and modification, and 4.6 per minute during post-modification ($p = .3$).

Clarification Pattern. Clarification pattern showed up in only 5 of 30 sessions with median rates of 0 throughout.

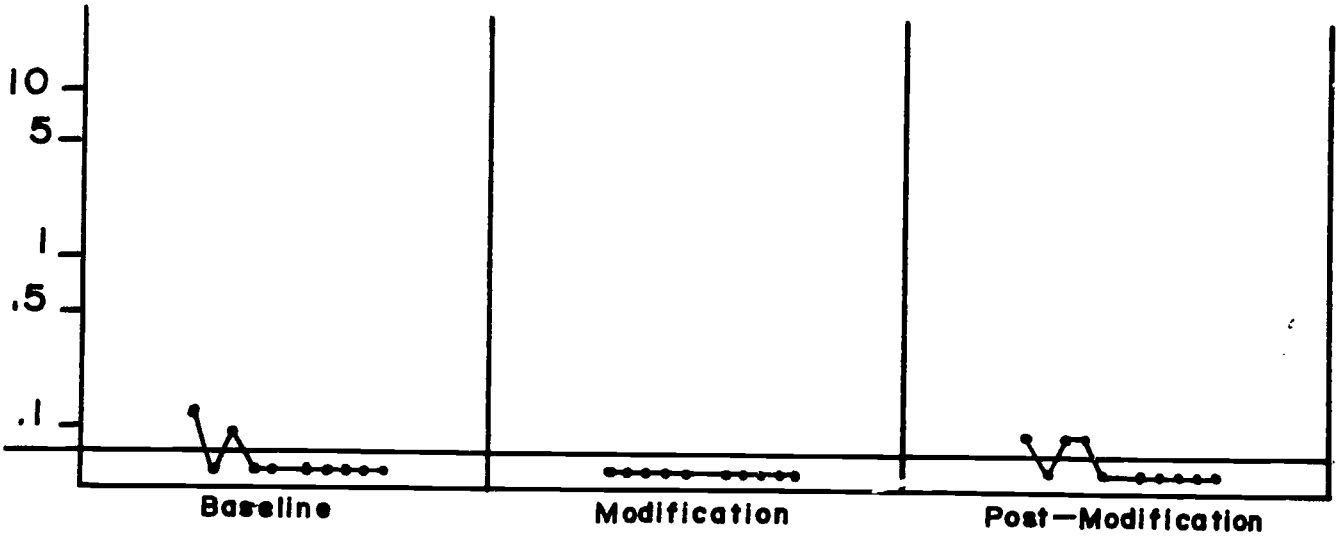
Broad Question Pattern. Broad Question pattern showed up in only 6 of 30 sessions with median rates of 0 throughout.

Summary

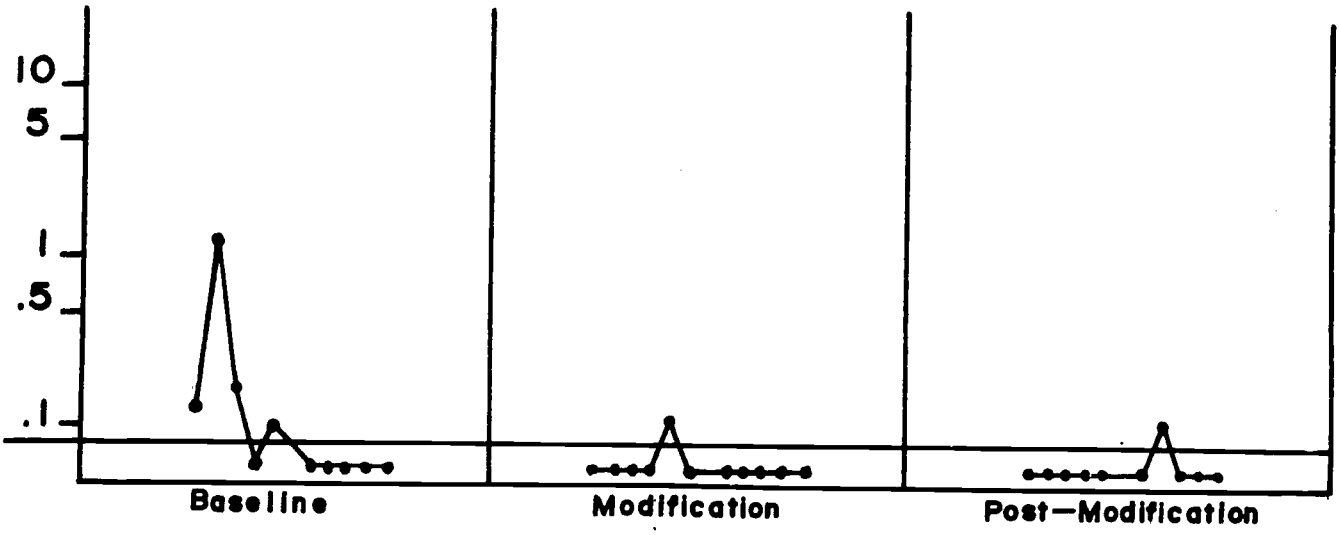
The case studies presented in this chapter include a brief description of teacher and pupil and discuss acceleration and deceleration of rates of teacher-selected pupil category and teacher-selected teacher category. A discussion of the three patterns is also provided. It should be pointed out that while the teachers consciously attempted to change the pupil and teacher categories they selected, they were not aware that data on the patterns would be graphed or discussed. In other words, any changes in pupil or teacher categories may possibly be



Dyad H Drill Pattern



Dyad H Clarification Pattern



Dyad H Broad Question Pattern

Figure 22. Dyad H Patterns

attributed at least in part to the fact that the teachers were making a conscious effort to effect change. However, any changes in patterns could not possibly be due to this since the teachers were not aware that the patterns were under study.

Chapter VI

Discussion

Summary of Study

This chapter discusses the results which were reported in Chapters IV and V. Table 9 shows a summary of results.

The purpose of the study was to determine if selected pupil and teacher categories and three interaction patterns would differ, if the teachers were given training and feedback in interaction analysis and Precision Teaching. Results are specific to the subjects involved in the study. Generalizations are to be made only about the process of obtaining the data--namely, the combination of interaction analysis and Precision Teaching.

Seven hypotheses were formulated with regard to two questions about teachers and moderately mentally retarded pupils.

(1) Do rates of teacher-selected teacher and pupil categories differ before, during, and after feedback conditions?

(2) Do rates of three questioning patterns differ before, during, and after feedback conditions?

To answer the questions, interaction analysis data were gathered on eight teacher-pupil dyads for 30 teaching sessions. Feedback consisted of interaction analysis raw data sheets, with two of the categories graphed.

During the first ten sessions, teachers received no feedback, nor did they know the nature of the observation which was being done. After the first ten sessions a short workshop was conducted to train

Table 9

Summary of Results

	Categories and Patterns								
	Pupil Category#		Teacher Category##		Drill Pattern		Clarification Pattern		Broad Questi Patter
Dyads	B-M*	M-P**	B-M	M-P	B-M	M-P	B-M	M-P	B-M
A	.01D	.08D	.08A	.1D	.03A	.03D	.08D	.07A	0
B	.000006A	.2A	.0007A	.2D	0	.04D	0	0	.04A
C	.002A	.1D	.002A	.2D	0	.03A	0	.2A	.04A
D	.2D	0	.3A	.0005D	.04D	.2D	.2D	0	.0005D
E	.2A	.2D	.003A	.2D	.03D	0	0	0	0
F	.3D	.001A	.03A	.08D	.1A	.003D	0	0	.0007A
G	.03A	.2D	0	0	0	.2D	0	0	0
H					0	.3A	0	0	0

* B-M = Baseline to Modification p Value
** M-P = Modification to Post-Modification p Value

#Pupil Categories

A--Distracting Nonverbal
B--Broad Response
C--Broad Response
D--Nonverbal Response
E--Pupil Statements
F--Pupil Statements
G--Pupil Statements

#Teacher Categories

A--Narrow Questions
B--Broad Questions
C--Broad Questions
D--Verbatim Repetition
E--Broad Questions
F--Broad Questions
G--Broad Questions

Table 9

Summary of Results

Categories and Patterns

gory#	Teacher Category##		Drill Pattern		Clarification Pattern		Broad Question Pattern	
M-P**	B-M	M-P	B-M	M-P	B-M	M-P	B-M	M-P
.08D	.08A	.1D	.03A	.03D	.08D	.07A	0	0
.2A	.0007A	.2D	0	.04D	0	0	.04A	.2D
.1D	.002A	.2D	0	.03A	0	.2A	.04A	0
0	.3A	.0005D	.04D	.2D	.2D	0	.0005D	0
.2D	.003A	.2D	.03D	0	0	0	0	0
.001A	.03A	.08D	.1A	.003D	0	0	.0007A	.0007D
.2D	0	0	0	.2D	0	0	0	0
			0	.3A	0	0	0	0

seline to Modification p Value
dification to Post-Modification p Value

#Pupil Categories

A--Distracting Nonverbal
B--Broad Response
C--Broad Response
D--Nonverbal Response
E--Pupil Statements
F--Pupil Statements
G--Pupil Statements

#Teacher Categories

A--Narrow Questions
B--Broad Questions
C--Broad Questions
D--Verbatim Repetition
E--Broad Questions
F--Broad Questions
G--Broad Questions

the teachers in the use of interaction analysis and Precision Teaching. Each teacher then selected a category of the coding system which the pupil exhibited and a category which she exhibited which she felt was in some way related to the pupil category.

During the second ten teaching sessions each teacher received the interaction analysis raw data from the coder immediately following each session. The teacher added to the graphs on which she had plotted rates for the pupil and teacher categories during the workshop.

During the third ten teaching sessions, the teachers received no data at all. Feedback was withdrawn at this point to determine whether rates attained during feedback would be maintained after feedback was withdrawn. As the extended use of interaction analysis can be only a training device, it is important to note what happens to the categories of behavior in question when the prosthetic device is finally removed.

All hypotheses were stated in null form, because each of eight teacher-pupil dyads was statistically treated separately and because it was not known what teacher and pupil categories each teacher would select to change.

The first hypothesis regarding the change of a teacher-selected pupil category was rejected for four of seven dyads between baseline and modification. Nonverbal distracting behavior was decelerated in Dyad A; Broad Response was accelerated for Dyad B; Broad Response was accelerated for Dyad C; and Pupil Statements were accelerated for Dyad G. Rates for these pupil categories were maintained (nsd) during post-modification, or after feedback was removed. The significance of the results may or may not be attributed to the training and feedback the

teachers received. Those which did not significantly change from baseline to modification were nonverbal response for Dyad D, statements for Dyad E, and Pupil Statements for Dyad F. Nonsignificant results were also found from modification to post-modification for two of these three, Dyads D and E. Pupil categories for Dyad F, while showing nonsignificant change between base and modification, showed significant acceleration between modification and post-modification, or after feedback was removed.

The second hypothesis regarding the change of a teacher-selected teacher category was rejected for four of seven dyads between baseline and modification. Broad Questions were accelerated in Dyad B, C, E, and F. Rates for these teacher categories were maintained (nsd) during post-modification, or after feedback was removed. Those teacher categories which did not significantly change from baseline to modification were narrow questions for Dyad A, verbatim repetition for Dyad D, and Broad Questions for Dyad G. Teacher category for Dyad D, while showing nonsignificant change between base and modification, showed significant deceleration during post-modification , or after feedback was removed.

The third hypothesis regarding the change in relationship or correlation between phases was rejected for Dyad B between baseline and modification. Significant results between modification and post-modification were found only for Dyad B. In Dyad B the categories were teacher broad question and pupil broad response. Even though the correlation significantly decreased, both teacher and pupil categories significantly accelerated.

In cases where teacher and pupil categories significantly accelerated during feedback and the new higher rates were maintained after feedback was removed, the significant results may or may not be attributed to feedback and the accompanying training. There are not enough data in this study to come to that conclusion. It is possible that change may have been simply due to sudden awareness on the part of the teacher that there are such things as broad questions and broad responses. Perhaps the change would have been significant with no feedback immediately following teaching sessions. The fact that the new higher rates were maintained after feedback was removed may point to the latter type of conclusion, or one might conclude that the prosthetic device of feedback, while necessary to effect change in the first place, has outlived its usefulness, is no longer needed, and the change is permanent. As has already been stated, there are far too few returns to come to such conclusions. From this study one can only describe what happened to rates of the categories and patterns in question prior to training and feedback, during feedback, and after feedback was removed.

The fourth hypothesis regarding change in rates of objectives attained was not treated statistically due to the failure of the investigator to realize at the appropriate time that the attainment of objectives by moderately mentally retarded pupils is sporadic and often temporary. That is, just because an objective is attained during one session does not mean that the same objective was retained throughout the remainder of the sessions. Thus, the rate of objectives attained per session was rejected by the investigator as a measure of pupil growth.

Results related to the fifth hypothesis, regarding change in rates of a drill pattern, showed significant acceleration between base

and modification for Dyad A, and significant deceleration for Dyads D and E. Dyad A significantly decelerated during post-modification, while rates of drill pattern for Dyads D and E were maintained (nsd) during post-modification. Rates of drill pattern for Dyads B, C, and F, while showing nonsignificant change from base to modification, did significantly change from modification to post-modification; Dyad B accelerated and Dyads C and F decelerated. Dyads G and H showed no significant change across all phases. It should be noted that in spite of these apparently non-similar results, rates in virtually all dyads were much higher and appeared to be much more stable than rates for any of the teacher and pupil categories or for the other two patterns. One can see from a quick glance at the graphs that median rates of the drill pattern ran roughly between three to seven per minute; whereas median rates for teacher and pupil categories and the other two patterns for the most part ran less than one per minute. This may be attributed to the nature of the curriculum (telling time) or to the low expectancy of the teachers who seemed to believe that the moderately mentally retarded pupils could not handle anything more complex than binary or narrow questions or specific directions. Or, it could be attributed to the fact that many teachers, perhaps even most teachers, have been found in much of the interaction analysis research in normal classrooms to exhibit a great deal of this type of pattern. It is interesting to note that relatively high rates of drill patterns were maintained even by those who significantly accelerated the use of broad question pattern.

The sixth hypothesis regarding change in rates of a clarification pattern was not rejected for any dyad in any phase. In fact, the pattern, which was defined as indicating lack of communication between

teacher and pupil, was exhibited in only a handful of the 30 sessions for dyads. No generalizations can be made here. There are moderately mentally retarded people whose verbal behavior is much less coherent than those used in this study, and there are also those whose verbal behavior is much more coherent. It is interesting to note from the graphs that in Dyad A when teacher use of narrow questions accelerated, clarification pattern decelerated; and when teacher use of normal questions decelerated, clarification pattern accelerated again, though not significantly.

The seventh hypothesis regarding change in the broad question pattern was rejected for Dyads B, C, D, and F between baseline and modification. The significant difference rates were maintained (nsd) after feedback was removed for Dyads B, C, and D. Rates of the broad question pattern were significantly decelerated after feedback was removed. Nonsignificant results were obtained across all phases for Dyads A, E, G, and H. Teacher and pupil categories for Dyads B and C were the components of the broad question pattern. Teacher category for Dyad F was one of the components of this pattern. Dyad D, interestingly enough, was exhibiting the broad question pattern two or three times per session prior to training and feedback, and only once in the last 20 sessions. It would appear that the teacher's concentration on other categories , interfered with his natural pattern of asking broad questions.

Conclusions

No generalizations can be made beyond the specific individuals used in this study. The strength of the study lies in the objective description of verbal interaction under three conditions: tutorial teaching prior to training and feedback, training and subsequent feedback regarding verbal interactions, and removal of that feedback. However,

some observations follow which strongly suggest areas for further research.

1. It appears that training and feedback in interaction analysis and Precision Teaching may have some effect on the verbal behavior of some teachers and moderately mentally retarded pupils.

2. When amount of change of selected pupil and teacher categories is not specified before an attempt to change is made, there is little correlation between those selected pupil and teacher categories.

3. Teaching moderately mentally retarded pupils how to tell time seems to invoke a relatively high rate of a drill pattern with inexperienced teachers.

4. For some dyadic combinations of inexperienced teachers and moderately mentally retarded pupils, there is little or no need for clarification in verbal interaction.

5. In spite of a relatively high and stable rate of a drill pattern, increases can be made in rate of a broad question type or pattern, especially when it is the stated goal of the teacher.

6. Moderately mentally retarded pupils are capable of producing broad responses, which may include productive thinking.

7. Same treatment of teachers produces differential results in terms of changes in specific selected categories and general interaction patterns.

Implications for Further Research

Probably the most important limitation of this study is the short period of time over which data were gathered. Thirty teaching sessions, plus all the training, were compressed into a two-week period

of time where teachers, pupils, and instructors usually put in a six-hour day. In order for behaviors or categories of behavior to develop and change naturally, more time in a natural setting is needed.

A second limitation of this study is that no adequate measure of pupil growth was obtained. Many researchers find achievement criteria one of the most difficult aspects of dealing with change in behavior.

A third limitation of the study, related to pupil growth is that while direction of change was specified by the teachers, amount of change was not specified. If this had been done, it would have been relatively easy to see whether the selected teacher and pupil categories had changed consistently with the amount of change specified.

With the above limitations in mind, the following suggestions are made for incorporation into research designs dealing with questions similar to those handled in this study.

1. Data should be gathered daily over a period of at least one school year in a natural classroom setting.

2. If many classrooms are used, each teacher and pupil should be given a different treatment until one is found for each which will produce the desired changes. This is suggested because same treatment produces differential results, so perhaps differential treatment would produce same results!

3. A measure of academic pupil growth should be determined and data should be gathered daily. Rate attempted, correct, and/or incorrect are typical measures used. While there is still some problem with the day-to-day consistency of such measures, this problem can be somewhat reduced if rates correct were separated into categories such as arithmetic

examples, sentence completion, etc. Even though sentence completion exercises, for example, may not be attempted daily, over a school year one could readily see, from a graph of rate correct done every time this type of work were attempted, whether the rate of that particular behavior had accelerated or decelerated.

4. Most definitely amount, as well as direction of change, should be specified. Only in this way is it meaningful to discuss the value of the change. For example, if a teacher chooses to accelerate his use of broad questions, he should specify that he wants to accelerate to five broad questions per ten-minute lesson. Then it is easy to see whether or not he reached his goal.

5. An unlimited number of times should be allowed for the teacher and/or pupil to try different "change plans." Eventually, with systematic attention, almost every behavior can be changed by some means.

6. Make curriculum a variable. What differences are there in interaction patterns, given different types of curriculum?

7. Look at experience and training of teachers as a variable. The teachers used in this study were all inexperienced with regard to moderately mentally retarded pupils. Perhaps the same patterns would not emerge with more experienced teachers.

8. Use nonverbal as well as verbal pupils and compare the interaction results.

Implications for Teacher Education

Teacher educators may view this study as an attempt to present a process approach to training teachers. A good process, or combination of processes, once integrated into a teacher's way of thinking about

and dealing with children, can be effectively applied to almost any appropriate problem. Inexperienced as well as experienced teachers need to have some way of systematically evaluating their own behavior. Before evaluation can occur, some form of objective data must be available.

This study is one of many attempts to show how objective data can be obtained and effectively utilized in the training of teachers. Following are a few suggestions for teacher educators.

1. Instead of requiring teacher trainees to work on behaviors which you feel are important, allow them to work on what they feel needs to be improved.

2. Have trainees work with pupils for a short period of time daily for several weeks. There is too little continuity in other typical types of arrangements.

3. Collect data for all of the interaction or all occurrences of pinpointed behaviors. Samples of time or interaction do not provide enough information for valid evaluation.

4. Stress making decisions from an analysis of data rather than on hunches.

Implications for Classroom Teachers

The study as it stands would be impractical for the classroom teacher to implement, the biggest problem being to gather the interaction analysis data daily. However, with a few initial observations via a coding system, a few appropriate behaviors or patterns could be pinpointed by the teacher and a daily recording procedures could then be set up. Graphing a few behaviors daily is quite manageable , whether they be teacher behaviors or pupil behaviors or both.

1. Initially graph rate of at least one behavior for each pupil every day. This will allow you to look at daily patterns to compare each pupil with his earlier performance.

2. In looking at the daily behavior charts, think about what events may have influenced the behavior of that pupil , then systematically change events in the environment to see what simultaneous changes may occur in the pupil's behavior.

3. Get someone to record at least one aspect of your teacher behavior. For some behaviors you could record yourself, for others you may have to get a fellow teacher or even a pupil to do it.

4. Establish specific quantitative goals for change.

5. Look at the relationship via the graph between your behavior and the pupil's behavior.

6. Try asking more broad questions of moderately mentally retarded pupils.

REFERENCES

Amidon, E. J. & Flanders, N. A. The role of the teacher in the classroom: A manual for understanding and improving teacher classroom behavior. (Rev. ed.) Minneapolis: Association for Productive Teaching, 1967.

Amidon, E. J. & Hough, J. B. Interaction analysis: Theory, research, and application. Reading, Massachusetts: Addison-Wesley, 1967.

Amidon, E. J. & Hunter, E. Verbal interaction in the classroom: The verbal interaction category system. Unpublished manuscript, Temple University, 1966.

Briggs, L. J., Campeau, P. L., Gagne, R. M. & May, M. A. Instructional media: A procedure for the design of multi-media instruction, a critical review of research, and suggestions or future research. Pittsburgh: American Institutes for Research, 1967.

Cain, L. F. & Levine, S. A study of the effects of community and institutional school classes for trainable mentally retarded children. San Francisco: San Francisco State College, 1961.

Cain, L. F., Levine, S. & Elzey, F. F. Manual for the Cain-Levine Social Competency Scale. Palo Alto: Consulting Psychologists Press, 1963.

Caldwell, T. E. Comparison of classroom measures: Percent, number, and rate. Unpublished manuscript, University of Kansas, 1966.

Caldwell, T. E. Six steps to precision teaching. Unpublished manuscript, Indiana University, 1968.

Cook, W. W., Leeds, C. H. & Callis, R. Minnesota Teacher Attitude Inventory. New York: The Psychological Corporation, 1951.

England, J. The Wayne County Intermediate Schools Study, Final Report Project 5-1051, Grant No. OE-5-10-022, U. S. Department of Health, Education, and Welfare, Office of Education, Bureau of Education for the Handicapped, 1969.

Fine, M. J., Allen, C. A. & Medvene, A. M. Verbal interaction patterns in regular and special classrooms. Psychology in the Schools, 1968, 5, 265-271.

Fink, E. R. Precision teaching the Montessori method with preschool retarded and disturbed children. Unpublished manuscript, University of Kansas, 1968.

Flanders, N. A. Some relationships between teacher influence, pupil attitudes, and achievement. In E. J. Amidon & J. B. Hough (Eds.), Interaction analysis: Theory, research, and application. Reading, Massachusetts: Addison-Wesley, 1967.

Furst, N. & Amidon, E. J. Teacher-pupil interaction patterns in the elementary school. In E. J. Amidon & J. B. Hough (Eds.), Interaction analysis: Theory, research, and application. Reading, Massachusetts: Addison-Wesley, 1967.

Gall, M. The rise of questions in teaching. Review of Educational Research, 1970, 40 (5), 707-721.

Goldstein, H. Report number two on study projects for trainable mentally retarded handicapped children. Springfield, Illinois: State Department of Public Instruction, 1956.

Gregory, T. B. A computer program for calculation of Scott's coefficient of observer reliability. Educational and Psychological Measurement, 1970, 30 (1), 183-185.

Guenther, R. J. Final report of the Michigan demonstration research project for the severely retarded. Lansing, Michigan: State Department of Public Instruction, 1956.

Haughton, E. Counting together: Precision teaching rationale--069. Unpublished manuscript, University of Oregon, 1969.

Hottel, J. V. The Tennessee experimental program of day classes for severely mentally retarded (trainable) children: Interim report of the study. Nashville, Tennessee: Peabody College, 1958.

Hudson, M. An exploration of classroom procedures for teaching trainable mentally retarded children. CEC Research Monograph, Series A, No. 2, Washington, D.C.: Council for Exceptional Children, 1960.

Johnson, G. O. & Capobianco, R. J. Research project on severely retarded children. Albany: New York State Interdepartmental Health Resources Board, 1957.

Kreider, J. Effects of computer assisted teacher training system feedback on increasing teacher rise of pupil ideas with EMR children. Unpublished doctoral dissertation, University of Michigan, 1969.

Lindsley, O. R. Procedures for writing manuscripts and style considerations. Unpublished manuscript, University of Kansas, 1966.

Lindsley, O. R. Training parents and teachers to precisely manage children's behavior. Paper presented at C. S. Mott Foundation. Compendium of Presentations of Special Education Colloquium Series, 1968.

McNemar, Q. Psychological statistics. New York: Wiley, 1969.

Milbury, A. W. What is the effect of a precision teaching program on the behavior of an adult trainable mental retardate? Unpublished doctoral dissertation, Indiana University, 1969.

Peck, J. R. & Sexton, C. L. Effect of various settings on trainable children's progress. American Journal of Mental Deficiency, 1961, 66, 62-68.

Sanders, D. C. Innovations in elementary classroom seating. Austin: University of Texas, Bureau of Laboratory Schools, 1958.

Schmitt, J. S. Modifying questioning behavior of prospective teachers of mentally retarded children through a computer assisted teacher training system (CATTS). Unpublished doctoral dissertation, University of Michigan, 1969.

Semmel, M. I., Herzog, B. & Jorgenson, F. A pilot study of the verbal interaction of regular elementary classes and special classes for the educable mentally retarded. Studies in Language and Language Behavior, I, October 1, 1965, Center for Research on Language and Language Behavior, University of Michigan, Contract No. OEE-5-14-036, U. S. Office of Education.

Semmel, M. I., Herzog, B., Kreider, J. & Charves, M. Teacher attitude and teacher-pupil verbal interaction patterns in the TMR classroom. In Final Report, Project No. 5-1051, U. S. Department of Health, Education and Welfare, Office of Education, Bureau of Education for the Handicapped, June 30, 1969, pp. 337-353.

Semmel, M. I. & Kreider, J. M. The relationship of pupil-teacher interactions in classrooms for the TMR to pupil gain in communication skills. Unpublished manuscript, Indiana University, 1970.

Simon, A. & Boyer, E. G. Mirrors for Behavior. Philadelphia: Research for Better Schools, Inc., 1967.

Stuck, G. B. & Wayne, M. D. Study of verbal behavior in special and regular elementary school classrooms. American Journal of Mental Deficiency, 1971, 75 (4), 463-469.

Van Every, H. The application of a computer assisted teacher training system to speech therapist training. Unpublished doctoral dissertation, University of Michigan, 1971.

Weaver, P. Effects of a computer assisted teacher training system and teacher expectancies on teacher-pupil verbal interaction with EMR children. Unpublished doctoral dissertation, University of Michigan, 1969.

APPENDIX A

Teacher Pre-Post Test

June 2, 1970

Name _____

Score _____

(1 point for each item correct)

Pretest for Selection of Teachers

1. Write the words for these symbols. Define briefly.

   I. A. _____

   P. T. _____

2. How would the following be coded:

   Are the flowers green? _____

   Name the system you are coding with. _____

3. Give an example of a binary response. _____

4. What does .1 mean on a 6 cycle log graph? _____

   _____

5. Rate is computed using time and frequency. Write the formula.

   _____

   _____

APPENDIX B

Coding System

Coding System*

Verbal Behavior

1. Statement or Phrase
    1. Complete thought
    2. Open-ended

2. Question
    1. Binary
    2. Narrow
    3. Broad
    4. Request for Clarification

3. Direction

4. Repetition
    1. Verbatim Repetition
    2. Rephrasing

5. Response
    1. Binary
    2. Narrow
    3. Broad
    4. Clarification

6. Positive Reinforcement

7. Negative Reinforcement

8. Criticism or Reprimand

9. Expression of Feelings or Emotions
    1. About Self
    2. About Others

10. Task Irrelevant Response
    1. Intelligible
    2. Unintelligible

Nonverbal Behavior

11. Demonstration
    1. Accompanied by task relevant verbal behavior
    2. Accompanied by non-task relevant verbal behavior
    3. Not accompanied by verbal behavior

12. Physical Restriction

13. Physical Response
    1. Elicited by other
    2. Not elicited by other, but task relevant
    3. Imitation

14. Task Irrelevant Behavior
    1. Encouraging
    2. Distracting

*Adapted from coding systems developed by Harolyn VanEvery and Diane Dolley.

Coding System*

Verbal Behavior

1. Statement or Phrase

   1. Complete Thought

      A complete sentence or a phrase which has the effect of a complete thought; e.g. The flowers are green. The green flowers.

   2. Open-ended Statement or Phrase

      A sentence or phrase which obviously requires that a word or words be filled in; e.g. The flowers are _____. Any verbal response to this must be coded 5_3.

2. Question

   1. Binary Question

      A question which requires a yes-no response, or which provides a limited number of alternative responses; e.g. Are these flowers green? Are these flowers green or blue?

   2. Narrow Question

      A question which has only one acceptable or correct response; e.g. What color are these flowers?

   3. Broad Question

      A question which has two or more acceptable or correct responses. An open-ended question; e.g., includes opinion.

   4. Request for Clarification

      A question which requires that the verbal behavior which immediately preceded this be restricted or otherwise clarified; e.g., I didn't understand that. Would you repeat it, please? What did you say?

3. Direction

   A task relevant statement or phrase which requires either a verbal or nonverbal response; e.g. Put your finger on the picture which has two things in it. Tell me how many things are in this picture.

4. Repetition (Can only follow another verbal category)

   1. Verbatim Repetition

      Verbal behavior immediately preceding this is repeated word for word.

   2. Rephrasing

      Verbal behavior immediately preceding this is repeated, but with different wording, i.e., rephrased; e.g. (Preceding---they are green.) The flowers are green.

5. Response

   1. Binary Response

      A yes-no response which includes one of the alternatives provided in a binary question. Usually follows a binary question, but does not necessarily have to; e.g. Yes, that's right. No, that's wrong.

   2. Narrow Response

      Response (statement, phrase, or word) to a narrow question---whether correct or incorrect; e.g. These flowers are blue.

   3. Broad Response

      Response to a broad question---an idea, concept or generalization; e.g. includes opinion.

   4. Clarification

      Can only follow a 2_4 (request for clarification). Otherwise, it is a repetition (4_1) or rephrasing (4_2).

6. Positive Reinforcement

   A positive value judgment is made about task related verbal or nonverbal behavior; e.g. Good, you're doing a fine job. (I like what you're doing (9) or That's right (5_1) would not be coded as 6---includes opinion.

7. Negative Reinforcement

   A negative value judgment about task related verbal or nonverbal behavior; e.g. That's sloppy work, includes opinion.

8. Criticism or Reprimand

A verbal attempt to stop the others from doing or saying something which is non-task relevant; e.g. Pay attention. Keep your eyes off the TV. (A nonverbal reprimand such as touching or physically restraining would not be coded as an 8 but a 12 (Physical Restraint.)

9. Expression of Feelings or Emotion

1. About Self

A statement or question regarding feelings of self about other or something; e.g. I like your green dress. I like you. Do you think I am pretty?

2. About Other

A statement or question regarding feelings of others; e.g. You look nice today. Do you like flowers?

10. Task Irrelevant Response

1. Intelligible

Any verbal behavior which is understandable which cannot be coded in any of the other categories; e.g. Close the door. Put the pencil on the table. I don't want to work today.

2. Unintelligible

Any attempt at verbalization which is not understood by the coder.

Nonverbal Behavior

11. Demonstration

1. Accompanied by task relevant verbal behavior

Physical demonstration of task accompanied by verbal explanation specifically related to task.

2. Accompanied by non-task relevant verbal behavior

Physical demonstration of task accompanied by verbal explanation which is not specifically related to task---i.e., verbal explanation which could also accompany any other kind of task; e.g. Write your name on the top of the paper like this. I'll show you how to do this.

3. Not accompanied by verbal behavior

Physical demonstration of task. No verbal behavior is exhibited. Silence.

12. Physical Restriction

Attempt to restrain action by touching or taking something away from child.

13. Physical Response

1. Elicited by other

Nonverbal response following a specific verbal request for some kind of action; e.g., Point to the number 2. (Points to number 2) May be correct or incorrect.

2. Not elicited but task relevant

Nonverbal response which is relevant to the task but not immediately preceded by a request to perform some action.

3. Imitation

Exact duplication of nonverbal task relevant behavior immediately preceding this. This category (13_3) can only follow another nonverbal category (11-14). May include both teacher and pupil doing something together---e.g., putting finger on numbers together and perhaps counting verbally at the same time.

14. Task Irrelevant Behavior

1. Encouraging

Smile, touch, teacher patting, holding hand

2. Distracting

Any nonverbal behavior which cannot be coded in any of the other categories; e.g., Walking around, pounding on table, hitting, kicking, etc.

*Adapted from coding systems developed by Harolyn VanEvery and Diane Dolley.

Pupil P															
Teacher T															

Pupil P															
Teacher T															

Pupil P															
Teacher T															

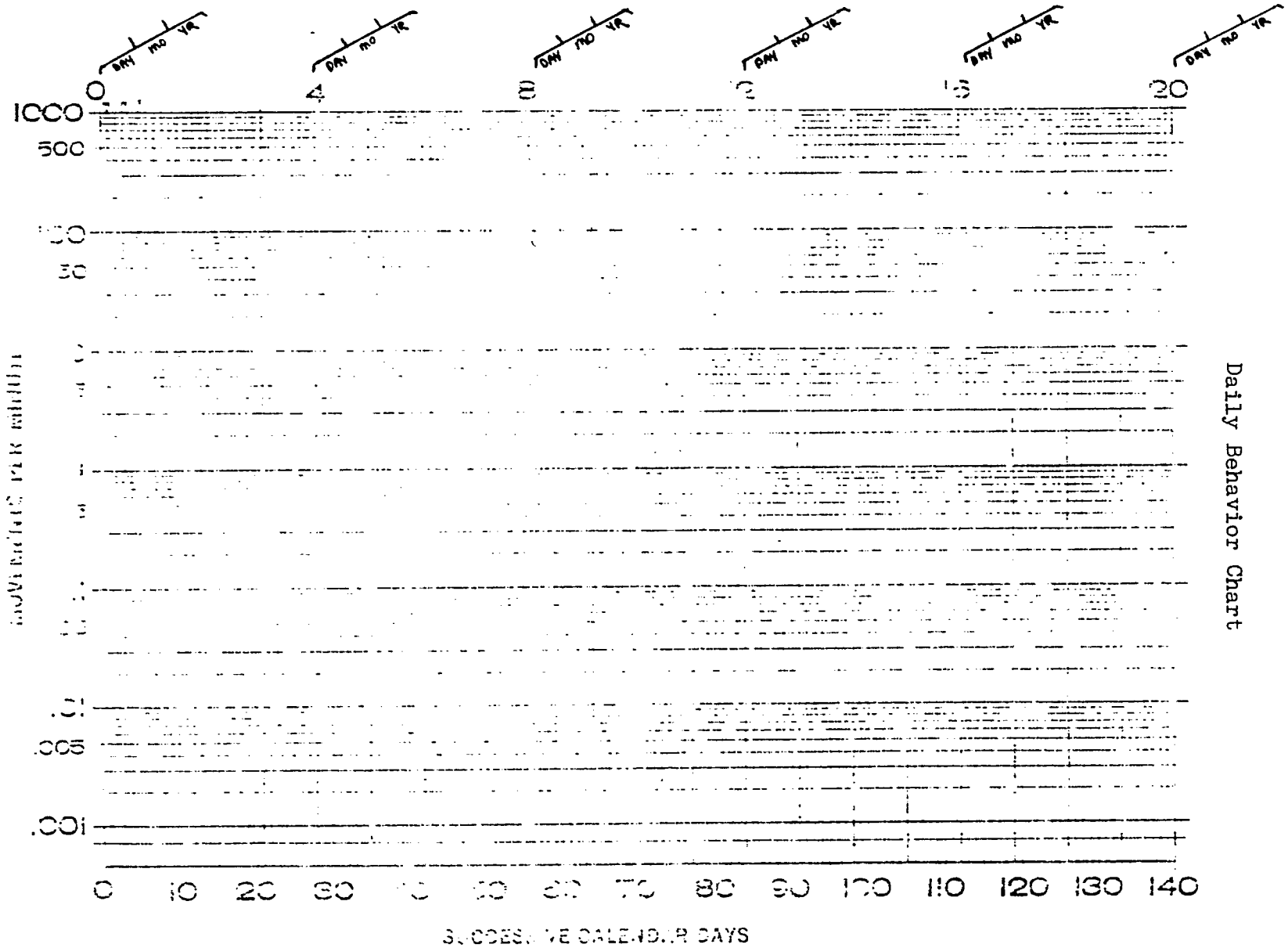
Pupil P															
Teacher T															

APPENDIX C

Precision Teaching Tools

Daily Behavior Chart (DC-8)
6 Cycle - 140 days (20 wks.)
Behavior Research Co.
Box 3351 - Kansas City, Kans. 66103

CALENDAR WEEKS



Daily Behavior Chart

SUPERVISOR	ADVISER	MANAGER	BEHAVER	AGE	LABEL	MOVEMENT
DEPOSITOR	AGENCY		CHARTER			

Rate Computation Sheet

OJECT MES: _____ SUPERVISOR _____ ADVISER _____ MANAGER _____ BEHAVIOR _____ MOVEMENT _____ TARGET

RATE COMPUTATION SHEET
WEEKS ◯ Through ◯

Sheet _____ of _____

Behavior Research Co. (RCS-5)
Box 3351 Kansas City, Kansas. 66103

ONT SIDE

TIME: CLOCK READING Hrs:Min	CLOCK Hrs x 60	IN MINUTES	RATE COMPUTATION	DAY	COMMENT
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST MON	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST TUE	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST WED	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST THU	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST FRI	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST SAT	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST SUN / DAY MO	NO CHANCE / IGNORED

TIME: CLOCK READING Hrs:Min	CLOCK Hrs x 60	IN MINUTES	RATE COMPUTATION	DAY	COMMENT
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST MON	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST TUE	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST WED	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST THU	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST FRI	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST SAT	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST SUN / DAY MO	NO CHANCE / IGNORED

FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST MON	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST TUE	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST WED	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST THU	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST FRI	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST SAT	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST SUN / DAY MO	NO CHANCE / IGNORED

FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST MON	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST TUE	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST WED	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST THU	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST FRI	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST SAT	NO CHANCE / IGNORED
FINISH / START			Rate / Movements Counted; Minutes of Counting	LAST SUN / / DAY MO YR	NO CHANCE / IGNORED

EACH BOX ABOVE IS ONE WEEK. EACH CELL (2 IN A BOX) IS ONE CALENDAR DAY AND ONE VERTICAL LINE ON DAILY CHART. SUNDAYS ARE THE HEAVY VERTICAL LINES ON DAILY CHART.

RATED DAYS: CONVERT START AND FINISH TIMES TO MINUTES AND SUBTRACT TO GET MINUTES OF COUNTING. DIVIDE NUMBER OF MOVEMENTS COUNTED BY MINUTES OF COUNTING TO GET RATE IN MOVEMENTS PER MINUTE. PLOT DOT ON DAILY CHART. CONNECT DOTS WITH LINE, SKIPPING ALL NO CHANCE AND PHASE CHANGE DAYS.

INVALID DAYS: MARK NO CHANCE IF THE MOVEMENT HAD NO CHANCE TO OCCUR. SKIP DAY ON DAILY CHART.

IGNORED DAYS: MARK IGNORED IF THE MOVEMENT COULD HAVE OCCURRED BUT WAS NOT RECORDED. DRAW LINE ACROSS ON DAILY CHART.

PHASE CHANGE DAYS: MARK LAST FOR THE LAST DAY OF EACH PHASE. SKIP AND DRAW VERTICAL LINE ON CHART AFTER THE LAST DAY OF EACH PHASE AND BEFORE THE NEXT CALENDAR DAY. DO NOT CONNECT DOTS ACROSS THIS PHASE CHANGE LINE.

APPENDIX D

Diagnostic Test and Lesson Plans

Diagnostic Test
and
Lesson Plans

Teacher Name _____

Pupil Name _____

Total Attempted _____

Total Correct _____

Total Time _____

Directions for Testing:

1. Refer only to C or Criterion items in the following pages. Words in parentheses are directions. The other words are what you should say to the pupil.

2. Give the pupil only one opportunity to make a response. Write his response in the space provided.

3. Do not comment on the child's response. Respond positively to the child, but neutrally to his response. Do not tell him whether it is right or wrong, good, or bad.

4. If the pupil misses five in a row---STOP. Move on to the next series if you are in a series. (Series are 1-12, 13-37, 41-52, 56-67)

5. Begin lessons at first item missed (responded to incorrectly or not at all). Teach lesson(s) for every item missed after that.

6. Score each item 1 if correct, 0 if incorrect. Write 1 or 0 to the left of the item number.

Directions for Lesson Plan Format:

You will receive blank lesson plan formats. Each item in this paper represents a lesson plan. You are given the Behavioral Objective (B.O.), Entry Behavior (E.B.), and Criterion (C). Copy this information on your lesson plan format. You will be required to fill in Strategy and Resources yourself.

B.O. Behavioral Objective
E.B. Entry Behavior
C. Criterion

_____ 1. B.O. To be able to name the number 1.
E.B. To be able to focus on a single item on a page.
C. (Write the number 1. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____ 2. B.O. To be able to name the number 2.
E.B. To be able to focus on a single item on a page.
C. (Write the number 2. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____ 3. B.O. To be able to name the number 3.
E.B. To be able to focus on a single item on a page.
C. (Write the number 3. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____ 4. B.O. To be able to name the number 4.
E.B. To be able to focus on a single item on a page.
C. (Write the number 4. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____ 5. B.O. To be able to name the number 5.
E.B. To be able to focus on a single item on a page.
C. (Write the number 5. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____ 6. B.O. To be able to name the number 6.
E.B. To be able to focus on a single item on a page.
C. (Write the number 6. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____ 7. B.O. To be able to name the number 7.
E.B. To be able focus on a single item on a page.
C. (Write the number 7. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____8. B.O. To be able to name the number 8.
E.B. To be able to focus on a single item on a page.
C. (Write the number 8. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____9. B.O. To be able to name the number 9.
E.B. To be able to focus on a single item on a page.
C. (Write the number 9. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____10. B.O. To be able to name the number 10.
E.B. To be able to focus on a single item on a page.
C. (Write the number 10. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____11. B.O. To be able to name the number 11.
E.B. To be able to focus on a single item on a page.
C. (Write the number 11. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____12. B.O. To be able to name the number 12.
E.B. To be able to focus on a single item on a page.
C. (Write the number 12. Show it to the pupil. Ask:) What number is this? (Write the pupil response in the box.)

_____13. B.O. To be able to count by rote to 13.
E.B. To be able to say each number regardless of sequence.
C. (Say) Count slowly as far as you can. Stop when you get to 13. (Write pupil response as he gives it.)

_____14. B.O. To be able to count to 1 (1:1 correspondence).
E.B. To be able to count to 1 by rote.
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 1 toothpick and take it away from the others. (After pupil has counted, put the toothpick back to form a row of 12 again.) (Write how many the pupil counted in the box.)

_____ 15. B.O. To be able to demonstrate understanding of the concept of 1.
E.B. To be able to count to 1 by rote. To be able to count to 1 (1:1 correspondence).
C. (Put 1 toothpick in one pile and 2 in another. Say:) Point to the group that has 1 toothpick. (Write the number of the group the pupil points to in the box.)

_____ 16. B.O. To be able to count to 2 (1:1 correspondence).
E.B. To be able to count to 2 by rote.
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 2 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.)

_____ 17. B.O. To be able to demonstrate understanding of the concept of 2.
E.B. To be able to count to 2 by rote. To be able to count to 2 (1:1 correspondence).
C. (Put 1 toothpick in one group and 2 in another. Say:) Point to the group that has 2 toothpicks. (Write the number of the group the pupil points to in the box.)

_____ 18. B.O. To be able to count to 3 (1:1 correspondence).
E.B. To be able to count to 3 by rote; to 2 (1:1).
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 3 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.)

_____ 19. B.O. To be able to demonstrate understanding of the concept of 3.
E.B. To be able to count to 3 by rote; to 3 (1:1).
C. (Put 3 toothpicks in one group and 4 in another. Say:) Point to the group that has 3 toothpicks. (Write the number of the group the pupil points to in the box.)

_____ 20. B.O. To be able to count to 4 (1:1 correspondence).
E.B. To be able to count to 4 by rote; to 3 (1:1).
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 4 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.) ☐

_____ 21. B.O. To be able to demonstrate understanding of the concept of 4.
E.B. To be able to count to 4 by rote. To be able to count to 4 (1:1 correspondence).
C. (Put 3 toothpicks in one group and 4 in another. Say:) Point to the group that has 4 toothpicks. (Write the number of the group the pupil points to in the box.) ☐

_____ 22. B.O. To be able to count to 5 (1:1 correspondence).
E.B. To be able to count to 5 by rote; to 4 (1:1).
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 5 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.) ☐

_____ 23. B.O. To be able to demonstrate the understanding of the concept of 5.
E.B. To be able to count to 5 by rote. To be able to count to 5 (1:1 correspondence).
C. (Put 5 toothpicks in one group and 6 in another. Say:) Point to the group that has 5 toothpicks. (Write the number of the group the pupil points to in the box.) ☐

_____ 24. B.O. To be able to count to 6 (1:1 correspondence).
E.B. To be able to count to 6 by rote; to 5 (1:1).
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 6 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.) ☐

_____ 25. B.O. To be able to demonstrate understanding of the concept of 6.
E.B. To be able to count to 6 by rote.
To be able to count to 6 (1:1 correspondence).
C. (Put 5 toothpicks in one group and 6 in another. Say:) Point to the group that has 5 toothpicks. (Write the number of the group the pupil points to in the box.) ☐

_____ 26. B.O. To be able to count to 7 (1:1 correspondence).
E.B. To be able to count to 7 by rote.
To be able to count to 6 (1:1).
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 7 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.) ☐

_____ 27. B.O. To be able to demonstrate understanding of the concept of 7.
E.B. To be able to count to 7 by rote.
To be able to count to 7 (1:1).
C. (Put 7 toothpicks in one group and 8 in another. Say:) Point to the group that has 7 toothpicks. (Write the number of the group the pupil points to in the box.) ☐

_____ 28. B.O. To be able to count to 8 (1:1).
E.B. To be able to count to 8 by rote.
To be able to count to 7 (1:1).
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 8 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.) ☐

_____ 29. B.O. To be able to demonstrate understanding of the concept of 8.
E.B. To be able to count to 8 by rote.
To be able to count to 8 (1:1).
C. (Put 7 toothpicks in one group and 8 in another. Say:) Point to the group that has 8 toothpicks. (Write the number of the group the pupil points to in the box.)

_____ 30. B.O. To be able to count to 9 (1:1).
E.B. To be able to count to 9 by rote.
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 9 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.)

_____ 31. B.O. To be able to demonstrate understanding of the concept of 9.
E.B. To be able to count to 9 by rote.
To be able to count to 9 (1:1).
C. (Put 9 toothpicks in one group and 10 in another. Say:) Point to the group that has 9 toothpicks. (Write the number of the group the pupil points to in the box.)

_____ 32. B.O. To be able to count to 10 (1:1).
E.B. To be able to count to 10 by rote.
To be able to count to 9 (1:1).
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 10 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.)

_____ 33. B.O. To be able to demonstrate understanding of the concept of 10.
E.B. To be able to count to 10 by rote.
To be able to count to 10 (1:1).
C. (Put 9 toothpicks in one group and 10 in another. Say:) Point to the group that has 10 toothpicks. (Write the number of the group the pupil points to in the box.)

_____ 34. B.O. To be able to count to 11 (1:1)
E.B. To be able to count to 11 by rote.
To be able to count to 10 (1:1)
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 11 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.)

_____ 35. B.O. To be able to demonstrate understanding of the concept of 11.
E.B. To be able to count to 11 by rote.
To be able to count to 11 (1:1).
C. (Put 11 toothpicks in one group and 12 in another. Say:) Point to the group that has 11 toothpicks. (Write the number of the group the pupil points to in the box.)

_____ 36. B.O. To be able to count to 12 (1:1).
E.B. To be able to count to 12 by rote.
To be able to count to 11 (1:1).
C. (Put 12 toothpicks in a row in front of pupil. Say:) Count 12 toothpicks and take them away from the others. (After pupil has counted, put the toothpicks back to form a row of 12 again. Write how many the pupil counted in the box.)

_____ 37. B.O. To be able to demonstrate understanding of the concept of 12.
E.B. To be able to count to 12 by rote.
To be able to count to 12 (1:1).
C. (Put 11 toothpicks in one group and 12 in another. Say:) Point to the group that has 12 toothpicks. (Write the number of the group the pupil points to in the box.)

_____ 38. B.O. To be able to demonstrate understanding of clockwise motion.
E.B. To be able to demonstrate understanding of circle.
C. (Say) Move your hand on the paper (on which you have drawn a circle) the same way the hands on a clock move. (Indicate direction here. _____)

_____ 39. B.O. To be able to discriminate between long and short.

E.B. To be able to demonstrate understanding of the concept long.
To be able to demonstrate understanding of the concept short.

C. (Draw two lines on a paper---one short and one obviously longer. Say:) Point to the long line. (Indicate which line pupil pointed to here. _____)
(Say) Point to the short line. (Indicate here. _____)

_____ 40. B.O. To be able to point to the hand on a clock which tells the hour.

E.B. To be able to discriminate between long and short.

C. (Draw a circle with a long and short hand - as on a clock. Say:) Point to hand that tells the hour on a clock. (Indicate which hand pupil pointed to here. _____)

_____ 41. B.O. To be able to fix a short hand on a clock to show 1:00.

E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 1.

C. (Use the clock which is provided for you for the next 12 items. Leave the long hand at 12. Say:) Fix the hour hand so the clock says 1:00. (Indicate what time pupil makes on the clock. _____)

_____ 42. B.O. To be able to fix a short hand on a clock to show 2:00.

E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 2.

C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 2:00. (Indicate what time pupil makes on the clock. _____)

_____ 43. B.O. To be able to fix a short hand on a clock to show 3:00.
E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 3.
C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 3:00. (Indicate what time pupil makes on the clock. _____)

_____ 44. B.O. To be able to fix a short hand on a clock to show 4:00.
E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 4.
C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 4:00. (Indicate what time pupil makes on the clock. _____)

_____ 45. B.O. To be able to fix a short hand on a clock to show 5:00.
E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 5.
C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 5:00. Indicate what time pupil makes on the clock. _____)

_____ 46. B.O. To be able to fix a short hand on a clock to show 6:00.
E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 6.
C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 6:00. (Indicate what time pupil makes on the clock. _____)

_____ 47. B.O. To be able to fix a short hand on a clock to show 7:00.

E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 7.

C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 7:00. (Indicate what time pupil makes on the clock. _____)

_____ 48. B.O. To be able to fix a short hand on a clock to show 8:00.

E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 8.

C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 8:00. (Indicate what time pupil makes on the clock. _____)

_____ 49. B.O. To be able to fix a short hand on a clock to show 9:00.

E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 9.

C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 9:00. (Indicate what time pupil makes on the clock. _____)

_____ 50. B.O. To be able to fix a short hand on a clock to show 10:00.

E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 10.

C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 10:00. (Indicate what time pupil makes on the clock. _____)

_____ 51. B.O. To be able to fix a short hand on a clock to show 11:00.
E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 11.
C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 11:00. (Indicate what time pupil makes on the clock._____)

_____ 52. B.O. To be able to fix a short hand on a clock to show 12:00.
E.B. To be able to discriminate between long and short.
To be able to point to the hand that tells the hour.
To be able to name 12.
C. (Leave the long hand at 12. Say:) Fix the hour hand so the clock says 12:00. (Indicate what time pupil makes on the clock. _____)

_____ 53. B.O. To be able to point to the hand on a clock which tells the minutes.
E.B. To be able to discriminate between long and short.
C. (Draw a circle with a long and short hand---as on a clock. Say:) Point to the hand that tells the minutes on a clock. (Indicate which hand pupil pointed to here. _____)

_____ 54. B.O. To be able to discriminate between before and after.
E.B. To be able to demonstrate understanding of the concept before.
To be able to demonstrate understanding of the concept after.
C. (Place a piece of paper on the table with a toothpick on either side of it. Say:) Which toothpick is before the paper. Point to it. (Indicate whether pupil pointed to before or after. _____
Which toothpick is after the paper. Point to it. _____)

_____ 55. B.O. To be able to trace half a circle.
E.B. To be able to identify a circle.
C. (Draw a circle. Say:) This is a circle. Start here. Take your hand and move it around half of the circle. (Indicate about how far pupil moved his hand around the circle. _____)

_____ 56. B.O. To be able to show half past 1:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 1.
To be able to use the minute and hour hands appropriately.
To be able to count (1:1) to 6.
C. (Use clock which is provided. Say:) Show me half way past 1:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 57. B.O. To be able to show half past 2:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 2.
To be able to use the minute and hour hands appropriately.
To be able to count (1:1) to 6.
C. (Use clock provided. Say:) Show me half way past 2:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 58. B.O. To be able to show half past 3:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 3.
To be able to use the minute and hour hands appropriately.
To be able to count (1:1) to 6.
C. (Use clock provided. Show me half way past 3:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 59. B.O. To be able to show half past 4:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 4.
To be able to use the minute and hour hands appropriately.
To be able to count to 6 (1:1).
C. (Use clock provided. Say:) Show me half way past 4:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 60. B.O. To be able to show half past 5:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 5.
To be able to use the minute and hour hands appropriately.
To be able to count to 6 (1:1).
C. (Use clock provided. Say:) Show me half way past 5:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 61. B.O. To be able to show half past 6:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 6.
To be able to use the minute and hour hands appropriately.
To be able to count to 6.
C. (Use clock provided. Say:) Show me half way past 6:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 62. B.O. To be able to show half past 7:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 7.
To be able to use the minute and hour hands appropriately.
To be able to count to 6.
C. (Use clock provided. Say:) Show me half past 7:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 63. B.O. To be able to show half past 8:00 on a clock.
E.B. To be able to trace half circle.
To be able to name the number 8.
To be able to use the minute and hour hands appropriately.
To be able to count to 6.
C. (Use clock provided. Say:) Show me half way past 7:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 64. B.O. To be able to show half past 9:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 9.
To be able to use the minute and hour hands appropriately.
To be able to count to 6.
C. (Use clock provided. Say:) Show me half way past 9:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 65. B.O. To be able to show half past 10:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 10.
To be able to use the minute and hour hands appropriately.
To be able to count to 6.
C. (Use clock provided. Say:) Show me half way past 10:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 66. B.O. To be able to show half past 11:00 on a clock.
E.B. To be able to trace a half circle.
To be able to name the number 11.
To be able to use the minute and hour hands appropriately.
To be able to count to 6.
C. (Use clock provided. Say:) Show me half past 11:00 on this clock. (Indicate what time pupil shows on clock. _____)

_____ 67. B.O. To be able to show half past 12:00 on a clock.
E.B. To be able to trace half a circle.
To be able to name the number 12.
To be able to use the minute and hour hands appropriately.
To be able to count to 6.
C. (Use clock provided. Say:) Show me half way past 12:00 on this clock. (Indicate what time pupil shows on clock. _____)

TEST ONLY TO HERE

****

USE SAME FORMAT BELOW AS FOR 56-67.

68. B.O. To be able to show time in 15 minute intervals (15, 30, 45 min. after)

69. B.O. To be able to show time in 5 minute intervals.

70. B.O. To be able to show time in 1 minute intervals.

71. B.O. To be able to show time or tell time in 1:00 notation.

Lesson Plan # _____

Teacher Name _____

Pupil Name _____

Behavioral Objective

Entry Behavior

Criterion

Strategy

Resources

APPENDIX E

Lindsley Mid-median Test of Exact Probability

Lindsley Mid-median Test of Exact Probability*

Example Data

	Phase 1	Phase 2
Median	.03	1.0
Lo-Hi	0.0 - .4	.1 - 210
Range	.4	1.9

Steps

1. Find median for Phase 1 and Phase 2

   Phase 1 median .03

   Phase 2 median 1.0

2. Find the mid-median for Phase 1 and Phase 2.

   a) 1.00 larger median
      - .03 smaller median

      .97 distance between medians

   b) .97 (distance between medians / 2 equals .485 or halfways between medians

   c) .03 smaller median

      # .485 half way between medians

      .515 mid-median

3. By drawing in the mid-median, data points in Phase 1 and Phase 2 can fall above or below the mid-median.

4. Count the number of data points in:

   a) Phase 1 that fall above the mid-median

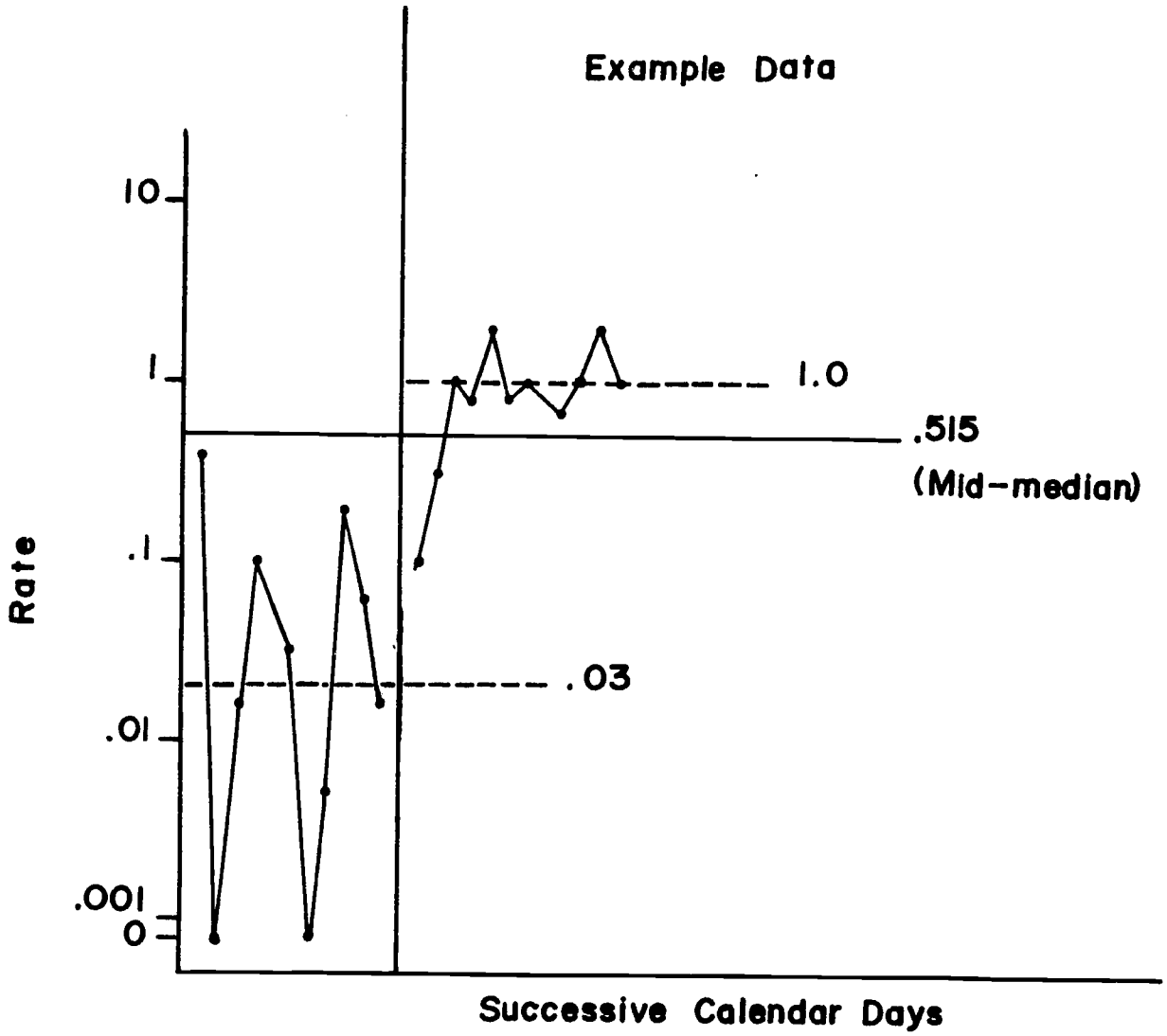
   b) Phase 1 that fall below the mid-median

   c) Phase 2 that fall above the mid-median

   d) Phase 2 that fall below the mid-median

5. Record each count in the same position in a 2x2 table as data points on the graph.

*This procedure was prepared by Dr. Thomas E. Caldwell in slightly different form. The reader may also refer to McNemar (1969) to the procedure for Fisher's Exact Probability


Example Data
10
1
.1
.01
.001
0
Rate
1.0
.515
(Mid-median)
.03
Successive Calendar Days

6. <u>2 x 2 Table</u>:

MARGINAL TOTALS

	0	9	9
	11	2	13
MARGINAL TOTALS →	11	11	22 ← GRAND TOTAL

7.

0	9	9
11	2	13
11	11	22

$$p = \frac{13!\ 11!\ 11!\ 9!}{22!\ 11!\ 9!\ 2!\ 0!}$$

Numerator = Marginal Totals

Denominator = Grand Total + 2x2 Table

8. <u>Fisher's Computation</u>

$$p = \frac{13!\ \ 11!\ \ 11!\ \ 9!}{22!\ \ 11!\ \ 9!\ \ 2!\ \ 0!}$$

13.12.11.10.9.8.7.6.5.4.3.2.1

11.10.9.8.7.6.5.4.3.2.1

$$p = \frac{13!\ \ \overset{1}{\cancel{11}!}\ \ 11!\ \ \overset{1}{\cancel{9}!}}{22!\ \ \cancel{11}!\ \ \cancel{9}!\ \ 2!\ \ \underset{1}{\cancel{0}!}}$$

22.21.20.19.18.17.16.15.14.13.12.11.10.9.8.7.6.5.4.3.2.1

2.1

$$p = \frac{1}{19x17x7x2x2} \qquad \text{or} \qquad p = \frac{1}{9044}$$

p = .00011

9. <u>Factorials of Integers</u> $p = \dfrac{13!\ \ 11!\ \ 11!\ \ 9!}{\boxed{22!}\ \ 11!\ \ 9!\ \ 2!\ \ 0!}$

a) $p = \dfrac{(6.2^{9})\ \ (4.0^{7})\ \ (4.0^{7})\ \ (3.6^{5})}{\boxed{(1.1^{21})}\ \ (4.0^{7})\ \ (3.6^{5})\ \ (2.0^{0})\ \ (0)}$

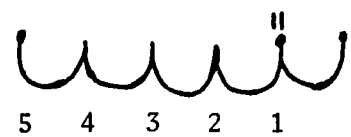
b) $p = \dfrac{(6.2 \times 4.0)^{16}}{(1.1 \times 2.0)^{21}}$

c) $p = \dfrac{(24.8)^{16}}{(\ 2.2)^{21}}$

d) $\boxed{\begin{array}{l} 16 \\ \underline{-21} \\ -\ 5 \text{ power} \end{array}}$

e) $p = \dfrac{(24.8)^{-5}}{(\ 2.2)}$

f) $p = 11^{-5}$

g) 

h) $p = .00011$