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ABSTRACT

Presented is the annual (1974) report of a project for the investigation and application of behavior analysis and modification with handicapped children. The program project is designed to assist teachers in the following areas: curriculum for mildly/moderately handicapped children being served in regular classes and for severely handicapped children in special classes, appropriate instructional procedures, instructional materials and program packages for children with a wide range of handicapping conditions, and measurement and assessment procedures. Major sections are given to the work of three teams--a team concerned primarily with developing a curriculum for use with handicapped children who are in regular classrooms, a team focusing on curriculum for children with moderate to severe handicaps, and a team to develop detailed task analyses for various basic skills and specific instructional programs for various basic skills. Seven papers are included to describe the work of team 1 on curriculum research including topics such as placing the child in the right reader, the improvement of oral reading and comprehension, and the effects of reinforcement contingencies on computational arithmetic performance. Considered is the work of Team 2 in the areas of measurement, administrative management decision system, intake-return-followup, establishing criteria performance levels, and instructional procedures. Included for Team 3 is information on the prototypic model and programs such as making change, telling time, fastening clothes, and shoe tying. (DB)

ANNUAL REPORT

A Program Project for the Investigation and Application of Procedures of Analysis and Modification of Behavior of Handicapped Children

OEG-0-70-3916(607)

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DEPARTMENT OF HEALTH EDUCATION, AND WELFARE
National Institute of Education

Introduction

Increased demands have been placed on schools to integrate more severely handicapped children into school programs and to assume total responsibility for their instruction. As a result, special education personnel who have previously served mildly and moderately handicapped children must now turn their efforts toward the more severely handicapped; and regular classroom teachers must learn to educate mildly and moderately handicapped children without regular and continued assistance from special educators. Both the regular teacher and the special education teacher will be faced with a population of children with which they have very little experience. During the period from September 1, 1973 to July 31, 1974 Program Project has continued to work toward its goal of assisting in the provision of appropriate education for all children by attending to the needs of teachers created by this shift in educational placement and responsibility. Specifically, Program Project has continued its activities and research designed to provide assistance and information to teachers concerning four major areas: 1) curriculum appropriate for mildly/moderately handicapped children being served in regular education settings and for severely handicapped children being served in self-contained special education classes; 2) instructional procedures appropriate for each of the target populations in each type of setting; 3) instructional materials and program packages which facilitate the progress of children with a wide range of handicapping conditions; and 4) measurement and assessment procedures which enable the teacher of either mildly/moderately handicapped children or severely handicapped children to select or devise the best possible educational program for each child, to monitor the effects of those programs, and to modify them as required.

Program Project Curriculum Research

All of the Program Project teams have been engaged in determining curricula appropriate for children with varying degrees of handicapping conditions. Team I has been concerned primarily with developing a curriculum to be employed in regular classrooms with mild/moderately handicapped children or pupils with learning disabilities. Team II has conducted similar research on curriculum design for children with moderate to severe handicaps. Team III has developed detailed task analyses for various basic skills, for which they have developed specific instructional programs.

Program Project Instructional Procedures Research

Once the curricula have been specified, the question of instructional procedures arises--how a curriculum is to be taught. Again, all three teams are involved in this effort. The activities of Teams I and II are particularly concerned with different instructional procedures. Because each team deals with different types of handicapped children and/or different curricula, however, their work is not duplicative.

Teams coordinate their activities to produce mutually illuminating, but not repetitive, results.

Program Project Instructional Programs Research

The requisites for program development include: 1) accurate probes to assess pupils' entering performance levels, thereby avoiding poor placements and lost time; 2) discrete and correctly sequenced steps which lead smoothly to mastery of each skill regardless of the child's entry behavior; 3) additional drills and activities for children requiring assistance beyond the basic program; 4) the requirement of active responses from the child at each level of the program to insure that the learning process is observable and measurable; 5) provision for self-recording and scoring not only to reduce the teacher's workload but also to provide more immediate feedback to the child; 6) "mastery" tests at appropriate intervals in the program sequence to insure that the child is prepared to undertake higher-level program tasks; and 7) an emphasis, whenever possible, on "teacher-free" instructional procedures to minimize program costs yet optimize the program's responsiveness to individual pupils' needs.

Materials appropriate for use with children with varying degrees of handicapping conditions have been developed by all teams, but Team III has engaged in materials development more precisely and systematically. Team III materials represent complete packages for the instruction of handicapped children in several basic skills areas. Though designed for the severely handicapped child, each program is appropriate for use with moderately handicapped pupils as well.

Program Project Measurement Procedures Research

Basic to any consistently effective educational program is a sound system of measurement. Program Project is a behaviorally-based research effort requiring the continuous assessment of each child's performance under each condition to be studied. The process of learning is closely scrutinized on a daily basis, so that changes in the program may be made immediately whenever necessary to minimize or avert "failure". There are several steps in the sequence of measurement followed by the Program Project teams. First, the child must be referred to the right program for the right purpose. Then, quick, accurate assessment of the pupil's present skills must be made to determine each child's entry level within each program. Third, accurate monitoring of the child's performance must be continuous in order to modify his program, if necessary, at that time when the change will be most beneficial. Finally, after attaining all specified program objectives, the child is ready to be placed in a regular classroom or other appropriate program. The progress of children is assessed continually during all "reintegration" efforts, and again at regular follow-up intervals. For each step in this sequence, several alternative approaches have been devised and tested by the Program Project teams, especially Team II, to meet the needs of children with a wide range of handicapping conditions and coming from or returning to a wide variety of situations.

Evaluation

Progress toward the stated goals of the Program Project has been steady and productive over the past year. The teams approcah their work with the scientific rigor required of functionally sound research, and at the same time maintian a high level of practicality in the questions they address. The teams are separate, but mutually supportive; the differences in the populations they serve and the questions they address insure that the Program Project will provide information and materials of concern to a wide range of programs serving handicapped children. The commonalities in the research approaches employed by the teams, on the other hand, increases communication and cooperative interaction among them; and provides a broader data base for the generalization of research results to the target populations of mildly, moderately, and severely handicapped children.

Information about the specific accomplishments of the three teams follow in the body of this Annual Report. Teams I and II have reported their work in a series of papers describing measurement and other instructional procedures and findings. Team III, whose work involves the development and field testing of instructional programs, has submitted reports on program development and completion.

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Status in September 1973

Present Status

Refinements of the Prototypic Model

- Possess prerequisite knowledge
- Make primary decisions
- Develop lattice for instructional program
- Final pretest package
- Decide on Program's format
- Determine initial fieldtest population
- Initial fieldtest
- Secondary fieldtest
- Final fieldtest of the entire program
- Instructional program developed for specific learning task

Application of the Prototypic Model: Instructional Program
- Development

The Shoe Tie Program

- Terminal goal and target population
- Skill sequence
- Pretest procedures
- Lesson procedures and materials
- Initial fieldtest results
- Secondary fieldtest results
- Current status

Make Change Program

- Terminal goal and target population
- Skill sequence
- Pretest procedures

TEAM I:

CURRICULUM RESEARCH

Team Members

Coordinator: Dr. Thomas C. Lovitt

Head Teacher: Cheryl L. Hansen

Assistant Teacher: Kathy Ashworth

Work Study: Bonnie Finholt

Secretary Oksana Diachok

APPLIED BEHAVIOR ANALYSIS TECHNIQUES AND CURRICULUM RESEARCH: IMPLICATIONS FOR INSTRUCTION

Tom Lovitt

University of Washington

Graditude is expressed to the following researchers who managed the investigations reported here: Karen Curtiss, Mary Kirkwood, Marie Eaton, Cindy Thompson, Colleen Blankenship, Cheryl Hansen, Debby Smith, James Smith, Mary Hurlbut, and Tal Guppy.

APPLIED BEHAVIOR ANALYSIS TECHNIQUES AND CURRICULUM RESEARCH: IMPLICATIONS FOR INSTRUCTION

Tom Lovitt
University of Washington

This chapter is a presentation of the curriculum research my associates and I have conducted with elementary a[illegible]en during the past six years using Applied Behavior Analysis techniques. The purpose of the chapter is to offer instructional suggestions to teachers based on our research. A second objective is directed toward other curriculum researchers, who, we hope, will be stimulated to refine and extend the notions of some of our projects.

Curriculum, as used in this report, refers to the many learning activities of elementary age children, such as reading, writing, arithmetic, penmanship, spelling. Curriculum, as the term is here used, also includes the many teaching procedures that are selected to assist in the development of academic skills. Some of these procedures are modeling, feedback, reinforcement contingencies, verbal directions.

Following is an outline of this chapter. The first section is an explanation of the Applied Behavior Analysis methodology, presenting first a brief outline of the development of this method, followed by a description of the basic components of the method. The second part of the chapter is a description of the setting and students used for the curriculum research.

In the third and most important section is a description of several research studies. These studies will be presented by subject matter area: reading, arithmetic, spelling, communication, and pupil management. In the final section some suggestions for future curriculum research are offered.

APPLIED BEHAVIOR ANALYSIS

A Brief History of Applied Behavior Analysis

Applied Behavior Analysis procedures, although of recent origin, have a rich and substantial heritage. Skinner, the founder of operant conditioning, provided the substance of what is today known as Applied Behavior Analysis. One of his many contributions was his support of the belief that frequency of responding was the basic datum of science. Response frequency has become a key element of the Applied Behavior Analysis technology. Another contribution of Skinner's to today's technology is the notion of establishing functional relationships between independent and dependent variables. Perhaps his greatest gift to Applied Behavior Analysis was that he so dramatically proved that many behaviors are influenced by various reinforcement contingencies.

From that beginning of operant psychology several branches of experimentation developed. Some researchers continued, as did Skinner, to use lower organisms as subjects. Some conducted laboratory experimentation with humans. Others began to work with adults and children in institutions for the psychotic and retarded. Although many of these researchers contributed to what is now Applied Behavior Analysis, I would like merely to trace the development of Applied Behavior analysis as it related to children.

Some of the early work with children using operant procedures was basic or laboratory research. These studies were conducted in settings not natural to the child's environment, and the responses the children were required to emit were not normally in their repertories. The purpose for these studies was to learn about certain conceptual systems rather than about the normal behaviors of children.

One such study was the now classic Azrin and Lindsley (1956) research, which examined the acquisition, extinction, and maintenance of a cooperative behavior. Baer and Sherman (1964) studied the generalized imitations of children. Bijou in 1958 studied the performance of children during extinction phases following various fixed interval schedules. These laboratory studies with children accomplished what they set out to do: they demonstrated that many of the principles of operant psychology which applied to animals held true likewise for children.

Encouraged by the successes of these laboratory findings, others began to use operant techniques with children in clinical settings. The classic study of this type was reported by Wolf, Risley, and Mees (1964). They dealt with several behaviors of a young autistic boy in the clinic and the home. Lovaas (Lovaas, Freitag, Kinder, Rubenstein, Schaeffer, and Simmons, 1966; Lovaas, Freitag, Nelson, and Whalen, 1967) in several studies used operant procedures to change various behaviors of schizophrenic youngsters. There were several other studies of this type where operant procedures were used to change, generally attenuate, the behaviors of children. They had in common the fact that they dealt with one child in a situation where no other children were around.

Operant conditioners then became more venturesome and entered classrooms. Many research studies were conducted which demonstrated that these techniques were successful when used with a single individual or a small group of individuals within classrooms.

Perhaps the first study of this type was reported by the Zimmermans (1962). They used extinction and positive reinforcement procedures to increase the spelling abilities of one subject and attenuate the tantrums of another. In 1963 Lloyd Homme and colleagues (Homme, deBaca, Devine, Steinhorst, and Rickert,) demonstrated that the Premack principle was an effective strategy for controlling a wide range of nursery school behaviors.

The work of Harris, Wolf, and Baer (1964) and others at the Developmental Psychology Laboratory at the University of Washington is noteworthy for this extension of operant principles to group situations. They demonstrated in a series of studies how isolated play, crying, climbing, and other nursery school behaviors were amenable to the contingent praise of teachers.

Several other researchers demonstrated how these principles could be used in classrooms with one or more children to attenuate certain troublesome behaviors. O'Leary and his colleagues (O'Leary, Kaufman, Kass, and Drabman, 1970) did such work, as did Becker and his fellow workers (Becker, Madsen, Arnold, and Thomas, 1967). The favored targets of these researchers were talk-outs and out-of-seats.

Many of these researchers used the term Behavior Modification to describe their methodology. They had taken the vital features of operant conditioning--identification of an observable response, measurement of that response over a period of time, involvement of reinforcement contingencies to affect the frequency of that response--and adapted them in order to study the problems of classrooms.

Along with this rash of studies which proved that operant or behavior modification techniques can effectively control troublesome behaviors of pupils, some researchers sought to demonstrate that these techniques were useful in changing the attending behaviors of pupils. Several investigators have demonstrated that teacher praise is associated with pupil attending. That is, when teacher praise is arranged contingent on the attending of pupils, the amount of time they "pay attention" is increased. for example, Hall and his colleagues have clearly demonstrated in several settings that teacher attention can alter the attending or studying behaviors of youngsters (Hall, Lund, and Jackson, 1968; Cossairt, Hall, and Hopkins, 1973).

Several researchers using Applied Behavior Analysis techniques investigated various academic behaviors of children. One of the earliest attempts to obtain academic measures was the work conducted by Birnbrauer, Wolf, Kidder, and Tague (1965) at the Rainier School in Buckley, Washington. In their programmed learning classroom those investigators reported that measures in reading, writing, and arithmetic could be continuously obtained. Arthur Staats and his group conducted several studies which related to the effects of reinforcement contingencies on various reading behaviors (Staats, and Butterfield, 1965; Staats, Finley, Minke, and Wolf, 1964; Staats, Staats, Schutz, and Wolf, 1962).

Perhaps the man who did most to stimulate the use of these procedures in academic settings was Ogden Lindsley. When he came to Kansas in 1965, his major objective was to adapt and extent the techniques of behavior modification so that they were used to measure and change such skills as reading, writing, and arithmetic. He referred to his system for obtaining measurement of classroom activities as Precision Teaching.

One of the essentials of this system is the movement cycle. According to Lindsley, every behavior, be it academic or social, should be defined as having a beginning and an end. Heretofore, behaviors were often counted on a sampling basis. Every n seconds an observation was taken. Another, and perhaps his most significant contribution, was that he reinforced Skinner's recommendation that behaviors be measured and graphed in terms of frequency: more specifically, movements per minute.

So it went from the operant conditioning work in the laboratories that was concerned with conceptual systems, to behavior modification which dealt with troublesome and attending behaviors in the classrooms, to precision teaching which emphasized the measurement of a wider range of classroom behaviors, including academic skills.

In describing our research I have chosen the term Applied Behavior Analysis. To me this is a more generic term in that it subsumes the principles and techniques of the groups just referred to as well as others. Also, by operating under this label, a researcher is allowed to use many techniques, methods of charting, and data gathering systems; he is not restricted to the artifacts or pet phrases of any sub-cult.

Characteristics of Applied Behavior Analysis

Several applied behavior analysts, in attempts to explain the system, have identified various components. One of the most widely quoted explanations was a paper written by Baer, Wolf, and Risley (1968). These researchers described Applied Behavior Analysis by stating that it was applied, behavioral, analytical, technological, and conceptually systematic.

In regard to Applied Behavior Analysis and curriculum research, I would like to characterize this system as comprising five ingredients: direct measurement, daily measurement, replicable teaching procedures, individual analysis, and experimental control.

Direct measurement. When Applied Behavior Analysis techniques are used, the behavior of concern is measured directly. If the researcher is concerned with the pupil's ability to add facts of the class 2 + 2 = [ ], or to read words from a Ginn reader, those behaviors would be measured. When Applied Behavior Analysis techniques are employed, the same behavior that is scheduled for teaching is measured. This form of measurement is contrasted to more indirect methods that use such devices as normative tests that could measure behaviors not of immediate concern.

Daily measurement. A second important ingredient of Applied Behavior Analysis is that the behavior of concern is measured, if not daily, at least very often. If, for instance, the pinpointed behavior is the pupil's ability to add facts of the class 2 + 2 = [ ], he would be given the opportunity to perform that skill for several days during a baseline before a judgment is made. The reason for using several days' data is quite obvious; it could be that on one day the pupil performed very poorly, the next day better, and so forth. Many times in teaching and research the pre- post-test methodology is used. A test is given before treatment and another is given after treatment. Judgments are then made, based on the comparison of the two scores. Judgments or decisions derived from such limited data could be pernicious; the consequences for some children could be disastrous.

Replicable teaching procedures. Another important feature of Applied Behavior Analysis is that, generally, the procedures used to generate the data in research efforts are adequately described. In most instances they are explained in enough detail that other interested researchers might replicate their studies. By contrast, other types of research sometimes explain general procedures rather casually. For example, one Brand X research study that used a phonics training program as an intervention simply said that "Daily phonics drills were conducted." It would be impossible for an interested teacher or researcher to replicate these investigations. In Applied Behavior Analysis research, if a phonics treatment was used, the reader would be informed not only about the amount of time used for instruction, but also which phonics elements were stressed, how they were presented, what the nature of the pupils' responses were, and what type of feedback or reinforcement was provided.

Individual analysis. The very heart of the Applied Behavior Analysis technology is that the data from individuals are presented. In fact, some have referred to this methodology as the Single-Subject method. In an Applied Behavior Analysis study, if data are obtained on five subjects, a graph of each subject's performance would generally be shown. In doing so, all of the ideosyncratic behavioral patterns become obvious. An inspection of these graphs would likely reveal that although the general effects on all five could be the same, no two graphs of pupil performance looked exactly alike.

Other research systems report the data of groups--experimental and control. Often a mean score is offered to explain the performance of a group. It could be that the average score represents the score of no one. It could also be that if a treatment has been used and the group effect was positive, what in fact happened was that the effect was very significant for some, ineffective for others, and had a slightly negative effect on others. However, when averaged, the composite effect was positive. It has never ceased to amaze me that in education, where bromides professing individual differences are so abundant, so much educational research is group relevant.

Experimental control. In every research study, regardless of the methodology, the researcher is obligated, in one way or another, to prove that the effects on the dependent variable were attributed to the manipulated or scheduled independent variable. He must establish a functional relationship.

The reason for such effort is extremely important. For if researchers recommend that method C be used by all reading teachers because the researchers found that it improved certain reading skills, they must be certain that variable C and nothing else caused the improvement.

In order to substantiate their claims, the Brand X researchers often resort to statistical control. Their typical research method is to form control and experimental groups, give a pre-test, provide a treatment for the experimental group and no treatment or a placebo for the control group, then give a post-test at the end of treatment. The pre- and post-test data of the two groups are then statistically analyzed and the winner announced. The significance of the conquest depends upon which probability level is achieved: .05, .01, .001.

By contrast, the applied behavior analyst would use experimental control to establish relationships between the independent and dependent variables. More specifically, he would use some form of replication.

The ABA design has been the favored form of replication. During the first A phase no treatment is arranged. Then a treatment is scheduled throughout the B condition. In the recapitulation phase the treatment is removed. If the behavior changed in the B phase from the first condition and changed back to its original level in the return to A phase, a reasonable case can be made that a functional relationship had been discovered. There are several other replication techniques available to the Applied Behavior Analysis researcher, such as the multiple-baseline and crossover designs.

SETTING AND STUDENTS

The majority of the research that will be presented here was conducted in the Curriculum Research Classroom of the Experimental Education Unit (EEU). This research was conducted over a period of several years with learning disabled children.

The EEU, directed by Norris G. Haring, has been in operation since 1965 and is part of the Child Development and Mental Retardation Center, University of Washington. It is committed to the basic notions of Applied Behavior Analysis. That is, all the important pupil behaviors are identified and measured daily. These data are used to make various educational and administrative decisions.

The Curriculum Research Classroom is smaller than the other classes at the EEU; smaller than the usual public school classroom. The staff includes myself, a head teacher, a research assistant, and a few graduate students.

For the past several years we have chosen, as a research population, elementary age children, ages 8 to 12, who have been identified as learning disabled. Each year we have had six or seven children in the classroom.

Before entering our class, these children attended either regular or special classes. Of the 35 children who have been in this class, 14 came from special classes. We have had only two girls in this classroom. Generally, their I.Q. scores (for whatever that is worth) have been in the normal range: from 80 to 115. Academically, the children we have selected were achieving below their peers in reading, some by as much as three years. Most of the children had related language arts deficits; they were relatively poor in spelling, composition, and penmanship. About half of them were below average in arithmetic computation.

Socially, with few exceptions, these children were quite normal. They could carry on conversations about their homes, pets, hobbies, and sports as well as most other children their age. Few of the pupils were behavior problems; they have generally not been naughty children. I must add, however, that many were referred because of behavior problems in addition to their academic deficits.

These children were as healthy as their non-EEU peers. Although they were absent a few days because of tonsil infections, colds, and flu, their absentee rate was no higher than would be expected of children their age. The same proportion of these children wore eye glasses as would be expected; none of them wore hearing aids. None of the children were physically disabled. Of the 35, about six were on some form of medication while in our class.

In regard to speech, only two or three of the children displayed, even mild, articulation problems. One pupil's speech was somewhat garbled, but this was due to a combination articulation, rate, and ghettoese problem.

The children were from middle to upper-middle class homes. Some of the occupations of their fathers were university football coach, Boeing engineer, physician, high school teacher, construction worker.

Each year we begin with a different group of children. The pupils stay in our class for four academic quarters. They are then returned to their original school systems. Most of them have gone back into regular classes, although some were placed one or two grades below their age peers.

RESEARCH

In this section, research will be explained by subject matter area: reading, arithmetic, spelling, communication, and pupil management. Many of the studies described here have been published in various educational or Applied Behavior Analysis journals. The complete articles will not be included; each project will be greatly condensed. Hopefully, however, enough information will be provided so that interested teachers may be able to apply some of the findings or techniques in their classes, and curriculum researchers may replicate certain of the procedures. For those who would like to read the entire reports, references are included (see footnotes 1 through 13).

Traditionally, there has been a research implementation gap. Researchers have bemoaned the fact teachers have not readily incorporated their findings. There are many reasons for this lack of rapprochement between researchers and teachers. I believe the primary reason, however, that accounts for the absence of extrapolation from research settings to classrooms is that many teachers and researchers have generalization deficits.

When some teachers read research they are unable to extract elements that could be implemented in their classes. They tend to view generalization as an all or nothing proposition. If they can not incorporate everything that was used by the researcher, they will not accept any of it.

Similarly, many researchers, when describing their investigations tend to convey the idea that their study should be generalized lock, stock, and barrel. Rarely do they suggest that some teachers in specific situations use certain of their techniques or findings.

Throughout this chapter I have attempted to respond to this generalization dilemma. Following each research summary in this chapter I have included a brief section entitled "To the Teacher." In those sections I have discussed several features from the research that teachers might consider using in their classes. These are specific recommentaitons that pertain to materials, instructional techniques, measurement, performance analysis, performance objectives, and learning principles.

Reading Research

Effects of phonics instruction on oral reading. Perhaps no other aspect of reading instruction has generated more debate and confusion than the issue of phonics training. Some reading experts have stated categorically that pupils must have an extremely good phonics background before formal reading instruction commences. Many of them argue that unless the pupil is provided with systematic part-word training, he will be lacking certain word attack skills and hence will not become a proficient reader. Other reading experts are less impressed by the argument that phonics skills will transfer to other, more complex reading behaviors. They maintain that the English language is so irregular that it is fruitless to teach phonics rules and generalizations. They recommend, therefore, that reading instruction be more direct, that pupils should be taught words rather than word elements.

As is the case with most controversies, extremists are rare in reference to the whole- part-word argument. Most teachers have taken moderate approaches on the matter. They see merit in teaching certain phonics generalities along with certain exceptions and some whole words. Nevertheless, even though most reading teachers do not take radical positions on this issue, the controversy persists.

The research described here was designed to bring data from an Applied Behavior Analysis approach to bear on this topic. We sought to obtain data regarding two questions: a) if the phonics skills of a pupil are improved, will his ability to read orally increase; and b) if his phonics skills improve, will concurrent gains be noted more in a phonics or a non-phonics designed reader.

The subject in this research was a 10-year-old boy. He had been described as dyslexic. Daily measures were obtained from this boy in seven areas: five phonics skills and two in oral reading. The five phonics skills emphasized medial vowels, consonant blends, sound blending, translocation of letters, and digraph-diphthongs. In oral reading the pupil read from a Lippincott and a Ginn reader. The former reader was designed primarily on phonics principles, the latter on the whole-word method.

To assess the boy's performance in the phonics areas, five word sheets were constructed. The medial vowel sheet contained a list of 20 three- or four-letter words. Each word contained a short medial vowel. The consonant list was made up of 20 words, each beginning with a different consonant blend. The sound blending list contained 20 consonant-vowel-consonant words. The translocation list comprised 25 words that contained letter combinations that are potentially transposable (flit, clap, spbt). The digraph-diphthong sheet was made up of 26 sets of words. Each set featured a different combination, e.g., ee or ay.

A correct response for the medial vowel and consonant blend tasks was the accurate writing of only the vowel or the blend. A correct response for the sound blending, translocations, and digraph-diphthong tasks was the correct spelling of the entire word. A correct oral reading response was the correct pronunciation of a word. Errors consisted of omissions, substitutions, and additions.

Correct and incorrect rate scores were obtained in each of the seven tasks. To obtain these rates the teacher timed each performance, e.g., medial vowels, and counted the number of correct and incorrect responses. She then divided the number correct and the number of errors by the time required to complete each task.

An AB design was used for this research, baseline and intervention. During the baseline period the pupil was provided with feedback on his phonics performance. When he responded to the five sheets the teacher corrected his papers and pointed out what errors were made and told him the correct responses. Meanwhile, throughout this baseline phase, no instruction was offered as he read orally from the two books. As he read, if he erred on certain words, the teacher merely suggested he continue reading.

Throughout the next condition instruction was scheduled. Prior to obtaining the seven measures a 10-minute instructional period was arranged. This instruction was based on the Slingerland teaching procedures which emphasized the principles of multi-sensory instruction. Some instructional time was devoted to each of the five phonics elements. No instruction was focused on oral reading. Reliability checks were made during both conditions of the study for each measured behavior. These checks pertained to timing, accuracy of marking the responses, and general procedures.

Three rather important findings came from this study: a) when phonics skills were precisely defined and when instruction was directed toward them, those skills were improved; b) when phonics skills improved, so did oral reading rate (correct rates increased, incorrect rates decreased); and c) more improvement was noted as the pupil read from the phonics reader than from the non-phonics reader.

In regard to the last point, Figure 1 is provided to illustrate the changes in oral reading rates across the two conditions for both readers. The data from the whole-word book are on the left portion of the figure, and from the phonics book on the right. The vertical lines in both portions of the chart separate baseline and instructional phases.

. . . .

Figure 1 about here

. . . .

One way to compare the data from both books is to contrast median scores. The correct rate median gains were greater for Lippincott than for Ginn. Likewise, the incorrect rate median gains were greater for Lippincott. Another way to compare the data is to contrast trends. An inspection of the correct rates across conditions in the Ginn reader reveals that the trend of those data was only slightly more acute during the intervention than the baseline phase. By comparison, the differences in the trends of the correct rate data in the Lippincott text are greater. When error rate data across conditions are studied, the trends in the Ginn book are about the same. However, when the errors in Lippincott are analyzed, the trend of the intervention phase was downward, whereas the trend of the baseline phase was upward.

"To the Teacher." There are at least three points from this study the teacher might consider. One important notion is to carefully define instructional procedures. In this project Slingerland techniques were used; not only were they precisely defined, they were consistently used.

Another point from this study is that pupils should be required to respond to the same material during a project. Daily, throughout this study the pupils responded to five word lists that were the same. Had those materials varied from one day to the next, the teacher would not have known which particular words were learned and would, therefore, not have known whether her instructional technique was effective.

A further item to consider from this project is that often, in order to monitor the development of advanced skills such as "creative writing" or "reading," several sub-skills related to that major skill must be measured. In this report seven measures were obtained daily: five in phonics, two in oral reading.

Comparison of measurement that is direct and daily with achievement test scores [2] Perhaps the most widely used technique for evaluating pupil progress is the achievement test. In many school systems an achievement test is given at the beginning and the end of the year. Achievement test scores pertain to such skills as reading, spelling, and arithmetic.

These scores are used for various purposes. Sometimes they are considered to document teacher competency. At other times they are used to make placement decisions; whether to assign students to special or regular classes, high or low reading groups, or to one grade or another. At other times they are used for purposes of communication, to report pupil progress to teachers, administrators, or parents.

The two important evaluative dimensions that are void when achievement tests are used are direct and daily measurement. Often the achievement test measures a behavior that is only indirectly related to the behavior of concern. And inevitably the achievement test provides an infrequent measure of performance, for generally they are given once or twice a year.

Although for some years we had expressed these criticisms about achievement tests and strongly recommended that they be replaced by direct and daily measures, we did not know how disparate the two systems were in regard to describing performance. Our criticisms were not substantiated by data. Two years ago, therefore, we arranged a situation to compare the efficacy of the two systems, achievement test and direct and daily measurement.

At the beginning and the end of the year we gave our pupils the Metropolitan Achievement Test (MAT) and the Wide Range Achievement Test (WRAT). Throughout the year we also obtained direct and daily data from the children in reading, writing, spelling, and arithmetic. At the end of the year we then compared the reading subtest achievement test scores with the reading data obtained from direct and daily measurement. Several differences between the two measurement systems were evident.

First it was discovered that the achievement tests did not agree among themselves. The fall tests disagreed more than one-half grade level for three of six children. The most discrepant scores were obtained by a pupil who received a 2.4 rating on one test and 4.4 on the other. The scores of the two tests in the spring disagreed four out of six times. The widest differences for a pupil on the two tests were 4.0 and 8.7.

In regard to placement we compared the actual initial placement of pupils when direct and daily measurement procedures were used with their fall achievement test scores. Using our method of placement we required each child to read several days from a number of readers representing different grade levels. We graphed correct and incorrect rate performances as they read from these texts. After several days we analyzed the data and selected initial readers for the children based on their relative performance. Only three of the six placements, according to direct and daily measurement, agreed within one-half grade level with an achievement test score. A comparison of the book level they were actually reading in at the end of the year with their spring achievement test scores revealed concurrence between an achievement test and actual placement four out of six times.

In regard to the data about pupil growth throughout the year, all the pupils gained when the MAT score was considered. Their spring scores were all higher than their fall scores. According to the WRAT, however, there was no growth for two pupils and a deterioration for another. When direct and daily measurement was considerd, all children improved. Furthermore, this improvement was indicated in three ways: their correct rates increased from fall to spring, their incorrect rates went down, and they read from more difficult material in the spring than in the fall. Achievement tests provided only a grade level difference score as a measure of improvement.

A final advantage of direct and daily measurement over achievement test measurement must be emphasized. When the former system is used, a teacher can see from one day to the next whether progress is being made.

If the data indicate the child is not improving, a different teaching routine can be scheduled immediately. By contrast, if a teacher waits until spring, to discover whether or not her teaching was effective, she would not have time to re-design her instruction if the pupil was failing.

"To the teacher." This project clearly points out the results of using indirect measures such as achievement tests. That is, pupil scores on achievement tests are not always correlated with their performances in the classroom. The report also suggests what can happen when performance is measured infrequently. Since all behaviors are variable, any educational decision made from one or two samples could be inappropriate; the consequences, for the child, could be less than desired.

This study also urges teachers to place students in readers based on their daily performance from classroom materials, and to use direct and daily procedures to communicate progress to parents and teachers. Further, this study strongly suggests that teachers use pupil data to evaluate all instructional techniques that might be scheduled to improve reading.

Another aspect of this study which merits consideration deals with communication. Many teachers, particularly special education teachers, have used direct and daily measurement data to communicate children's growth to their parents. They have found this method of communication far superior to other styles because of its objectivity and individuality.

A final note from this study pertains to the widespread and current practice of using achievement tests to evaluate performance contract situations and teacher performance. Many teachers have been critical as to the use of achievement tests for these purposes. Unfortunately, when asked for alternative evaluation strategies, many are unable to respond. The method for evaluating reading in this study and other academic skills throughout this chapter--direct and daily measurement--should be seriously considered as a replacement for achievement tests.

Effects of various reinforcement contingencies on oral reading rate.[3] The research presented here comprised three studies. In each, the effects of a reinforcement contingency were investigated. In two of the studies the contingency was arranged for correct responses and in one, for errors. The reinforcer in these studies was leisure time. Pupils, during certain conditions, were able to earn minutes of free time.

In each of these studies correct and incorrect rate data were gathered. Incorrect responses were additions, omissions, and substitutions. The studies shared other common features. As the pupils read, some feedback was provided; if a word was mispronounced or left out, the word was pronounced by the teacher. Comprehension data were obtained in all the studies in addition to the oral reading data. Reliability checks were also obtained. A second observer monitored some of the sessions and checked the teacher's timing, counting, and general procedures of the experiment. A final feature included in all of the projects was that each pupil read daily from two readers. One reader was used as the experimental text, the other as a control. In the conditions where a reinforcement contingency were scheduled, it was associated with only the experimental text. No interventions were scheduled for the control reader.

In Study 1 an 11-year-old boy read orally for five minutes each day from two readers. The experimental reader was a Bank Street text, whereas the control reader was a library book, Encyclopedia Brown Saves the Day.

This project used an AB design. During the first condition neither instruction nor reinforcement contingencies were arranged. Only a type of feedback was in effect. Throughout the second condition a reinforcement contingency was arranged. The requirements of this contingency were that if, after the five-minute reading period, his correct rate was equal to or exceeded 50 words per minute, he was granted points on a 25:1 ratio (for each 25 points he earned one minute).

When his performances in the two conditions were compared, it was revealed that, on the average, his correct rate improved by about 12 words per minute from first to second condition, while his error rate was reduced about one word per minute. His reading rates throughout both conditions in the control reader were stable, hence unaffected by the contingency.

In the second project the pupil was a 9-year-old boy. Daily, he read from a Bank Street and a Merrill reader. The former text was designated as the experimental book; the later, the control book. The project used an AB design. The first period was the baseline; during the second condition a contingency was arranged for the experimental text. The contingency focused on errors and involved a withdrawal of points. Each day the pupil was given, non-contingently, 15 points. The points were then taken away on a 2:1 ratio, for every two errors one point was withdrawn. At the end of the reading session the remaining points were redeemable for minutes of free time.

The results of this project revealed that the student's incorrect rate improved from one condition to the next. However, his correct rate across conditions was unaffected. His rates in the control text were unchanged across conditions.

In Study 3 the pupil was an 11-year-old girl. The two readers were from the MacMillan and Laidlaw series. The MacMillan book served as the experimental reader.

This experiment was composed of four phases; an ABA design was used. In the first and third conditions, feedback was provided as the girl read. Neither instructions nor reinforcement contingencies were arranged. Throughout conditions two and four, a 30:1 ratio for correct responses was scheduled. For each 30 correctly read words, one point was given.

The results of this project indicated that, generally, the girl's reading performance was superior throughout the conditions of reinforcement to those phases performed without contingencies. In Conditions 2 and 4 her correct rates were higher and her incorrect rates lower than during Conditions 1 and 3. Her correct and error rates, as she read from the control reader, were stable throughout all conditions.

As a result of the reinforcement contingencies, improvement was noted in all three studies. Of perhaps some interest were the specific effects of the contingencies in Studies 1 and 2. In Study 1 the contingency applied to correct responses; in Study 2 the contingency was arranged for errors. In Study 1 correct rates were influenced more than error rates. In Study 2 errors were more influenced.

"To the Teacher." Many procedural features from this study could be used by teachers. First, the time for reading instruction was rather brief, about 15 minutes per day per child. It has been our experience that when good material is used, when the ongoing reading procedures are satisfactory, and when effective teaching techniques are used, pupils thrive, even though the reading periods are short. This should be rather encouraging to teachers who have several children in their classes, and yet want to individualize their programs.

Another consideration from this study regards the use of two readers. Classroom teachers may not be as concerned with the control feature of the second reader as we were. However, a teacher might want to use two readers for a different reason; perhaps for generalization purposes. She could have a pupil read from two texts and arrange some teaching technique such as drilling on errors for only one reader. By obtaining data from both readers the teacher could determine, first of all, whether the technique influenced the reader it was associated with, and second, whether the effects transfered to the other reader.

Teachers should note the various ways contingencies were arranged in this report. Pupils can be given something for a certain type of performance or they can lose something depending on their performance. They could gain points for correct responding and lose for errors. Reinforcement systems have further flexibility since the gain and loss ratios can be adjusted. A pupil could gain points on a 5:1 ratio (one point for five correct responses), or the ratio could be set at 500:1. The possibilities are infinite. Another dimension of the reinforcement system is the event that is either gained or lost. Such events in the past have been points, minutes of free time, models, classroom privileges, recess.

Effects of previewing on oral reading.[4] Whereas the previous study investigated reinforcement contingencies as they influenced oral reading, this experiment dealt with non-contingent interventions. These non-contingent events were three types of previewing: oral, silent, and teacher previewing.

Various forms of previewing have been used for years by teachers of reading. Publishers have recommended this approach as a method for teaching fluency. In spite of the widespread use and support of this technique, little research on the topic is available.

Two studies that used three types of previewing will be presented. In both studies the general procedures were the same. The pupil read orally for two minutes daily. Feedback regarding mispronounced or omitted words was provided throughout the studies. In both studies reliability checks were obtained regarding timing, accurate monitoring of responses, and general operating procedures.

In Study 1 the pupil was a 10-year-old boy. He read from a Lippincott reader each day. This project consisted of five conditions and used an ABA design. Throughout Conditions 1, 3, and 5, only feedback was scheduled.

During the previewing conditions the pupil was requested to read orally the material he would again read orally. The first reading was considered as practice, the second the "real" performance. Throughout the first reading the pupil was coached on difficult words; this was not the case when he read a second time. Only the data from the second reading were graphed.

These data indicated that oral previewing had substantial effects on correct rate. Although his incorrect rate maintained across the various conditions, his correct rates, during previewing conditions, were nearly double those rates when previewing was not used.

In Study 2, two types of previewing were used--silent previewing and teacher previewing. The subject in this study was nine years old. He read each day from a Lippincott text.

This study used an ABA design for both types of previewing. During the first condition only the feedback procedures previously described were in effect. Throughout the second phase, silent previewing was scheduled. Prior to reading the story orally, the boy read it silently. As he did so, he could ask the teacher for unknown words. In the third condition the previewing technique was not included. These data indicated that the technique greatly influenced correct rates and mildly influenced incorrect rates.

The next part of the study investigated the silent previewing technique. Following the baseline phase, which was the final condition of the first part of the study, the teacher read to the pupil the material that he subsequently read orally. Throughout the next condition no previewing was used; then, in the final or fifth condition, previewing was again instituted.

In comparing the data from the final three conditions, it was apparent that although incorrect rates were not affected across conditions, correct rates were substantially altered. During the teacher previewing condition the pupil's correct rate was nearly double that prevailing during non-previewing conditions.

"To the Teacher:" In this report, all types of previewing were effective. Their greatest effects, however, were on correct rates; incorrect rates were not significantly improved.

Therefore, if a pupil's rate of committing errors is too high and the teacher desired to concentrate on reducing them, she should perhaps select a tactic other than previewing. She might choose to drill the pupil following each reading assignment on the errors he had made. Or, she might design a technique that focused on some particular error pattern of the pupil. However, if the teacher's goal is to improve a pupil's fluency--his correct rate--one of the types of previewing used here could be appropriate.

We have investigated other types of previewing, such as allowing the pupil to listen to a tape recording of the story he will read. In another project we recorded on language master cards phrases from the story the pupil would subsequently read. After he listened to the phrases he read the complete story. Insofar as increasing fluency, all these previewing techniques have generally been effective.

Relationship of oral reading and comprehension. In the previous two studies the major concern was the measurement and development of oral reading. In this study, although oral reading was again of primary concern, equal emphasis was directed toward silent reading and answering comprehension questions.

This study ran for three quarters. Daily, four measures were obtained. The measures pertained to oral reading, answering comprehension questions from orally read material, silent reading, and answering questions from material read silently. Throughout t first two quarters the pupils read orally from a Lippincott reader and silently from a Ginn text. The two readers were matched as to reading difficulty. That is, as the pupil read orally from the two texts for a few days, his rates in both texts were about the same.

Each day the pupil read 500 words orally in a Lippincott reader, then answered 30 comprehension questions. As the pupil read, the teacher supplied missing and mispronounced words. He then read 500 words silently in a Ginn reader and answered 30 comprehension questions. No feedback was provided for silent reading. The comprehension questions were of three types: interpretation, recall, and sequencing.

Following a baseline period where neither instruction nor reinforcement contingencies were in effect, the class was split into two groups. With one group a contingency was scheduled for oral reading rate; for the other, the contingency was arranged for the comprehension of orally read material.

The contingency was based on progress and focused on errors. In oral reading a projected trend was drawn on the graph. If on any day a pupil's oral reading rate was lower than that slope, he had to practice the words he erred on. Each error was embedded in a phrase; for several minutes he practiced reading those phrases. In comprehension a similar projected trend was drawn. If, on any day a pupil's comprehension score was below the line, he had to re-do the questions he had incorrectly answered.

A crossover design was used for this research. During the first quarter the contingency was in effect for some of the pupils for oral reading, and for other pupils for comprehension. Throughout the winter quarter the project was conducted again. The only difference was that the groups were alternated. Those who were in the oral contingency group in the fall were now in the comprehension group.

The project was run for a third time in the spring quarter. At that time the mode of reading the texts was switched. Lippincott now became the silent reader and Ginn the oral reader. During that quarter both contingencies were alternately arranged for all pupils. If, during the first part of the quarter a pupil was in the group where the contingency was on oral reading, he was, in the second half of the quarter, transferred to the group where the contingency was on comprehension.

Reliability checks were scheduled throughout the year. These checks focused on timing, accurate counting of responses, and general procedures.

Several findings from this research should be noted: a) when the contingency was arranged for oral reading, that performance improved; b) when the contingency was arranged for oral reading comprehension, that performance improved; c) when the contingency was arranged for oral reading, oral reading comprehension was unaffected, silent reading and silent reading comprehension improved, and d) when the contingency was arranged for oral reading comprehension, oral reading improved, silent reading and silent reading comprehension improved. The biggest gains were those indicated by points a and b.

"To the Teacher." Teachers could consider some procedural matters from this study. Throughout this project the pupils read 500 words each day orally and silently. This seemed to be a reasonable amount; the pupils were generally attentive and they read enough material so a complete story or a large portion of a story was covered.

Other projects discussed in this chapter were scheduled by time, that is, the pupil read two or five minutes each day. Whether the teacher prefers that pupils read a fixed number of words or for a certain period of time each day, she should settle on one method or the other. If the situation is not stabilized in respect to amount or time, the data from one day to the next will not be comparable. Some teachers are, however, dissatisfied with both options because they want children to read complete stories. One way to schedule uniform times or amounts and also allow pupils to finish their stories is to have them read beyond the point of timing. If, for example, the teacher requires the pupil to read for five minutes and at the end of that time a half page remains of the story, she could make a mark at the five-minute point, and let him continue reading until a logical conclusion is reached. The data from the five-minute reading could be recorded, thus providing the teacher with a reliable measure since the same unit of reading was measured each day.

From this project teachers could also consider the instructional technique that was used and the way it was scheduled. First, the instruction for oral reading amounted to requiring the pupil to rehearse his erred words embedded in phonics; the procedure for teaching comprehension merely required the pupil to correct his incorrect answers. Second, instruction for oral reading or answering comprehension questions was scheduled only when the pupil's performance was unsatisfactory. If his performance was adequate he received no instruction.

A final point to be considered from this project is that teaching should be focused on the behavior of concern. In this project the greatest oral reading and comprehension gains occurred during those phases when a teaching technique was directed toward those behaviors. Although generalizations sometimes occur, as noted in the first reading project, the teacher should still direct her attention to the immediate behavior of concern, rather than a related skill.

<u>Arithmetic Research</u>

<u>Using an antecedent event to facilitate subtraction</u>. In the early days of behavior modification and Applied Behavior Analysis, behaviors were altered almost exclusively by reinforcement contingencies. Since reinforcers such as tokens, praise, or candies were always presented after the designated behavior occurred, they were referred to as subsequent events. That many

subsequent events functioned as reinforcers has been amply demonstrated. Some reinforcement theorists have boasted that if they can find a reinforcer for a given individual they can teach him several skills. I certainly would not contest such a claim--reinforcers are here to stay.

However, behaviors are altered in other ways. Many times the events that come before the behavior occurs are influential. Certain antecedent events have long been used by teachers and parents in their efforts to instruct children. Many of those events are reported in this monograph; for example, previewing, modeling, and verbal instructions.

The experiment briefly described here was one of the initial Applied Behavior Analysis research efforts that investigated the effect of an event other than a reinforcement contingency. The experiment comprised three studies; each used an ABA design. The pupil in the experiment was an 11-year-old boy.

Study 1 consisted of three conditions. Throughout the study the boy was required to perform 20 problems of the type [ ] - 2 = 6. In the baseline phase he received no teaching, feedback, or reinforcement. When he finished the 20 problems, he was thanked and sent on to another academic activity.

During the second condition, he was required to verbalize each problem before he wrote the answer. He said, for instance, "Some number minus 2 equals six." He then wrote the answer. The teacher monitored his behavior during this phase and reminded him occasionally to verbalize each response. During a third phase, he was asked to refrain from verbalizing the problems and answers.

The data from this study indicated that his performance was far superior in the condition where verbalization was required than during the baseline phase when no verbalization was demanded. Further, his performance maintained, even improved, in the final condition when verbalization was no longer practiced.

Two other studies like the first were carried out. In the second, problems of the type [ ] 20 = 40 were used. The problems in the third study were like 4 - 3 = 9 - [ ]. Both of these studies comprised three phases. During the first, no verbalization was required. The pupil verbalized each problem and answer throughout phase 2; then, in the final phase, he no longer verbalized.

The results of these studies were identical to those of Study 1. During the baseline phase his correct rate and accuracy were low, then much improved in the second phase. In the final condition the behavior of subtracting was maintained, in spite of the removal of the cue.

"To the Teacher." The experiment demonstrated that a technique that has been used for years by teachers and parents can be effective. Many teachers have encouraged their pupils to think before they make a response. More importantly, this experiment demonstrated the inclusiveness of Applied Behavior Analysis techniques. Clearly, all the teaching variables used by teachers for years--modeling, various aids, and mnemonic systems--can be evaluated within the Applied Behavior Analysis framework. These events can as easily be subjected to analysis as the many reinforcement variables that have for so long been monitored by this system.

This project, like several others, emphasized the idea of using consistent materials. If a teacher wishes to teach a specific skill, she must define that skill, then provide the pupil with materials of that type. Often teachers are frustrated in their attempts to teach specific arithmetic skills from commercial texts. The items in some texts vary considerably from one page to another. Teachers who wish to teach pupils to be proficient with specific skills are, therefore, forced to construct their own arithmetic sheets. When it is necessary to prepare supplementary materials, the teacher should first define a specific class of problems to teach (e.g., addition problems where the addends are from 3 to 9 and the sums from 6 to 18). Next, several sheets which contain problems of this type should be made; the same number of problems should be on each sheet. The teacher may also want to use all different problems on a sheet and different arrangements of problems from one day to the next.

The sequencing of phases in this report merits some consideration. Each project in this report consisted of three phases. During phase one--baseline--it was confirmed that the pupil needed assistance. During phase two--when the verbalization technique was scheduled--he improved. During phase three--when the technique was removed--his behavior maintained. This arrangement of phases should be the most popular teaching design; for not only does it allow the teacher to ascertain the effects of her teaching technique (phase 2), but it allows her to view how well the pupil's behavior maintained when the technique is taken away (phase 3).

Another feature to be brought out from this project could be offered as a warning, "don't allow a teaching technique to be used too long." In this project, although the pupil reacted favorably when the technique was scheduled, he improved even more when the technique was removed. Although the teaching technique was initially necessary, had it been left in too long subsequent growth would have been inhibited.

Use of modeling to influence acquisition of arithmetic skills.[6] The instructional technique used in this study is perhaps the oldest and most widely used technique available--showing and telling someone how to do something. Many times teachers, in their efforts to assist pupils to compute certain types of arithmetic problems, go to the chalkboard and demonstrate how a problem should be solved. As they go through the steps of the problems, they verbalize the process. Sometimes the sample problem is left on the board as the children complete their assignment.

This experiment comprised three studies. Throughout, ABA designs were used. In Studies 1 and 2 the intervention involved the demonstration of a problem, then leaving that sample as a model for the pupil to consult. In Study 3 components of that technique were investigated. Reliability checks were obtained in all three studies in regard to timing, accuracy of marking responses, and general procedures.

In Study 1 the pupils were assigned different types of problems. Some were presented problems like 470 249 = [ ], others, multiplication problems like 22 x 13 = [ ] and 8 x 0 = [ ]. During the baseline phase the pupils received no instruction, feedback, or reinforcement. They worked for two minutes each day on the sheets.

Throughout the intervention condition the modeling technique was used. The pupils were shown how to do a problem of the assigned type and that model was left on their sheet. They could refer to the model at any time. The data throughout this condition revealed that rapid acquisition occurred for all pupils. Furthermore, throughout the intervention phase their scores were nearly all perfect. In the final condition, when the modeling intervention was removed, their scores, with few exceptions, remained high.

Throughout Study 2 the pupils were assigned different problems than those used in the first study. Again a baseline phase was scheduled. Their performances were generally 0% throughout this period. Next a feedback intervention was arranged. Following the completion of an assignment the teacher marked each pupil response as correct or incorrect. This checked paper was handed back to the pupil. Since the students could not do many of the problems, most of their responses were marked as errors. None of the pupils progressed during this condition, although the procedure was in effect for about seven days.

In the third phase, the same modeling technique used in Study 1 was scheduled. The results of that period were as impressive as those revealed in Study 1; effects were immediate and lasting. When the intervention was withdrawn, the accuracy of the pupils continued to be good.

In Study 3, elements of the modeling intervention were used. Throughout this study different problems were again assigned. As in the other two studies, the pupils worked two minutes each day on the problems. In the first phase no teaching was scheduled. During the intervention phase the model alone was used for some of the pupils. The sample problem was placed on their work sheets, but they were not shown how to perform the problems. For other children, during the intervention period, only the demonstration was provided. The teacher showed them how to do a sample problem, then took away the model. The pupils were unable to refer to the sample as they worked the problems.

The results of these efforts indicated mixed success; for some pupils this partial technique was effective, for others it was not. Since the total technique--demonstration and permanent model--required about two minutes of instructional time, it was recommended that the whole intervention be used.

"To the Teacher." There are a number of features from this report that reinforce notions presented in other projects. For one, this report illustrates again how arithmetic problems of certain types can be taught as a group. For another, this report also used a maintenance phase that served to indicate whether a certain level of performance would maintain once instruction was removed.

Another point that has been stated earlier, is that effective teaching techniques are not always complex. The one used here--modeling--consisted of only a few elements and took only a few seconds to administer. In fact, some children, as indicated by the last experiment in this report, were able to learn new information when only a part of the modeling technique was used.

In regard to teaching procedures, I advocate that they, of course, be effective, but as simple as possible. There are two reasons for using only the mildest and briefest remediation procedure. One, if a procedure is used that takes more time than necessary, teacher and pupil time are wasted. Two, if a complex procedure is used to effect change, an inordinate amount of time could be spent in weaning the pupil from the procedure. Teachers, like physicians, should prescribe enough treatment to cure the problem, but no more: for in both cases treatment immunities may build up that require the use of complex solutions.

The important message, however, to come from this project is that once a type of skill has been specified for instruction, and a legitimate technique such as modeling is arranged, the acquisition of that skill can be sudden. In this project, once the teacher showed the pupils how to do the problems, they invariably complied. Their acquisition of the skill was not gradual over a period of days, but immediate.

<u>Proficiency techniques and arithmetic</u>.[7] With some pupils, for certain types of problems, the basic concern is for proficiency, not acquisition. Some pupils are able to compute certain problems, but they require so much time to arrive at the answers that they are not proficient.

In order to use computation skills in everyday situations, a person must be somewhat facile. If he is required to make change, he must do so within a reasonable time. If someone buys a commodity from him worth $15 and gives him $20, he must rapidly calculate how much change he must return. The customer would be unimpressed if the merchant took 10 or 15 minutes to complete such a transaction.

In this series of studies, several interventions were scheduled in attempts to assist pupils to become proficient with certain arithmetic facts. In most instances, ABA designs were used; in every study reliability measures were obtained.

Initially, in order to determine whether the pupils were proficient or not, we obtained data from public school pupils the same age as ours, as they worked on several types of problems. We then calculated the correct rates of those pupils for the various classes of problems. Next, for all classes of problems, the correct rate scores were ranked. We selected the 75th percentile score for each class as the desired rate; to be proficient, our pupils had to score at or above that score.

During Study 1 a baseline period was initially scheduled. Throughout the intervention period a verbal instruction was programed. Each day, prior to the arithmetic assignment, the pupil was instructed to "go faster."

The results indicated that the correct rates of all children improved during this phase. Most of the pupils obtained rates that were proficient. When the instruction was no longer scheduled throughout the third phase their correct rates continued to be satisfactory.

In the next study, following a baseline phase, contingent toy models were arranged. Throughout this intervention phase a 4:1 ratio was scheduled; for each four correct responses one point was granted. Models were purchased for 50 to 75 points. All the children's correct rates improved when this contingency was arranged, but not as much as when the simple instruction was used. Some of the pupils' scores reached proficiency. When the intervention was removed, the correct rates of the pupils generally maintained.

In the next study three types of feedback were investigated. Following a baseline phase, a type of feedback was arranged. The three types of feedback were: a) indicate correct and incorrect problems on the pupil's paper, b) inform him of yesterday's and today's correct rate, and c) tell him the day's rate and the desired rate.

The results from these feedback studies were very unimpressive; only small gains were noted for a few children. When the interventions were removed, some rates actually fell below baseline level.

The final intervention in this series of studies was a combination of the two most successful proficiency techniques. The intervention comprised the instruction to "go faster" and the toy model contingency. Following another baseline, this intervention was arranged. During the intervention phase, prior to responding to the problems, the pupil was given the instruction; then, following the session, he was granted points redeemable for models on a 4:1 ratio.

The results of this study were the most impressive. All pupils' correct rates improved more than they had when either the instruction or the model intervention was used. In every case proficiency rates were reached.

"To the Teacher. An important feature of this project teachers should consider regards the distinction between acquisition and proficiency. One reason to develop such a discrimination is that the goals for either are different. Generally, the objective of acquisition projects is accuracy; whereas the objective of proficiency projects is increased speed.

A further reason for distinguishing between the two types of performance is that, quite likely, certain instructional techniques are better suited for one aspect of performance than the other. When the concern is to assist pupils to acquire certain behaviors, some of the instructional procedures might be modeling, various manipulative aids, drill. If the concern is to develop proficiency, certain useful techniques might be those discussed in this report. telling the pupil what is expected and reinforcement contingencies.

This project again noted the positive effects of simple teaching. When the pupils were told to "go faster," they did. In fact, the effects of simple instructions were even more influential than contingent models. Often, when instructions are clearly and consistently stated, pupils will comply.

It must be pointed out, however, that the best effects on math performance were noted when the two procedures were combined. Although I have cautioned against using more instruction than is necessary, it could be that in order to obtain immediate and impressive proficiency gains, two established procedures should be combined.

A further note from this research that should be considered by teachers is in reference to an ineffective procedure. Teachers should be on the lookout for not only those procedures that are generally effective, but those that are generally ineffective. Three types of feedback were used in this study and the performances of only a few children were minimally influenced. In the preceding study a type of feedback was not effective in an acquisition situation.

To us, these results were surprising, for there is an abundant literature about feedback which generally acclaims its benefits. It is possible that our pupils had poor experiences with feedback and generalized from that. It is also possible that the types of feedback we used would be effective in other academic areas or that other types of feedback would be more effective in math. These considerations nothwithstanding, I would recommend teachers carefully evaluate their feedback techniques.

Withdrawal of positive reinforcement.[8] The primary difficulty of the pupil in this study was not acquisition, for she could solve rather complex computational problems. Neither was her difficulty one of obtaining proficiency. Her correct rates for most basic facts matched those of her peers.

This young lady's performance was erratic. Some days, when asked to perform certain subtraction problems, she was very accurate. On other days, she erred on all the problems. Occasionally her responses to a row of problems would simply be a series of numbers, like 21, 22, 23. She was apparently not motivated to perform consistently.

Daily, this young lady was assigned three pages of arithmetic problems. On each page were 25 problems of a different class. The Class 1 (C1) problems were like 18 - 9 = [ ]. C2 problems were of the class 24 - 6 = [ ]; borrowing was required. C3 problems were like 34 - 6 = [ ]; again borrowing was required. For each class of problems several sheets of different problems were developed. Thus, the pupil worked on different figures from day to day. Reliability checks, pertaining to items previously mentioned, were obtained throughout the study.

The design of the study was a multiple baseline. Throughout the baseline phase, which ran for six days, no instruction, feedback, or reinforcement was scheduled. When the pupil had responded to the problems on the three sheets, she submitted her papers to the teacher. No further interaction took place. Her performance during this period was variable. Her scores on two of the three sheets were high one day and low the next (see Figure 2).

Figure 2 about here

Throughout the second section of this project a withdrawal contingency went into effect; for each error she made on the C1 sheet, one minute of recess time was taken away. The data from this phase revealed that her scores on C1 were high, but her scores on the other two sheets remained low.

During the next phase the same withdrawal contingency was associated with the C2 problems, in addition to the C1 items. In the next condition the contingency was arranged for all three sheets. Throughout those phases the results were imprssive. Successfully, as the contingency was arranged, the girl's performance improved.

During the next two conditions, the contingency was removed, first from the C2 sheet, then from C1. In the final phase the contingency was in effect for only the C3 sheet. As indicated in the figure, her accuracy on all the sheets remained high, even when the contingency was removed.

In this project, instructions were not used; for in the past she had been asked to "be more accurate" and "work faster." She was not responsive to comments alone. Neither in this project were other, commonly used instructional techniques like feedback, modeling, or teaching aides, used. She knew how to solve the problems, and did so when she wanted to. Hers was a motivational problem. Since she saw no reason for performing the problems, her motivational system needed to be altered. To effect that change she was deprived of recess time contingent on errors.

That the girl was sensitive to the withdrawal contingency was indicated by her response pattern in two ways. First, she reacted immediately. On each sheet, the day the contingency was scheduled, her performance improved greatly. Second, this immediate accuracy was noted on only the contingency sheet; when the point removal technique was arranged for C1, only performance on that sheet improved, not on the other two.

It was somewhat encouraging when her accuracy continued to be high during the final two phases. When the contingency was removed from the C1 and C2 sheets, her performance did not collapse; apparently something was maintaining her behavior besides the withdrawal contingency.

"To the Teacher." Several times I have mentioned that the simplest techniques possible should be used to change behavior. I have also stated that when artificial arrangements are used to induce favorable change, teaching is not finished even though the target behavior improved. When an artificial technique is used to stimulate progress, once progress is noted, the teaching situation must continue until the pupil can perform the behavior under natural conditions. However, this is not to say that artificial circumstances should never be arranged; for if the goal is to teach something and that skill does not naturally develop, synthetic aids, sometimes in the form of reinforcement contingencies, must be used.

Furthermore, reinforcement contingencies should be the initial teaching technique in instances where the teacher knows the pupil can perform the task but will not. If the teacher has every reason to believe a pupil is capable of performing a task (perhaps he demonstrated this ability in the past), the teacher would probably be unwise to select teaching strategies like modeling or instructions. For if the pupil is not motivated to perform the task, he probably will not until the motivational atmosphere is changed. Often teachers in instances like this shift from one non-contingent teaching technique to another in a Quixotic search for an effective technique, when instead they should have changed the motivational system by arranging a contingency.

In selecting a contingency the teacher has the choice of giving the pupil something contingent on a specified behavior or taking something away. In this project minutes of recess were taken away for incorrect answers. It could have been arranged so that additional minutes were given for correct answers. Another possibility, of course, would have been to give something for correct answers and take away for incorrect answers.

Obviously, whether the event is given, taken away, or both, it should be something of value to the pupil. Otherwise, it would be unlikely that his performance would be affected by a contingency.

Various types of story problems. The preceding projects in this section dealt with computation problems. Obviously, there are other important components of the mathematics curriculum. One of the major elements of a complete math program in the elementary grades is story problems.

Most teachers agree that pupils must know how to use the computation skills they have acquired. Many believe that story problems provide an opportunity to use those skills in a realistic way.

Most elementary teachers also agree that it is one thing to teach children to develop computation skills and quite another to teach problem solving skills, i.e., story problems. Some teachers have attributed this discrepancy to the fact that when pupils are required to solve story problems, they must read, and the reading levels of math texts are beyond those of their reading texts. In a comparison study that we conducted it was revealed that this was not necessarily the case. When matched by grade level--readers and math texts-some children actually read better from certain math texts than from their assigned readers.

With that information we designed an investigation for the purpose of identifying which elements of story problems were most troublesome. Our first step was to study the story problem formats from three commercial arithmetic texts. We then constructed several problems for a number of format types

Our plan was first to offer pupils problems of a very simple type, then to present problems that included more format variation. The problems were changed from one class to the next by either adding one more element or changing one feature of the problems. Most of the classes of problems represented a specific format found in commercial arithmetic books. Using such a plan, advancing pupils from one class of problems to the next, we anticipated that we would be able to detect which elements of story problems were most troublesome.

Before the pupils were given the story problems, we tested them to be certain they knew the 32 words used in the first class and could compute the facts used in these problems. Once this was determined, we proceeded with the study. The first class of problems was like the following: "John had 2 apples. Tom have him 4 apples. How many apples did John have then?" All of these problems used the same proper nouns, only the noun apples, and were made up of three sentences.

Rather than describe the other classes of problems, I will note some of the format modifications that were included. In one class we added a lead sentence that was not necessary for solving the problems: "John liked apples." In another class we put in a sentence that had misleading information. If the problem dealt with apples, some information about another category, plus an irrelevant numeral, was included.

In some classes a wide variety of nouns were used; initially only apples was used. Later, the proper nouns were expanded; initially, only John and Tom were used. In some problems the numerals were presented in two different ways (David had <u>four</u> burros. He was given <u>2</u> burros). In another class blanks were included; ordinarily they had not been used.

The thirteenth class was a potpourri. Problems from all the preceding classes were presented on the same sheets. When a student had reached criterion for all 13 classes he was assigned, over a period of days, 85 problems taken verbatim from three elementary arithmetic books. These problems were mixed both in terms of format and process; one problem that contained four sentences and required addition was followed by another problem that required subtraction and included irrelevant information.

Each day the pupils were given three sheets of problems from a class: one add, one subtract, and one combination add-subtract. There were five problems on each page. Several sheets were made for each format--add, subtract, add-subtract. The pupils responded to different problems from day to day. When these problems were presented to the pupils, they initially received no feedback. This baseline ran for six days. If at the end of that time their scores were perfect for three consecutive days on all three sheets, they were advanced to the next class of problems. If, however, their last three scores were not 100%, a teaching technique was arranged. Now, following the completion of an assignment, the pupil was required to read aloud each incorrectly solved problem. Two other teaching techniques were devised and successively used if the first technique proved ineffective.

This strategy of moving from one class to another only when three successive 100% days were noted on all sheets was adhered to throughout the study. Reliability checks were obtained as the students performed each class of problems.

The results indicated that our children had little difficulty in advancing through the 13 classes. In respect to correct rate and accuracy, the scores were lowest for most of the pupils when they began the class that included the misleading information. Furthermore, most pupils had difficulty with problems which included an irrelevant lead sentence, a blank, and numerals presented in two ways. When the pupils were required to respond to the mixture of problems on class 13 and the 85 problems from the math texts, they committed very few errors.

Throughout this study about 40% of the errors were operational (add rather than subtract) and 40% computational (4 + 3 = 8). More errors were made on the combination sheets than on those where only addition or subtraction were required.

When the first instructional technique was required, it was generally effective. There were few instances when the other two techniques were used.

In order to respond with consistent accuracy to the story problems in commercial texts, the pupil must develop several skills. Certainly he must have the requisite computation and word-calling behaviors. Beyond those skills he must be prepared to write his answer following or sometimes within the problem, to discriminate between necessary and irrelevant data, to classify and group nouns, and finally to make dozens of discriminations between various cues and foils from one problem to the next.

Apparently our project was to some extent successful. After the pupils had responded correctly to our 13 classes of contrived problems, they were quite able to solve the multi-differential problems from the commercial texts.

"To the Teacher." One of the important features of this study for teachers to consider is the necessity to design materials. The story problems in all the commercial books we investigated varied considerably from one to another. Furthermore, most books contained few story problems of any type. If a teacher desired to teach story problems she should first identify the types of problems, then she must generate several problems of each type.

This study represented one strategy for teaching story problems, that of assisting pupils to develop competencies with first one specific type problem, then another. When pupils were able to compute problems of one type at a time, they were assigned problems of all classes. This instructional strategy could apply to subjects other than story problems, that is, teaching one class of problems at a time, then teaching pupils to solve problems of many types together. In spelling, for example, words that contained one phonic element could be taught, then other types. Finally, words of many classes could be simultaneously presented.

By contrast, another teaching strategy would be to present problems or items of several classes at the same time, then, if the pupil could not discriminate between types, certain types could be removed from the program until he could discriminate from among those left. In this study, the pupils could have initially been offered story problems from 12 different classes. If they could not solve problems of certain types--if certain types were confusing--those problems could be pulled out of the program. Problems of other classes could also be removed until a pupil's performance was satisfactory. Once that point was reached, certain problem types could be gradually put back into the program. An instructional technique could then be focused on the newly introduced problems.

Another feature of this study that deserves some consideration is the practice of analyzing errors. In this project errors were categorized as operational or computational. Had some students committed several errors of one type, specific remediation for that form of error would have been arranged. Regardless of the program--reading, penmanship, computation, story problems--the teacher must do more than count correct and incorrect responses. The child's style of responding must be analyzed. Often if the child's pattern of responding is studied, clues for subsequent remediation will be provided.

Spelling Research

A free time contingency with fourth graders.[9] One of the few studies reported in this chapter that were not conducted in the Research Classroom was carried out in a regular fourth grade. Perhaps the most significant feature of this investigation was the demonstration that leisure time could serve as an effective reinforcer for most of the members of a class. In order to arrange leisure time as a contingent reinforcer the classroom was slightly modified.

The study took place in a class of 32 pupils. The project was conducted entirely by the classroom teacher, who administered the spelling program, calculated and graphed the pupils' scores, and managed the contingency system.

This study used a simple AB design. During the baseline phase of the study spelling was administered in a very traditional manner. On Monday the new words were introduced and the children read a story containing those words. On Wednesday a trial test was given. On Thursday they completed some workbook exercises pertaining to the words, and wrote each word several times. On Friday the final test was given. Each pupil's Friday score was graphed as a correct percentage score.

During the next phase the pupils were presented the new list of words and given the same type of spelling assignments as before. The pupils were now simply required to hand in their work. No specific time was scheduled for the completion of these activities as there had been during the first phase. The major difference between this condition and the former was, however, that spelling tests were given four days a week, rather than only one.

During this phase the pupils were through with spelling for the week when they received a 100% score. If on Tuesday, the day of the first test, a pupil scored 100% and he had handed in the assignments, he was free during the time of the subsequent spelling tests to engage in a number of leisure time pursuits. He could read a comic book, work on a puzzle, draw pictures. The pupils continued taking the test until results were perfect, or through Friday.

Throughout this phase the teacher recorded the pupil's score as 100% if he returned a perfect paper on Tuesday, Wednesday, Thursday, or Friday; otherwise, if the pupil never achieved 100%, his Friday score was recorded. Furthermore, the teacher recorded on each pupil's graph a number which corresponded to the day the score was obtained: 1 = Tuesday, 2 = Wednesday.

As a result of being able to earn free time or to escape from spelling, the performances of most children improved. Twice as many 100% papers were recorded in the second condition than during the first. Many children obtained 100% scores in the second phase that had never before done so.

"To the Teacher." This project, beyond the fact that a system to arrange free time in the classroom was devised, suggests a strategy for assisting teachers to gather data. Perhaps when teachers are requested to obtain data and plot graphically the academic performances of pupils, spelling is the best place to begin. Two reasons might support such a statement. In the first place, spelling is probably instructed more systematically and tested more regularly than other academic skills. The procedures for instructing spelling are essentially the same from week to week. Furthermore, spelling performance is generally assessed at least once each week. The second reason for using spelling as the spring-board for obtaining records of academic performance is that most teachers already record pupil performance in spelling. Many teachers indicate in their record books the weekly percentage scores of the pupils. It is a simple matter to convert these notations into percentage points on a graph.

Although this project dealt with spelling, arrangements similar to those used here could be incorporated in other subjects. The only requirements would be: a) arrange a definite period each day to offer the subject; b) establish a criterion for satisfactory performance; and c) designate some place for pupils to spend their leisure time, and, of course, provide enough events that are reinforcing.

This strategy, for example, could be used in arithmetic computation. The pupils could be given a set of problems to master each week. A specific period each day could be scheduled to work on those facts. On several days of the week tests could be given, and when the students scored perfectly, they could be relieved from math computation for the week. In this project the pupils took free time at their desks; for them this was a satisfactory arrangement. Pupils of other ages or types might be more reinforced by leisure time if a special room was set aside for games and free play. Several studies have been conducted where special rooms have been established to be used exclusively for free time.

Teachers could certainly improve upon this project in terms of individualization. Throughout this project all pupils were assigned the same spelling words. Although all students improved, some students had to work harder than others. A teacher could use the same free time contingency used here, but individualize the spelling words, arithmetic problems, or other academic assignment.

<u>b - d reversals</u>.[10] A problem with many learning disabled children, at least insofar as their teachers are concerned is the reversal dilemma.

Teachers frequently express their concern about children who transpose letters. The classic example used when discussing reversals is the b - d transposition.

Reversals can be noted in two forms: writing and speaking. In the former a pupil could, when asked to write the word dog, reverse the d and instead write bog. At that point the pupil has a spelling problem. The project described here is within that context.

The subject of this experiment was a 10-year-old boy. A teacher in our class had observed that on occasion, when he was asked to write certain words he reversed some letters. Often he reversed the letters b and d.

An ABA design was adopted in this study. During a baseline period the pupil was asked to spell several three-letter words that ended or began with either b or d. The data during this phase pointed out the frequency and extent of the difficulty. He rarely substituted d for b, but often substituted b for d. Further, he reversed d more in initial than in final position

The intervention was simple and effective. Every day during the intervention phase the teacher showed the pupil the word dam. He was then asked to read the word, then name the first letter, then write the word. Next, he was shown the word bam and asked to name the first letter. He was again asked to name the first letter of the word dam, then instructed to write the letter d. After this teaching period, which lasted about 45 seconds, he was asked to spell the same words used throughout the baseline.

The effects of this procedure were noted immediately. After five days his accuracy for all words was 100%. Throughout the next phase no instruction was provided. He continued to discriminate correctly between b and d.

The next concern was to determine the extent to which this newly acquired b - d discrimination generalized. Generalization was assessed from two more word lists. The words on the first generalization list were short words which contained a b or d in final or initial position. Although these were different words than were used on the first list, the pupil spelled them all correctly. The second generalization list was composed of two-syllable words that included a b or d in final, medial, or initial position. His ability to discriminate again generalized; he spelled all the words accurately.

The teacher was then curious as to whether this generalization would be noted in a context other than spelling. Although she hoped such a transfer would occur, she knew it was possible for the child to develop a skill in one situation and be unable to extend the skill to other settings. In order to discover whether the discrimination skill had transferred to another situation, the teacher checked through several of his penmanship papers for a period of time following the b - d study. She found very few instances where one letter was substituted for the other.

"To the Teacher." This project points out the advantage of pinpointing several related behaviors and measuring each over a period of several days. By so doing, the teacher discovered the student's reversal difficulty was not pervasive. He generally substituted b for d. Thus, a precise and extended diagnosis, like the baseline of this study, is called for to determine the extent and frequency of the problem. It is certainly much easier to design a remedial technique for the overuse of <u>b</u>'s, than for more global reversal problems. Of those pupils said to have reversal difficulties, it is possible that more of them occasionally transpose certain symbols than invariably transpose all reversible symbols.

A second point about this study that some might consider significant is the extent to which generalization was monitored. By measuring the pupil's ability to discriminate with words and in other situations, the teacher knew that learning had transferred; she knew that the remediation was not situation-specific. His dyslexic ailment was apparently cured. It must be emphasized, however, that although generalization occurred, teaching was directed toward the primary behavior of concern.

A third point of possible interest is another example of simple, yet effective, teaching. When the little <u>dam</u> procedure was scheduled (which was prompted by the student's behavior) his performance quickly and significantly improved.

<u>Communication Research</u>

<u>Penmanship: Correct next day</u>. This project was based on a penmanship study conducted by Hopkins and his colleagues (1971). Their subjects were first and second graders whose mode of writing was either manuscript or cursive. In their investigation the total penmanship period was initially 50 minutes, including work and free time. During certain phases of that study the pupils could go to a playroom when they had finished their

writing assignments. In that investigation, the amount of time scheduled for the total penmanship period was systematically reduced; the amount of time available for play was accordingly lessened. The data indicated that as the time for the total penmanship period was shortened, the rate and accuracy of penmanship improved.

The ideas of allocating a specific amount of time for a period, which included work and free time, and allowing pupils free time when they finished their assignments, appealed to us. Further, we were curious about two other aspects of the Hopkins investigation. In the study, although there was not a systematic effort to deal with errors, the pupils' incorrect rates were generally low. It had been our experience in past penmanship studies that unless some attention was directed to errors, rather high error rates could be expected. The second feature that intrigued us was that their students' manuscript and cursive writing rates were so low. Compared with writing rate data we had obtained from normal first and second graders, the pupils in their study were not nearly as proficient.

In an attempt to replicate certain features of the Hopkins research and to provide data regarding our queries about that study, we designed a similar penmanship study. In order to investigate whether systematically attending to errors would influence quality of performance, several conditions were scheduled where an error contingency was alternately arranged, then withdrawn. In response to the aspect of proficiency, we obtained writing rate data from normal children and used these as desired rates for our pupils.

Our study began by requiring the pupils to alternate writing styles for a few days. One day they copied a 500-symbol story in manuscript, the next in cursive. The purpose was to determine which mode would be used for initial instruction.

Once we had made this determination, the investigation began. Each day the pupil was given a sheet on which a 500-symbol extract from a reader of each child's reading level. A symbol included a letter, punctuation mark, or space.

An ABA design was used throughout the study. During the first phase the pupil simply brought his completed paper to the teacher, who checked to see if everything was copied. The pupil was then free to go to a leisure time area.

The total penmanship period lasted 30 minutes. If the pupil finished his assignment in 15 minutes, he was free to play for 15 minutes. Following the 30-minute period the pupils participated in a social studies activity.

Each day two data plots were entered, correct and incorrect symbols per minute. Errors comprised the following categories: case, punctuation, spelling and penmanship. Reliability measures were obtained throughout the study in regard to accuracy of checking responses, general procedures, and timing.

Throughout the baseline period the teacher did not attend to errors. During the next condition, however, a quality control contingency was put into effect. Now the pupil had to correct his errors from the previous day. If a pupil left out some letters or illegibly formed some letters on Monday, he was required, on Tuesday, to complete the regular Tuesday assignment, then correct all his Monday mistakes.

This condition was in effect for about 20 days. During the next phase the quality control was lifted; the arrangements were identical to those of the baseline.

For the majority of the boys this correct-the-next-day contingency was very effective; their incorrect rates dropped considerably. For a few pupils, however, this technique did not result in reduced errors. Of those children, the error rates for two were reduced when they were required to correct their mistakes twice rather than once the next day. For a third boy, whose errors were not initially attenuated, the same procedure was used, but he was required to correct his mistakes the same day. This alteration resulted in success.

Included is Figure 3 that illustrates the performance pattern of one of the boys. The correct-the-next-day contingency was effective for him.

Figure 3 About Here

During the pre-baseline period it was decided to commence his training with manuscript writing. During the baseline phase his correct and incorrect rates were fairly close together, indicating very low accuracy In fact, his errors were increasing from day to day. The data in the next phase were quite different. Immediately, when the error correction rule was imposed, his correct rates increased a bit and his incorrect rates began to plummet. When the error contingency was withdrawn throughout the next phase, the effects were almost as radical and immediate: his incorrect rates suddenly increased. In the next phase, when the error rule was reinstated, his errors once more dropped considerably.

In regard to errors, our project did not totally agree with the Hopkins data. The errors of our pupils were not lessened until a contingency was scheduled. Such an apparent difference in the two studies could have been due to distinctive instructional styles of the teachers. Perhaps Hopkins' teacher had, in the past, attended more to errors than our teacher. Or, possibly the manner in which errors were checked was more stringent in one situation than in the other.

As to writing proficiency, we had, prior to the study, obtained writing samples from dozens of children in both manuscript and cursive form. We ranked those data and selected as desired rates the 75th percentile correct rate score and the 25th percentile incorrect rate score. For manuscript, these rates were 22 correct words per minute and .15 errors per minute. In the figure included here it can be noted that the pupil's correct rates always exceeded the criterion, but his incorrect rates were much too high.

In the Hopkins research the rate of the best manuscript writer at any point in the study was far less than the desired rate we had chosen. This discrepancy could be accounted for in part by the fact that they counted only letters, whereas we counted symbols (letters, spaces, and punctuation). A more probable reason for this discrepancy, however, was that the pupils in the Hopkins study copied from a chalkboard, while ours copied from a paper at their desks.

"To the Teacher." There are several points from this study that have been emphasized earlier. First, the contingency used here was about the same as that arranged in one of the spelling studies: when work was satisfactorily completed, free time was available. In this study, as in others, errors were categorized so that each pupil's mistakes could be analyzed by type.

Although in this study the same type of intervention was used with all pupils, the exact way the intervention was used depended on the behavior of each child. During the period when the intervention was scheduled, the pupils had to re-do all their mistakes; if a pupil had difficulty with a particular letter or letter combination, he had to practice it.

This brings out another feature of individualized teaching that has at least been attended to in this chapter, that is, individualized instructional procedures. Although many people at least pay lip service to individualized teaching, they generally interpret that to mean that individuals are being taught skills at various levels. If instruction is to be truly individualized, it would require that every component of the educational situation be individualized. That would certainly include the program <u>and</u> the teaching procedures.

A feature from this study referred to earlier in an arithmetic report was the matter of desired rates. Prior to running our penmanship study we gathered some penmanship data from regular school children. These data served as desired rates. The primary reason for obtaining desired rates from other pupils is for reference purposes; we must have some gauge as to the extent pupils should be taught. Certainly, in situations where the goal is to normalize children or to send them from a remedial setting to a regular situation when their problems are solved, desired rates should be gathered. For if the pupils are expected to survive in a class where the performance levels are currently higher than theirs, they must be instructed to the point where they are equally proficient.

A final point to consider from this study deals with calibration. It will be recalled that in our study we counted symbols written, whereas in the Hopkins study words written were counted. In many subject matter areas the teacher can identify the item to be measured along a scale from very broad to very specific. For example, in reading the teacher could measure the following: books, chapters, pages, paragraphs, lines, words, or phonemes read. Obviously, it would be easier to measure books read than phonemes pronounced. The decision, however, as to the amount of precision required should not be based totally on ease. The teacher should generally measure that which is being taught. If instruction is focused on specific phonemes, they should be measured, not lines read. Correspondingly, the teacher should probably not measure more specifically than need be.

Cursive writing. Effects of selected checking. Second only to reading, penmanship has generated more research, discussion, and controversy than any other academic subject. Perhaps the biggest controversy regarding penmanship instruction focuses on the manuscript-cursive issue. Most schools routinely start all children on manuscript writing, then shift to cursive. Some schools make this shift at the end of the second grade, others as late as the end of the third grade. Convincing research to support the notion that cursive writing is enhanced by manuscript writing, much less that children should print until a certain grade, is to my knowledge, non-existent.

Another issue relating to the teaching of writing pertains to the sequencing of instruction. Some experts state that instruction should be based on letter families; words that have common characteristics should be introduced and taught together. Others claim there are certain letters that are inherently difficult for pupils to form and specific instruction should, therefore, be focused on those letters.

This penmanship study stemmed from those two issues. In respect to the manuscript-cursive argument, we simply started all our pupils at the beginning of the year on a cursive program, regardless of their past penmanship experiences. As to the beliefs that instruction should center on certain families or specific letters, we individualized the instruction. Attention was directed to the specific letters each pupil had difficulty with. Another interest we had in conducting this project was to study transfer of training; to determine whether, if teaching is focused on certain letters, other non-taught letters will improve.

A final objective we had was to establish a cursive writing program that was quick and effective. In the previous year (the preceding project) we were able to change the writing rates, hence the legibility of the pupils, but we believed that program required too much time.

Each day, in this project, the pupils were required to perform several tasks. Two worksheets (lower and upper case) were used to obtain the pupils' responses. On one worksheet they copied, using manuscript letters, from a list of lower case cursive letters. Next, they spoke the letters, then wrote the alphabet in order, using lower case cursive letters. On the same worksheet they wrote 16 lower case cursive words. The other worksheet was similar. The differences were that the two letter writing tasks on the second sheet were upper case, and the pupil did not write the 16 words.

The reason the pupils were required to write lower and upper case manuscript letters and to speak the names of the letters, was that many writing experts consider these prerequisite skills for cursive writing. Although data regarding these skills were kept throughout the project interventions were never focused on those skills. We were, however, interested in "backward" generalization. By measuring components of manuscript and cursive writing, and by focusing the interventions on cursive writing, we felt we would obtain data regarding transfer effects.

A multiple baseline design was used. During the baseline period no teaching, feedback, or reinforcement was scheduled for any of the writing behaviors. At the end of this phase each pupil's lower case cursive errors were analyzed. The five letters that were most often illegible in the baseline were selected as target letters. Throughout the intervention period if a pupil incorrectly formed any of those five letters he had to complete a worksheet devoted to each letter. If letters other than the five were incorrectly formed, he was not required to complete the exercise. The pupil was not told which five were selected.

When a letter was perfectly formed for three consecutive days, it was dropped from the program. When one of the five target letters was passed, a new one was selected. This procedure continued until all letters were passed. A second observer periodically checked the scoring of the papers.

The same intervention, once proficiency had been obtained for lower case cursive letters, was successfully applied to lower case cursive words, then upper case cursive letters.

After the baseline period it took pupils an average of 12 days to reach proficiency in lower case cursive letters. Most of the students reached criterion on lower case words and upper case cursive letters in about the same length of time.

The results from this study indicated that irrespective of the pupil's penmanship backgrounds, they could be taught to be competent cursive writers. As to the opinions of others about initially teaching certain difficult words or families, those beliefs are perhaps unfounded. At least in this study when instruction was focused on words that were particularly troublesome for students, the results were positive. As to there being particular letters that are difficult for all children, we found that, to the contrary, each pupil's hard and easy words were unique.

In regard to transfer of training, several instances were noted. As some children were taught to write certain letters, those letters and other non-taught letters improved. In some instances the writing of lower case words and upper case cursive letters improved when teaching was keyed on lower case letters. Finally, in some instances transfer across type of writing was indicated. As some pupils were taught to write cursively, their manuscript writing improved.

As to our final objective, to design a cursive writing program that was quick and effective, evidence to support the latter characteristic was offered. To substantiate the former qualification, only five hours of instruction was generally required for a pupil to complete the program.

"To the Teacher." The teaching procedure in this study like the technique in the preceding study, was individualized. The students practiced on items that were troublesome for them, no others. In this study they rehearsed letters, whereas in the preceding study they practiced words.

Another feature of the intervention--its intermittency--should be pointed out. During the intervention phase in this study, the pupil had to practice on only five letters which were selected by the teacher. If the pupil missed one of those five letters he had to write that letter several times; if he erred on other letters he did not have to practice them. The pupils' penmanship throughout this project was generally good, they did not become sloppy on non-selected letters. Apparently this was due to the fact they did not know which letter, if improperly formed, would result in extra practice.

Intermittent checking could be done in another way. For example, if a teacher, for some reason, does not have time to check all the pupils papers each day, she could check all of them some days or some of them all days. If the teacher's primary aim is to maintain proficiency, such intermittent evaluations could be effective and economical.

Learning to type. Many teachers devote large blocks of time daily to the instruction of penmanship. Some, as a result, train dozens of fastidious writers. It has been my experience, however, and this is shared by others, that it would require inordinate amounts of instructional time before some children would become proficient writers. That is, able to write legibly at reasonably high rates.

Few would debate the fact that individuals are required, on occasion, to be able to write with a pen or pencil. Everyone uses this medium to write lists or reminders for themselves and others, to sign checks, to fill out applications. However, typing is a superior communicative substitute for most forms of writing except for the situations that require a personalized note or signature.

When rate is considered, typing is at least three times faster than hand scribbling. My writing rates for a 15-30 minute period average about 20 words per minute. My typing rates over the same period are about 60 words per minute. As to legibility, of course, everything favors the typist. If an a is struck on the keyboard, it always comes out the same and always looks like a. When I write a it sometimes looks like a, at other times o, on occasion u, and on a bad day, who knows.

Perhaps one reason that so many individuals find writing--letters, stories, random thoughts--so painful and others are so inept is that their only mode of textual creation is pencil pushing. Writing is particularly punishing for the person whose characters are illegible and whose rate is slow.

Teaching a person to type is not like teaching someome to fly a 747 or captain an ocean liner. Typewriters are readily available. With some slight rearrangement of priorities, every family can own a typewriter; they are certainly less expensive than cars, TV sets, and stereo equipment.

With our pupils we began with line 1, Lesson 1, of the book, You Learn to Type. After considering many books, we decided this one was the best for our pupils. For the most part, we simply proceeded through the book, skipping only a few of the lessons.

Each day the students were assigned six lines. The book specified correct and incorrect rates for each line. In order to pass a line these rates had to be met. When a line was passed it was checked off and a new one added.

The data we kept throughout the year were: a) correct and incorrect words per minute (a "word," according to the book, was five consecutive spaces); b) cumulative lines passed; and c) average number of characters per line. /We believed these three bits of data represented a fair indication of typing proficiency.

Some of the interventions we used throughout the year were the following. a) to monitor the proportion of time the pupil looked at his book; b) to tell the students what their rates should be to pass certain lines; c) to tell them how many lines they passed the previous day; d) to require them to practice troublesome lines; e) to require that they practice certain two-letter combinations, and f) to praise them for looking at the book.

The results, after three quarters of instruction, were very encouraging. Of the seven boys, the average had completed 15 lessons. The average correct and incorrect rates at the end of the year were 13 and 3.5. All but two boys had learned all the letter characters, upper and lower case. The average total instructional time was 10 hours.

In conjunction with this typing project, we obtained data each day regarding the pupils' writing and typing rates. Each day they were required to respond, by writing and typing, to three stimuli, for one minute each. They were expected to copy a sentence printed on a card, describe a picture, and copy a dictated sentence. The purposes of these comparisons was to determine whether typing rates, over a period of time, would surpass writing rates.

Throughout the first quarter these rates, for all three stimuli, were highly discrepant. Without exception, all the pupils' writing rates were higher than their typing rates. Then during the second quarter the writing rates began to peak and the typing speeds climbed. Finally, toward the end of the third quarter the typing rates for some boys equaled and a few surpassed their writing rates

Learning to type is, for most young children, a reinforcing activity, particularly when they type on an IBM Selectric, as our youngsters did. At no time throughout the year did we have to coax them to perform. Elaborate reinforcement contingencies were never required to motivate the children to type.

"To the Teacher." One important point brought out by this project is that teachers should regularly and seriously review what children are being taught. I have referred to our research as being concerned with basic skills, however, that which is basic could and does change from time to time. I feel that currently, typing should be considered a basic skill; for it is a most efficient means of communication. But whether others agree with my curricular priorities is secondary to the point made earlier, that teachers should regularly scrutinize their curricular offerings. They should evaluate what is taught children in light of the skills required to survive in today's world and in the world of tomorrow. Teachers must be careful not to teach outdated and irrelevant skills.

Another point to consider from this project related to teaching commitment. If typing is chosen as a skill that children should develop in the elementary schools, time should be allocated for the development of that skill over a period of two, three, perhaps four years. To become a proficient typist a student must receive a certain amount of instruction each week over a long period of time; proficiency is not developed in a few days.

Unless teachers and curriculum planners allow for enough time over an extended period to develop certain complex behaviors like typing, many skills will be underdeveloped. In such instances, when pupils do not become proficient, perhaps instruction on those skills should never have begun in the first place. Unless minimal proficiency is reached, in regard to some behaviors, the behavior is not useable. Therefore, teachers, prior to instructing certain skills should be certain they have set aside enough time to fulfill their instructional commitments.

A final point to be considered from this project was that, like others, several measures were obtained each day. As mentioned earlier, when the goal is to teach rather complex behaviors, it is sometimes necessary to measure multiple behaviors.

<u>Creative writing</u>. In conceptualizing this research, the word "creative" was used in a most liberal manner. To us, creative writing was any writing of an individual that was for him unique. We were not trying to develop

writers who expressed strange, bizarre, or fantastic thoughts. Rather, our goal, in this research and other similar attempts, was to encourage youngsters to express themselves in a way that is comprehensible to themselves and to others.

A further long-range objective of our writing efforts has been to conceive of writing as an ideational mediator as well as a communicative device. It has been my experience that often, when a person writes about something, particularly when he describes what he has done and why, his thinking about that activity is thereby influenced. Often one finds, with the effort of putting his thoughts into words, that the logic of his argument is less defensible than it had at first seemed. When a person writes he is forced to use words that precisely convey his meaning, to arrange sentences so that his line of thought sequentially unfolds, to give emphasis to the more important portions of his argument. We have conceived of writing as more than a method for communication.

An initial problem in conducting creative writing research is to decide which elements of the process should be measured. In a recent study dealing with composition (Brigham, Graubard, and Stans, 1972), the authors measured the following elements: number of words, number of different words, and number of new words. A panel of judges also evaluated the context of the stories on a five-point scale.

In making our selection of components to measure, we wanted to measure enough elements so that both the content and the mechanics of writing would be described. At the same time, we did not want to be overwhelmed with data, to the point that they would be unmanageable. We, therefore, selected six elements that were measured daily. Our primary measure was word frequency. Although such a measure reveals nothing about the quality of the writing, it does provide a quantitative index. We also measured the frequency with which punctuation and capitalization were used correctly and incorrectly. These were the basic measures of mechanics. In addition, we kept data on the average length of sentences and the number of different words used each session. These latter two measures furnished, to some extent, an index of complexity if not content. The final meausre was a creative writing scale developed by Winnifred Taylor (1965).

Daily, the pupils wrote for 10 minutes. Three different settings were used. On two days the stimulus was story starters. A portion of a story was read to the pupils and they supplied the ending. Twice a week, story titles were presented. On one day, generally Friday, the youngsters were free to write about a topic of their choice.

Ordinarily, it is not advisable in a daily measurement project to change the setting so often. In this case we felt justified in doing so; for when we kept the setting more consistent in previous writing studies, our pupils became very bored; their writing was anything but creative. In another effort to sustain interest throughout the project, the boys were allowed to read their stories to their classmates after the period. Most of the time they took advantage of this option.

An AB design was used in this study. Throughout the baseline no teaching, feedback, or reinforcement was scheduled. During the next phase two types of feedback were provided. For one group the feedback centered on mechanics, for the other, feedback pertained to content. For each group six statements were provided the pupils after the teacher had scored their papers. Three of the statements were positive and three were negative. With the mechanics group, the teacher pointed out to the pupils three places where they correctly used punctuation or capitalization and called to their attention three places that could be improved. With the content group three positive and three negative statements were offered relating to style, syntax, and description.

Following this condition of partial feedback, a "total" feedback phase was instituted. At this time the pupils were given feedback on several deatils pertaining to either content or mechanics.

Periodic reliability measures were obtained throughout the various phases of this project. These measures were in regard to the scoring of the several writing behaviors, timing, and general procedures.

Following are some general results from this research. Comparisons were made between the baseline condition and the combination of the feedback conditions. Regarding the effect of feedback on mechanics, we found that although both groups improved in their use of punctuation and capitals, the group where feedback was directed to mechanics improved more. As to the effects of feedback on content, both groups showed about the same amount of improvement. The word per minute rates of the pupils remained about the same throughout the study. In reference to average sentence length and the use of different words, the frequencies of these elements increased for most pupils irrespective of the focus of the intervention.

When the degrees of feedback were compared--partial vs. total--the differences were mixed. For some pupils certain aspects of writing improved more during one condition; for some pupils other aspects improved more during the other condition.

Of some interest was the fact that mechanics was more influenced by feedback than content. This perhaps has to do with the fact that content is more difficult to define than mechanics, hence is more difficult to evaluate. Finally, in respect to feedback for mechanics, some creative writing experts have warned about this practice. They have suggested that if mechanics are heavily attended to, creativity will be inhibited. The contrary was the case in this study; feedback on mechanics positively influenced mechanics and content

"To the Teacher." This project illustrates, along with several others, the necessity for obtaining multiple behaviors in order to explain the development of a complex skill. As suggested in this report, enough behaviors should be selected for daily measurement to provide an adequate picture of the developing skill. One consideration in selecting those behaviors has to do with calibration. Some discussion was provided on this topic earlier, which suggested that teachers measure behaviors that are being taught

Another consideration, insofar as selecting behaviors to measure, is to be certain that important behaviors are being measured, not merely behaviors that are easy to measure. The teacher must always keep in mind that measurement of student behaviors is not an end of itself. Measurement merely allows the teacher to determine whether she is teaching what she intended to teach. The skills the pupils develop are of ultimate importance.

Another point brought out in this project is that often, when teachers desire to assist pupils to acquire certain tasks, several individually derived teaching procedures are necessary. In this project, as pointed out, a feedback technique assisted the pupils to approach competency, but they certainly did not totally master the fine art of writing, not even in regard to mechanical usage. The teacher, even though she may have found a successful teaching technique and the pupil is currently making progress, must continually monitor her efforts and file away techniques that could be used in the future. A creative teacher must always be on the lookout for individually designed teaching techniques. She must amass a huge repertory of potential interventions.

Instructions were used to increase verbal behaviors.[11] The pupil in this study was a 9-year-old boy. His speech was very difficult to understand. When a speech therapist attempted to pinpoint more precisely his problems, he was unsuccessful. The boy did not consistently misarticulate any sounds and he did not stutter. At times his voice was husky and his speech very rapid, but neither poor quality nor excessive rate appeared to be persistent characteristics. He did use ghettoese speech at times and occasionally resorted to current adolescent jargon and even used words and phrases of his own invention. Since we could not pinpoint specific verbal behaviors, yet believed we should improve his speaking, we decided initially to focus on sheer word output.

This study used a pre- post-test and a multiple baseline design. Pre- and post-tests were administered before and after several daily measures were obtained. Throughout the period of daily measurement a multiple baseline design was used

Before the daily measurements began, the boy was asked to describe three pictures from a Peabody Language Development Kit. His descriptions of these pictures began with the phrase, "This is." We, therefore, decided to measure, throughout the daily sessions, the ratio of different sentence beginnings as well as the average number of words per response.

Throughout the investigation the daily sessions lasted 10 minutes. Picture cards were presented to the pupil one at a time. During the baseline phase the pupil was instructed to tell about each card. He could respond to each card as long as he wished. The data in this condition indicated his average number of words per response was four, and his ratio of different sentence beginnings was low. If a picture of a cup was shown his response was, "This is a cup."

Based on these data our decision, during the next phase, was to try to alter the ratio of sentence beginnings. Before each session in this phase, the boy was told to use different ways to begin sentences. He immediately complied; throughout that phase his beginnings were gratifyingly varied.

Meanwhile, in this phase his average response length was only slightly influenced; most of his responses were four to six words.

Therefore, during the third condition, the pupil was still instructed to vary his sentence beginnings, but, in addition, to use more words. He again complied. The data revealed that his average response length doubled, while his ratio of sentence beginnings remained high.

Following this condition a post-test was scheduled. The pupil was required to describe the same three pictures used in the pre-test and three others he had never seen. During the post-test, on both sets of cards, he used over three times as many words as he had during the pre-test. Thus, not only did instructions influence his verbal output throughout the daily sessions; this characteristic generalized also to a different situation.

During the final phase of the study, following conditions where the pupil had been successively instructed to vary sentence beginnings and to use more words, no instructions were given. Throughout these sessions the examiner simply showed the pupil a series of cards. The data from this phase were extremely variable. His beginning ratio was high one day, then low the next. His performance in regard to frequency of words was just as inconsistent. Since he had previously been responsive to instructions, it was now as though he was exploring, trying to determine what the examiner wanted him to do.

"To the Teacher." In schools and clinics many and varied instructions are used in efforts to teach children. These instructions are intended to serve many functions. They are used to inform pupils which response to make. Pupils are requested to walk, run, sing, write. Instructions are employed to tell pupils how to respond. They are asked to walk more softly, run faster, sing louder, write more neatly. Furthermore, instructions are used to inform students when to respond. They are told to perform now, in five minutes, and when the bell rings, tomorrow.

Sometimes these instructions are effective, sometimes not. Many children, like the pupil in this study, would do what was expected of them if they just knew what it was. Often when instructions are used, they are not precisely stated or consistently given. Some children have been instructed to "do better work," to "think before they act," to "improve their performance." Such directives may only confuse children; their efforts, following such instructions, may be erratic. At other times instructions are clearly stated, but not consistently administered. In a writing session, for example, perhaps one day the teacher requests more words, the next day neater writing, then more imaginative content, then "watch the capitalization", or "be careful of the punctuation." Although some children can cope with such a barrage of instructions, others flounder.

Studies such as this which show that certain behaviors can be influenced by carefully given instructions, should be encouraging to teachers who are trying to influence the behaviors of children. It would appear that if the student is capable of performing the requested skill, the first attempt to stimulate that behavior should be a clearly stated instruction. Furthermore, if that behavior is desired over a period of time, the same instruction(s) should be given.

Obviously, other teaching techniques should be used with the non-motivated student, the one who can perform the requested task but won't. One recommended technique would be to couple instructions with reinforcement contingencies; ask for the bahavior and pay off when it occurs. This technique was used in an arithmetic project described earlier.

Instructions should also be coupled with or supplanted by other teaching techniques if the desired bahavior is not in the pupil's repertory. If, for example, the pupil was requested to say the sound of c or add the digits 2 + 2 = [ ] and had never done so, instructing him to perform these tasks might be futile. Some other form of prompting those behaviors, such as modeling, would of course be recommended.

A final point to be brought out from this study refers to pinpointing. The first task of the teacher setting out to change some behavior is to pinpoint the behavior that should be altered. Next, that behavior should be measured and, if necessary, an intervention should be arranged to alter the behavior. Measurement should then, of course, continue in order to determine whether the pin pointed behavior was in fact altered.

Sometimes, however, it is not apparent which precise behavior should be changed. Although the teacher knows something is not quite right, she is unable to put her finger on the problem. Sometimes in cases like this, the teacher will consider the matter over a long period of time and lament the fact she cannot isolate the important behavior. No attempt will be made to change the behavior. I believe a more productive strategy, in cases like this, is to study the situation a certain amount of time in an effort to isolate the behavior of concern. Then, if the problem is not obvious, something should be changed in an attempt to improve the situation. When such a strategy is followed the general behavior could be improved or the "real" behavior of concern could emerge. Such an approach was taken in this project. Although the teacher evaluated the boy's speaking as poor, he did not know which speech element was inadequate and needed correction. Rather than prolong the search for the key behavior, the teacher changed two aspects of the boy's speech that could be pinpointed. Once those behaviors were changed, the teacher reevaluated the boy's speech and decided it had, in fact, improved.

Pupil Management Research

Pupil selects either math or reading.[12] This study was designed to determine the effects of selecting either reading or mathematics on performance rates in those two activities. The project was conducted with two boys, one eight, the other twelve.

The first pupil was permitted to select whether to work on mathematics or reading for a 20-minute session each day. The mathematics materials was from Suppes Book 2A, while Book 7 of the Sullivan materials was used for reading.

Following this period of pupil selection, two teacher-selected periods were scheduled. During the first such period, the pupil was required to continue for 40 minutes in the academic area he had chosen during the pupil-select period. In the third period, which lasted for 60 minutes, the alternate academic material was scheduled.

The sequence of periods for the second pupil differed. In the first period, one of teacher-selection, he was alternately programed either mathematics or reading for 30 minutes each day. Mathematics was supplied from Suppes Book 3B and reading from the Sullivan Books 19 and 20.

In the second period, which also lasted 30 minutes, he was allowed to select either reading or mathematics. Finally, for the 30 minutes of period 3, the boy was assigned the academic material alternate to that presented in period 1.

Three calculations wer obtained each day, one each for mathematics and reading when the teacher selected the program, and one from the pupil-select period. The results for the first pupil revealed that on 24 of 26 days, his performance rate was greater when he selected the subject than his rate on the same program when it was selected by the teacher. The performance of the second boy was similar, in that during 17 of 25 sessions his correct rate was greater when he selected than on the same material when the teacher selected.

For these two boys it appeared that self-selection was a motivating variable. Being allowed to select, even between two relatively low-strength tasks (mathematics and reading), was for them a reinforcing event.

"To the Teacher." We have conducted a number of pupil-management projects during the past few years that have focused on various management components. In some, the pupils have graphed their own data, in others pupils have specified their own performance objectives and designed their own daily schedules. Projects have been conducted wherein pupils timed their performance, counted and corrected their responses. In a recent project a pupil selected his own instructional technique. In the project that follows, a young man designed his own contingency system.

Invariably, these projects have shown that pupils are motivated when they are given a piece of the action. This motivation is indicated by the fact that during those conditions under which they are partially responsible for their behavior, their performances are generally better than when the teacher manages the entire situation.

Pupil specified contingencies in academic areas.[13] This experiment was concerned with the comparative effects of teacher- or pupil-specified contingencies. The pupil in this experiment was a 12-year-old boy. The investigation consisted of three separate studies--two that manipulated the contingency manager and one that manipulated magnitude of reinforcement. Each study used an ABA design. Throughout these studies the boy received points for academic responses. In reading he was granted two points for each correctly read page. That ratio was 1:2. The ratios in the other academic areas varied. Points were redeemable for minutes of free time.

During Study 1, baseline data relevant to the pupil's academic response rates were obtained for nine days. Each day a response rate figure was calculated that represented the boy's performance in all of his subject matter areas. Throughout this period no attempt was made to explain to the student the response-per-point ratio in each academic area.

Following this baseline period, the next phase of the study was instituted. It was the intent at this time to instruct the pupil about the relationship between correct answers and contingent points. Each day, in this condition, the teacher verbally explained the contingencies and placed a written copy on the boy's desk. The contract was composed of nine agreements, each of which had a response-per-point ratio. For example, the pupil was granted two points for each page read and one point for 10 correctly answered problems. As he completed each academic assignment, he was shown how many responses had been made and was asked to calculate how many points he had earned.

In the next condition, the copy of the response-per-point requirements was removed from the pupil's desk. He was now asked to specify his own payment for each of the nine areas. These new specifications were copied on a card and attached to his desk. Finally, in the last phase, the teacher-imposed contingencies were again in effect.

During the next quarter Study 2 began. Procedures for this investigation were exactly like those in Study 1. Teacher contingencies were explained, written out, and attached to the student's desk in Phases 1 and 3, while during Phase 2 the pupil's contingencies were in effect. Figure 4 illustrates the data from Study 2.

Figure 4 About Here

Following this replication study, Study 3 was conducted. Since during Study 2 the pupil had altered all the teacher imposed requirements to grant himself more points per response, it was necessary to determine whether being able to specify his own contingencies had effected the academic increase or whether this gain was due to the increased payoff. Study 3, therefore, consisted of three phases: a) the teacher specified the response-per-point requirements she had placed in effect throughout Studies 1 and 2; b) the teacher specified the requirements that the pupil had instituted during Study 2; and c) the teacher again specified her original requirements. The only difference between Studies 2 and 3 was that in Study 3 the teacher imposed the contingency requirements throughout, whereas in Study 2 the pupil set his own contingencies during Phase 2.

The data from these experiments indicated that, for this boy, self-specified contingencies were associated with increased academic response rate. This was evidenced in Studies 1 and 2 since during the periods when the pupil specified the contingencies his median performance rate was higher than during the periods when the teacher imposed the contingencies. In addition, the data from Study 3 revealed that the response rate was due to the contingency manager and not to reinforcement magnitude since his rates were about the same across all phases.

"To the Teacher." Teachers should, for several reasons, consider training their pupils to manage certain of their own affairs. One reason was mentioned in the preceding projcet. That is, pupils are often motivated when allowed to assume certain responsibilities for their own development. Another important reason for teaching pupils to manage certain of their behaviors is that they can assist their teachers. In some classrooms children have been taught to calculate the time they spend on certain programs, to total their correct and incorrect answers, chart their rates, and evaluate their own performances.

Another reason for developing pupil management skills relates to the academic curriculum. When children are taught to correct, count, chart, and evaluate their own performance, they are learning in functional ways to add, divide, tell time, and compare. The amount of pupil involvement and the extent to which this involvement is incorporated into the math and science curriculum is dictated only by the ingenuity of the teacher.

Obviously, the primary reason for teaching pupil management behaviors is that by so doing, pupils could emerge from schools as independent, productive, and creative citizens. To train such students should, I believe, be one of the primary objectives of education.

EPILOGUE

Curriculum research, particularly when Applied Behavior Analysis procedures are used, is a very exciting adventure. It is extremely reinforcing to identify important behaviors, arrange various techniques and procedures in efforts to develop those behaviors, then be informed daily about the function of those variables.

That Applied Behavior Analysis procedures are suitable for carrying out curriculum research has been demonstrated, not only by the varied projects reported here, but by several researchers throughout the country. A tremendous amount of work, however, remains to be done. The state of the art now regarding the use of Applied Behavior Analysis procedures and curriculum probably corresponds to the degree of sophistication existing 10 years ago when behavior modification pioneers were adapting operant techniques to alter talk-outs and out-of-seats in classrooms.

In the basic subject matter areas many more investigations should be conducted. The behaviors measured in the subject areas reported here were the simplest and most fundamental. In reading, for example, projects were included that dealt with phonics behaviors, oral and silent reading, and some types of comprehension. Future research could identify more complex reading behaviors such as paraphrasing stories, integrating material read from several sources, criticizing stories.

Our measures in arithmetic were similarly fundamental, various types of computation and story problems. A great deal of work remains to be done in the latter area. Research should also focus on other aspects of mathematics such as time-telling, measuring, sets, and unions.

In spelling, future researchers need to focus on the matter of sequencing, which words or letter combinations should be taught before others. Spelling researchers also need to identify which teaching techniques seem to be most useful for certain types of words. Our work in typing is but a beginning. In that research we followed closely the sequence of activities from a commercial book. Perhaps by using Applied Behavior Analysis techniques researchers will be able to identify a better sequence of tasks and more effective teaching procedures.

In penmanship some of the basic issues, including the development of manuscript before cursive writing, remain to be resolved. Applied behavior analysts should focus on such issues. Personally, I believe that although the penmanship questions have not been answered, there are other curricular questions of far more importance.

Creative writing offers a wealth of possibilities for the innovative Applied Behavior Analysis researcher. Curriculum researchers are perhaps the farthest away from identifying the important behaviors of writing and the techniques that will develop those behaviors than in any other area.

Not only does a fair amount of research need to be done by the applied behavior analyst in the basic skills just described, but other, perhaps more complex, subjects must be investigated. There is little, if any, research of the Applied Behavior Analysis variety in such areas as social studies, science, art, music, history, geography.

The question arises, whose obligation is it to conduct this research? I believe the primary responsibility rests with research facilities such as ours. Teachers can ill-afford to spend time researching the effects of various instructional techniques or identifying behaviors that are measurable. They are in the business of developing behaviors. It is the researcher's responsibility to investigate current curricular practices in schools. The researcher is also responsible for suggesting curricular innovations based on his investigations.

Further, it is the researcher's responsibility to present his findings in such a way teachers can incorporate them in their daily routines. Throughout this chapter I have attempted to present research so certain elements could be used by teachers. The approach was to synthesize several projects and follow each with specific suggestions about which aspects could be assimilated.

Finally, once the curriculum researcher has identified important areas for investigation and clearly presented his findings, it is up to the teacher to blend those findings with her basic technology. As I mentioned before, the creative teacher is one capable of extracting various elements from research projects and modifying others so they are functional in her situation.

Teachers will develop in proportion to the extent they can generalize. Some third grade teachers are willing to learn from only other third grade situations. To them, research or clinical evidence from other situations is not relevant because of the different setting, type of subject, behavior measured, or remediation technique. These teachers deny themselves many learning opportunities.

The teacher most capable of growth can extrapolate from many situations, some quite different from her own. It is my hope that teachers can generalize from the studies in this chapter, even though most of the research was conducted in a laboratory setting with learning disabled children.

Many teachers of mildly handicapped, even normal, children should be able to incorporate certain of the suggestions from this chapter regarding the arrangement of materials, designing of materials, diagnosis, error analysis, selection of teaching techniques. Several of the more general notions, for example, those in reference to various reinforcement arrangements, should be applicable to a wide range of individuals.

The reason for the wide extrapolation potential of the research from this chapter is that Applied Behavior Analysis techniques were used. When this approach is used, explicit behaviors are dealt with in a straightforward manner. Generalization in this context, therefore, pertains to identifiable environmental relationships. For instance, a teacher of neurologically impaired children identified a boy whose penmanship skills are inconsistent. One day his writing is beautiful, the next terrible, the next fair, and so on. Following a baseline period the teacher arranged a withdraw-of-positive-reinforcement procedure, similar to the one used in a math project reported here. For each incorrectly formed letter, the boy lost 30 seconds of shop time. Although there were many procedural differences between the penmanship and math project (sex, type of pupil, subject area, reinforcer), the teacher generalized the important environmental relationship from the math project to her spelling situation: contingent on errors, reinforcement was withdrawn.

Thus, researchers and teachers are granted two tremendous advantages when Applied Behavior Analysis techniques are used. First, in response to educational researchers, when these techniques are used most all the features of educational curriculum can be studied. Second, in response to teachers, when the concept of generalization is derived from the Applied Behavior Analysis approach, teachers are provided with infinite opportunities for developing their instructional skills.

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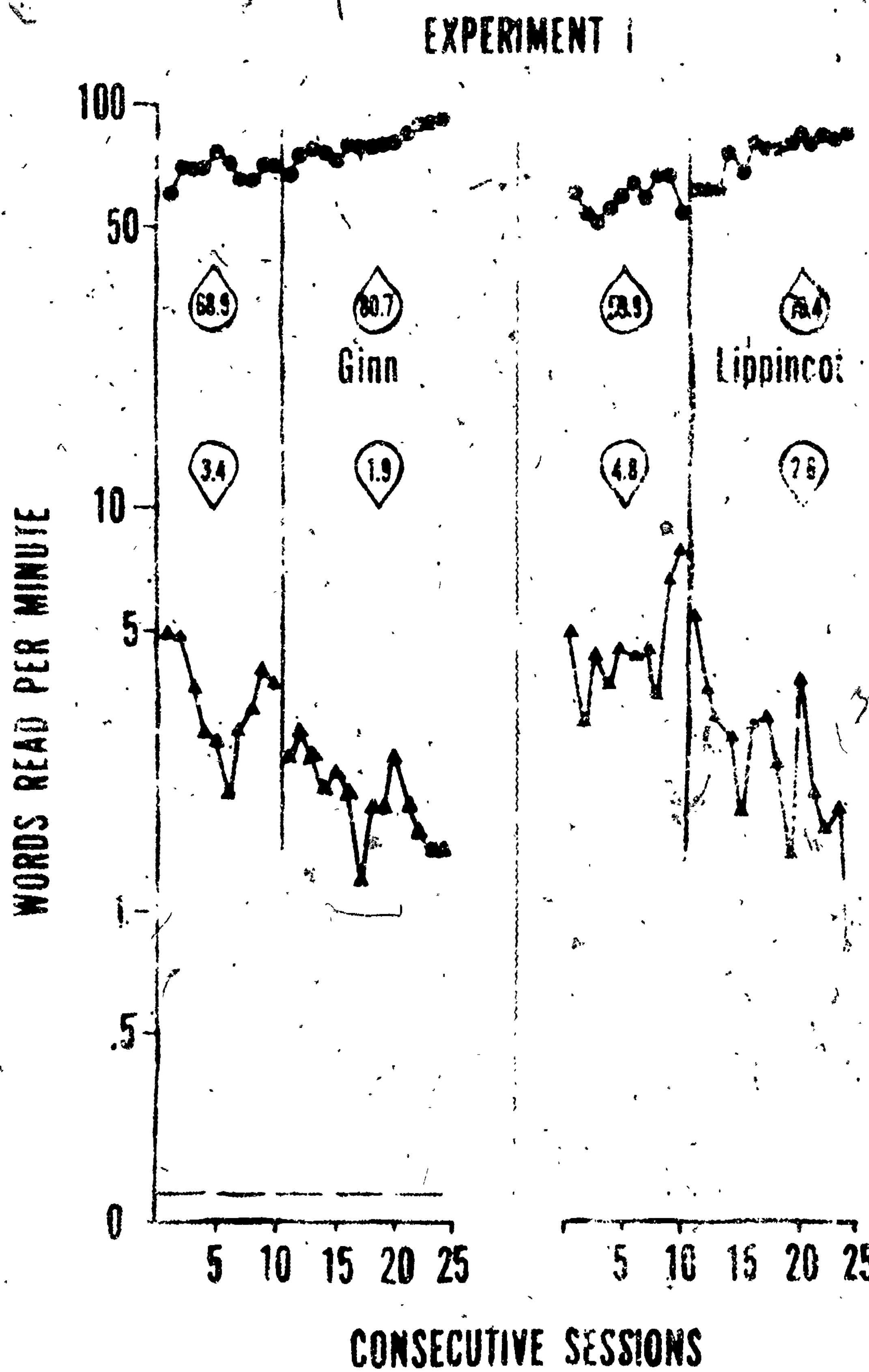
FIGURE CAPTIONS

Figure 1 Correct and incorrect rates throughout two phases as the boy read from a Ginn and Lippincott text. The numerals in the tear drops indicate correct and error rate means.

Figure 2 Percent correct scores for the three arithmetic sheets throughout the study. The data scores on S^1 and S^2 were erratic during baseline. Furthermore, the withdrawal technique was successively effective on each sheet of problems.

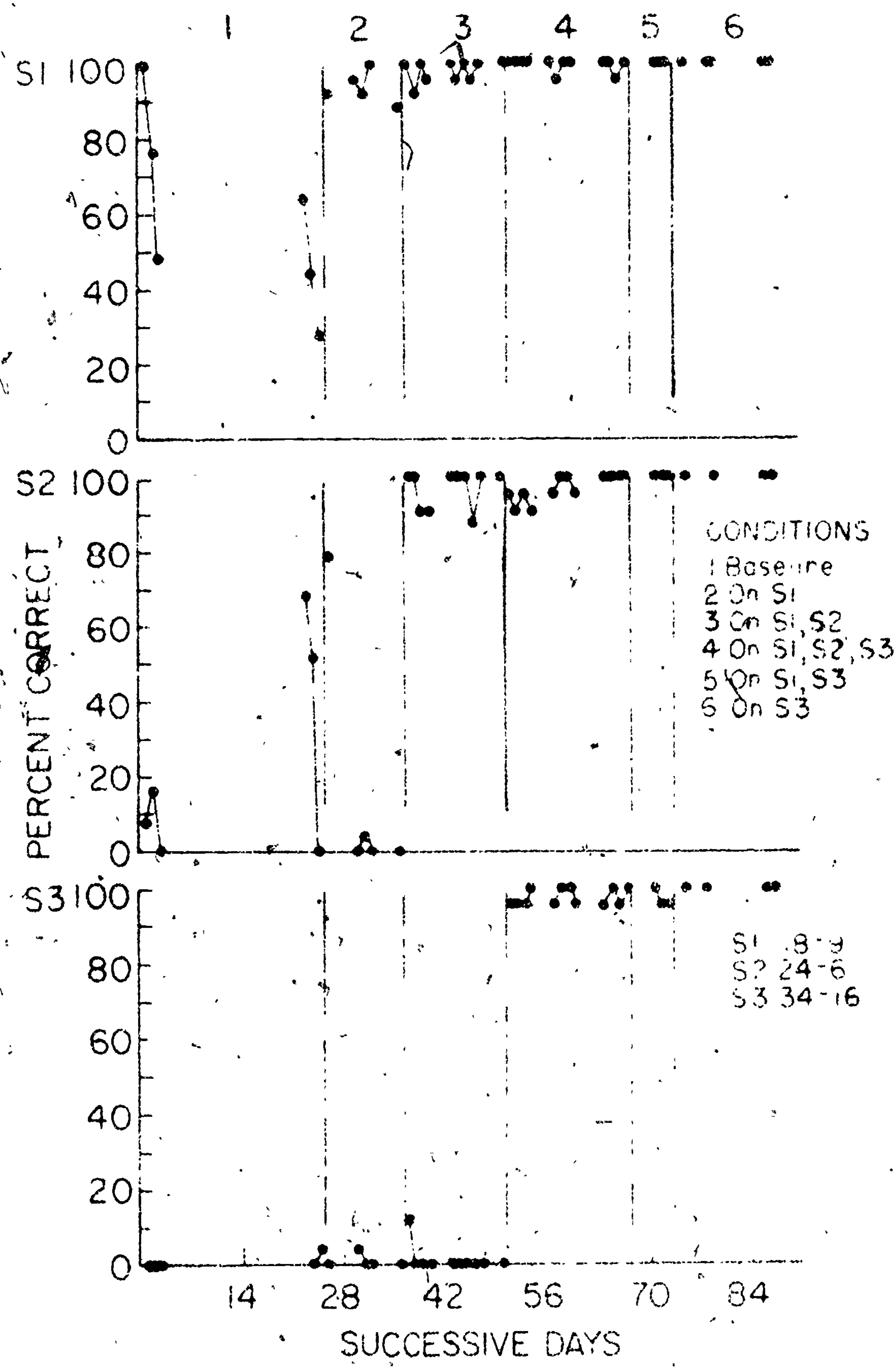
Figure 3 Correct and incorrect rates of writing symbols throughout four experimental conditions. For the first six days the pupil alternated between manuscript and cursive writing. Throughout the first condition no quality control was arranged; throughout subsequent phases the correct-the-next-day contingency was arranged, then removed. Correct rates generally improved throughout the study. Error rates were greatly influenced by the contingency; when arranged, the error rates were low, when not arranged, the error rates were high.

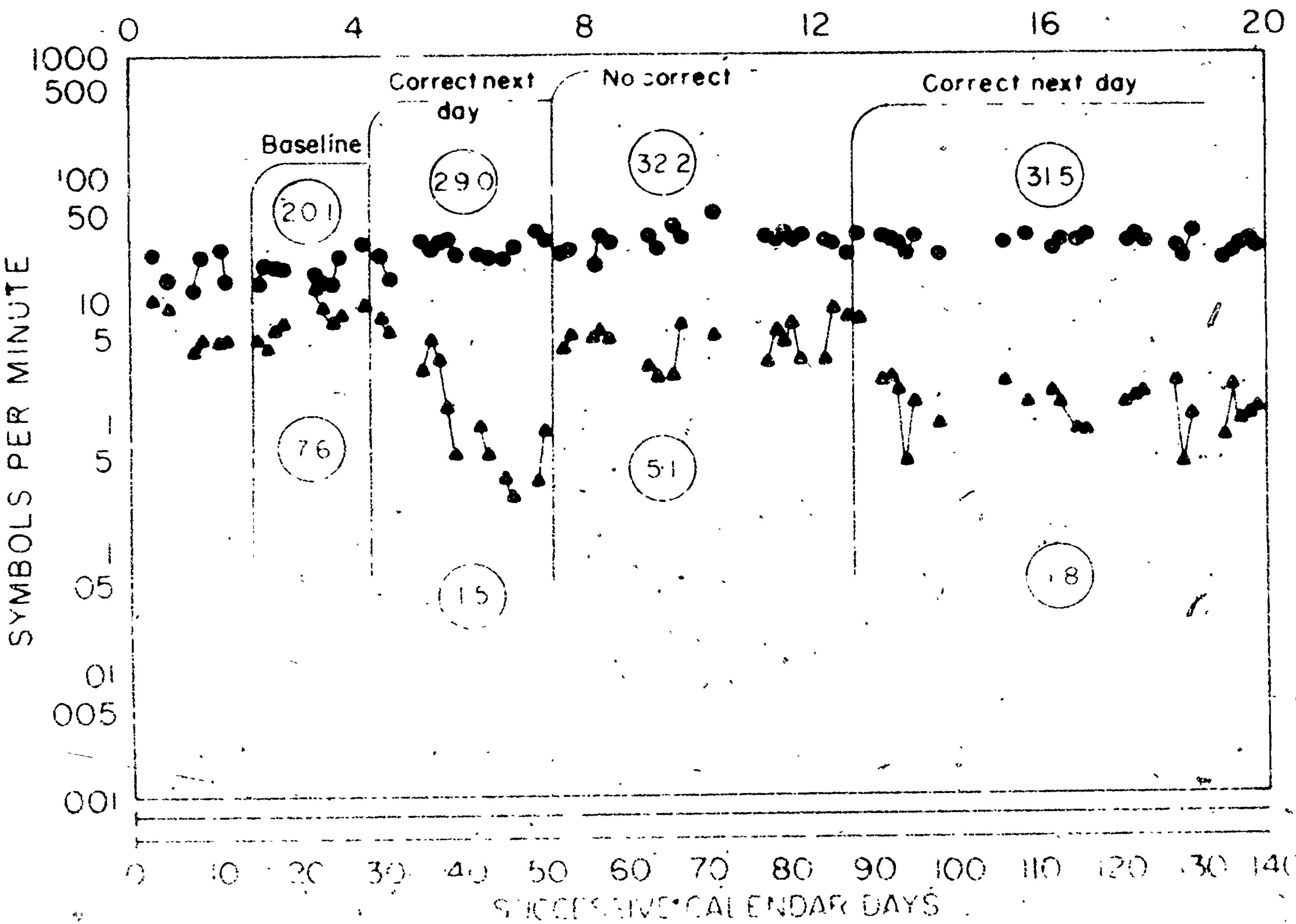
Figure 4 Response rates throughout the three conditions of Study 2 (Experiment II). These data indicate the pupil's rate was higher during the condition that he specified the contingencies than when specified by the teacher.



EXPERIMENT I
WORDS READ PER MINUTE
100
50
10
5
1.
.5
0
68.9
80.7
3.4
1.9
Ginn
4.8
7.6
Lippincot
5 10 15 20 25
5 10 15 20 25
CONSECUTIVE SESSIONS

EXPERIMENT I Study I

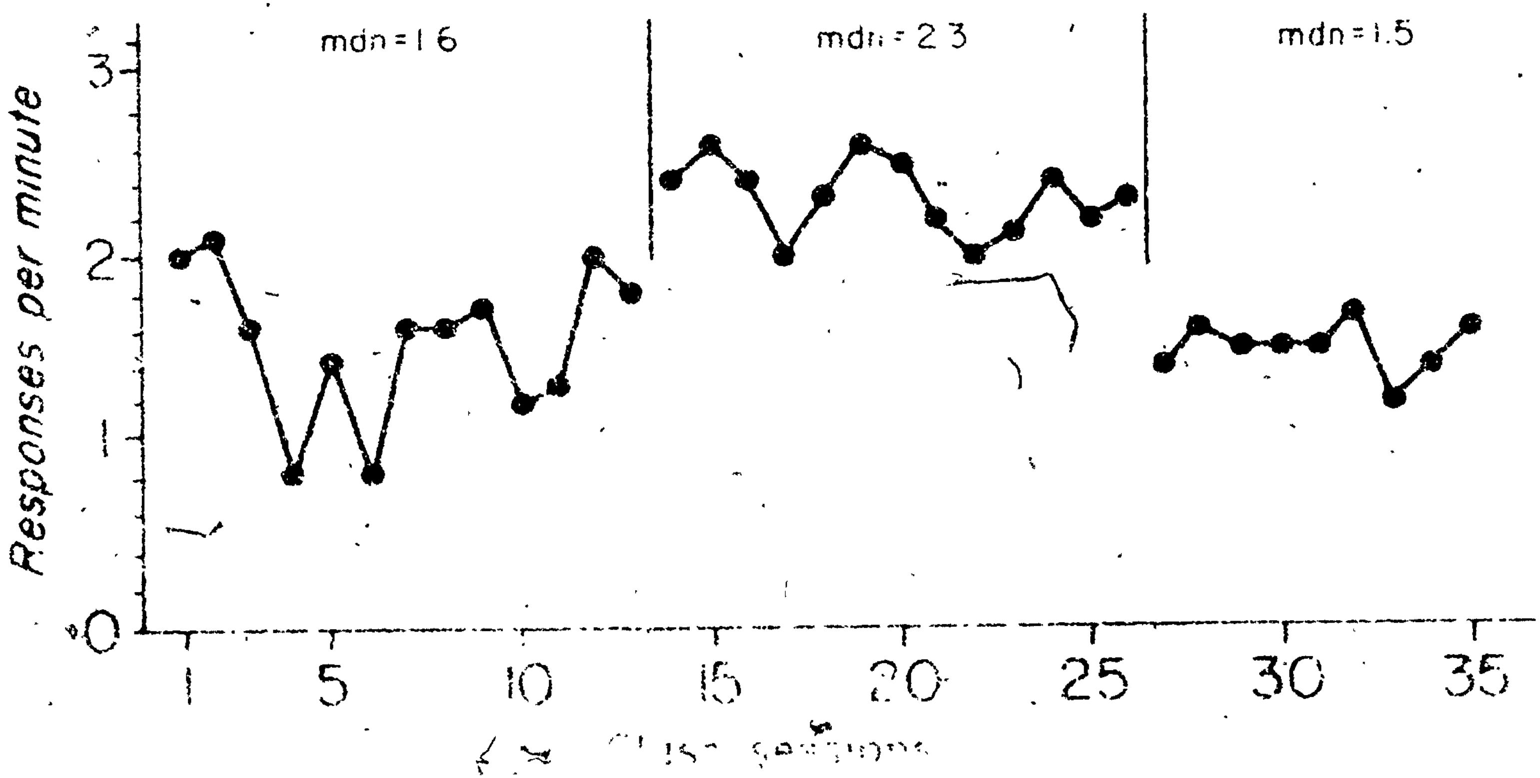




0
4
8
12
16
20
Baseline
Correct next day
No correct
Correct next day
201
76
290
15
322
51
315
18
1000
500
100
50
10
5
1
5
05
01
005
001
SYMBOLS PER MINUTE
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
SUCCESSIVE CALENDAR DAYS

Experiment II

Teacher vs. self-contingencies



ROUND ONE--PLACING THE CHILD IN THE RIGHT READER

Thomas C. Lovitt and Cheryl L. Hansen

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ABSTRACT

A method for placing children in readers was devised and implemented which combined aspects of the Informal Reading Inventory with techniques developed by applied behavior analysts. Using this method three reading behaviors of pupils were measured directly and frequently: correct oral reading rate, incorrect oral reading rate, and correct comprehension percentage. Seven intermediate age boys with reading problems read and answered questions from books D through K of the Lippincott series. They read five 100-word segments from each reader and answered six comprehension questions from each segment.

Each student was placed in a reader based on his three performance scores during this period. The effectiveness of the placement method was judged in terms of how well it predicted subsequent reading performance in the students' instructional readers.

Two major findings resulted from this study. First, although oral reading rates and comprehension scores generally worsened as the grade level of the material increased, the performance differences between adjacent books were minimal. Correct rate was more sensitive than either incorrect rate or comprehension percentage to changes in grade level. Second, after placement in the readers, all the students progressed satisfactorily throughout the remainder of the year.

ROUND ONE--PLACING THE CHILD IN THE RIGHT READER[1]

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The first concern of the teacher of reading is to place her students in readers. Once an interesting and motivating series of books has been chosen, on whatever basis, each pupil must be assigned to a specific book in that series that will assist him to become a competent reader. The pupil should neither be placed in a reader that is too easy nor in one that is too difficult. Although most teachers agree with this concept, there is little agreement as to how pupils should be placed in readers that are, for them, "just right."

Currently, there appear to be four methods for placing children in reading texts. Some teachers place children on the basis of chronological age or grade. Others use achievement tests, publishers' basal reader tests, or Informal Reading Inventories (IRI).

The most casual method for placing children is to assign them texts which correspond to their chronological ages or grades. According to this approach, if a child is eight or nine years old and in the third grade, he would be placed in a third grade reader. This placement method has the least to recommend it; for ability is often unrelated to either age or grade.

A second placement method is to assign pupils to certain texts because of their achievement test scores. The problem with using this approach is that achievement test scores are often indirectly related to the performance of pupils in the classroom; and furthermore, achievement test scores are infrequently gathered (Lovitt & Eaton, 1974). Indirect refers to the fact that a pupil might be expected to respond to an item of one type on an achievement test, e.g., answer a certain type of comprehension question, but is required to do something quite different in the classroom, e.g., read orally. Infrequent simply refers to the fact that achievement tests are given only once or twice a year. The problem with such a strategy is that single impressions of performance often misrepresent a person's "true" ability.

A third method for placement is to use the reading placement test which accompanies certain basal reading series. These reading tests, although quick to administer and directly related to the material used during subsequent instruction, are generally given only once. As we mentioned, one test score, whether it is from a direct or an indirect test, does not always reveal the true ability of an individual.

A fourth approach used to place children in readers is the Informal Reading Inventory or IRI (this technique was first recommended by Betts in 1946). When the IRI method is used, a pupil is required to read orally or silently from a series of reading passages arranged in order of difficulty: pre-primer, primer, first reader (1^1), 1^2, 2^1. Ordinarily, two reading skills are assessed at several levels: word recognition and comprehension. The pupil's percentage scores for those tasks across the levels are calculated and compared to normative scores. The pupil's scores for each reading component across levels are then transformed to one of three competency levels: independent, instructional, or frustrational. The pupil is then placed in a book where his scores indicated the "instructional level."

From the point of view of the applied behavior analyst, the IRI placement method has much to recommend it. When an IRI is used, the pupil's performance is directly measured, for the reading material is the same throughout testing and instruction. However, as is the case when achievement tests or publishers' tests are used for placement, generally only one reading sample from each level is obtained when the IRI procedure is used. As mentioned earlier, when only one sample of a person's performance is obtained, a distorted impression of his ability could be presented, hence a pupil could be inappropriately placed.

In the present study, a reading placement method was devised and implemented which combined some aspects of the IRI (direct measurement across many levels) with the techniques developed by applied behavior analysts (direct and frequent measurement). Using this approach, three reading behaviors were measured for several days from several levels of the reading series that was ultimately used for instruction. It was our intent to place children in the highest reader possible--a level where they would be motivated but not frustrated. Further, it was our intent to place children in readers on the basis of their performance.

METHOD

Subjects

The pupils in this study were seven boys between the ages of 8 and 11. They attended the Curriculum Research Classroom, Experimental Education Unit, University of Washington.

The boys were referred to this class by a suburban, upper-middle class school district near Seattle because of learning disabilities. At the time of referral the students were from one to three years behind their peers in reading, math, and spelling. All of them had, at one time or another, received remedial reading instruction.

Our goal for the students, during their one year's residence at the Curriculum Research Classroom, was to alter their competencies in the basic skill subjects which included reading and comprehension, to the extent they were at grade level. The study was conducted during late September and early October, 1973.

Material Selection and Preparation

The Lippincott reading series (McCracken & Walcutt, 1970) was used for reading placement and instruction. The Lippincott series utilizes a lettering system to denote grade levels. Book D is the first grade reader, Books E and F are second grade readers, Books G and H are third grade readers, and Books I, J, and K are fourth, fifth, and sixth grade readers.

Five samples of oral reading and comprehension were collected from each reading level. Each student read five 100-word segments (the first 500 words) from the first story from seven of the eight reading levels. In the G reader, the pupils read the first 500 words of the second story because it was believed the first story, "Hansel and Gretel," was too well known to the students, and because of this, their performance could be affected.

Six comprehension questions per each 100-word segment were written. These questions pertained to four aspects of comprehension: recall, sequence, interpretation, and vocabulary. Recall questions dealt with facts from the story; for example, "Where did Danny Morgan live?" Sequence questions pertained to the temporal ordering of events; for example, "What did Danny want to do after he and his father rode to Lookout Point?" Interpretation questions included synthesis, inference, translation, and application processes; for example, "Why didn't Brick Morgan like the Indians?" For the vocabulary aspect of comprehension, the students were told a word and were then asked to select a synonym for that word from a choice of four other words. The first three types of comprehension were assessed from levels D through H. All four types of comprehension were measured from Books I through K.

Daily Procedures

Reading placement was carried out on an individual basis in a small room adjacent to the main classroom. At the beginning of the study, each student was told he would be asked to read orally and answer questions from several books in order to determine which reading level was best suited for him. He was asked to try his best as he read the various selections and not to worry if some passages were difficult. Each student spent about 15 minutes reading per day over a period of two weeks.

The order in which the pupils read the books varied each day. On the first day of placement a student read the first 100 words and answered comprehension questions from the following four readers: D, F, H, and J. On the next day he was assigned the first 100 words from Books K, I, G, and E. Different arrangements were used the other days. Generally, four to six segments were read each day, until all 40 segments had been read.

During the oral reading session the teacher tallied the number of correctly and incorrectly read words. Incorrectly read words included omissions, substitutions, additions, mispronunciations, and hesitations longer than four seconds. Proper names and places, repetitions, and self-corrections were not counted as incorrect responses. If the student could not pronounce a word or mis-read a word he was told that word and encouraged to continue reading. Comprehension was checked after each 100-word segment was read. The teacher read the questions and the student answered them orally.

Following each reading session the teacher calculated three pieces of data from each segment: oral correct words per minute (wpm), oral incorrect wpm, and percentage of correctly answered comprehension questions. The first two figures were obtained by totaling the number of correctly and incorrectly read words from each segment. The third figure was obtained by dividing the number of correctly answered questions from each segment by the total (6).

EVALUATION

In order to make a placement decision for each child, mean correct and incorrect oral reading rates, and average percent correct comprehension scores for each reader were computed. The mean correct rates per level for each student are indicated in Figure 1. An examination of these data revealed that, in general, an inverse relationship existed between correct rate and grade level. In 76% of the cases, as grade level increased, correct rate decreased. All students had higher correct rates in Book D than in Book K. On the average, their correct rates were 27 wpm higher in Book D than in Book K. In Book D, the group average was 58.3 wpm, whereas the group average in Book K was 31.3 wpm.

Insert Figure 1 About Here

An analysis of the mean incorrect rates of the students generally revealed a positive relationship between incorrect rate and grade level. In 53% of the cases, as grade level increased, mean incorrect rates increased. Figure 1 shows the mean incorrect rates for each student at each reading level. All of the students had lower incorrect rates in Book D (mean = 5.4 wpm) than in Book K (mean = 6.9 wpm). On the average, incorrectly read words increased 1.5 wpm between Book D and Book K.

The comprehension scores of the students was to some extent affected by the grade level of the materials. Figure 2 indicates the mean percent comprehension scores in Books D through K for each student. In 51% of the cases, an inverse relationship existed between comprehension and grade level. The average comprehension score was 30.3% higher in Book D than in Book K. The average comprehension score in Book D was 94.6%, and the group average in Book K was 64.3%.

Insert Figure 2 About Here

In summary, the abilities of most pupils to read orally and comprehend were adversely influenced as grade level increased. This performance decrement from one level to the next was most obvious when correct reading rate was considered. As grade level increased, correct rate decreased 76% of the time, incorrect rate rose in 53% of the instances, and correct comprehension percentage fell 51% of the time.

Although the ability to read lessened as grade level increased, the decrement between adjacent reading levels was often slight. In over 50% of the instances, the differences between the correct rate, incorrect rate, and comprehension means of adjacent reading levels was less than five correct wpm, one incorrect wpm, and 5% comprehension.

PLACEMENT

After an examination of the previous year's reading data and the progress made by those seven students, we determined the guidelines for placing the current group of children. We decided to place a student in the highest level reader in which his average correct rate was between 45-65 wpm, his average incorrect rate between 4-8 wpm, and his average comprehension score between 50-75%.

Our initial consideration for placement was the pupil's average correct rate. We next studied his mean incorrect rate, then his average comprehension score. Using this approach, the mean correct rate for the seven boys in their assigned readers was 48.0 wpm (range from 45.5 to 53.4 wpm). The median incorrect rate for the group was 4.9 wpm (range from 3.1 to 7.0 wpm). With one exception, the incorrect rates of the boys in their instructional readers were within the desired limits.

In certain instances we were unable to use our comprehension criteria because the level of comprehension exhibited by the students was often higher than 75%. The mean comprehension score for the boys in their assigned readers was 86.7% (range from 55 to 95.8%).

Utilizing these placement criteria, the students began their instruction in various Lippincott readers. One student began in each of Books D, E, H, and I. Three students were placed in the F reader.

Figure 3 shows the placement data for one pupil. In the top graph are his oral correct and incorrect rates for the eight readers. In the bottom graph are his percentage scores for answering comprehension questions. Using our placement criterion, this boy was placed in Book D.

Insert Figure 3 About Here

EFFECTIVENESS OF PLACEMENT METHOD

The effectiveness of our placement method was determined in two ways. One method was to compare the pupil's performance in his assigned book during placement with his performance in that same book when he read from it during the instructional period. If the placement procedure was reliable, then little difference in performance would be noted between the placement period and the baseline condition (the first condition of the instructional period).

After the instructional reader for a student was identified, he began reading and answering questions from only that book. Each day he read 500 words and responded, in writing, to 20 or 30 comprehension questions, depending on the level of the assigned reader. During the first seven days of the instructional period, baseline procedures were in effect.

When the data from the placement period and the baseline condition of the instructional period were compared, we discovered that the correct rates of five students were lower during the baseline condition. Although the group difference between placement and baseline was only -1.6 wpm, the individual difference between the means ranged from -8.2 to +11.3 wpm. All the students had lower incorrect rates during baseline than during placement. The students had an average of -1.9 incorrect wpm less during baseline (range from -3.1 to -2.9 wpm). These correct and incorrect rate differences could be attributed to the fact that the pupils read from four to five 100-word segments each day during placement and from one 500-word segment during baseline.

Six of the seven students had lower average comprehension scores during baseline. The average comprehension score for the group was reduced 15%: from 81.5% during placement to 66.9% during baseline. These comprehension percentage differences may be attributed to one or two variables. During placement, the students responded to six questions from four or five reading segments. During baseline they answered from 20 to 30 questions from one reading segment. Furthermore, during placement the pupils responded orally to questions that were read to them, whereas during baseline they read the questions and wrote the answers.

In summary, the correct and incorrect rates and the comprehension scores were generally higher during placement than during baseline. Although the correct and incorrect rate differences were slight, the comprehension score differences between the two periods were rather significant.

A second way in which we evaluated the effectiveness of the placement program was to assess the progress of the students throughout the year, once reading instruction began. If the students were appropriately placed, their reading scores should improve throughout the year. When the data from our students were analyzed it was apparent that all seven students had progressed throughout the quarter. Although one student did not initially experience success in his originally-assigned reader, his reading improved when he was changed from Book I to Book H. It should be mentioned that the pupil requested the change.

After one quarter of instruction, the correct rates for all seven students had increased from their baseline rates. These increases ranged from +6.5 to +14.2 wpm. The average incorrect rates for four students decreased from baseline to end of the quarter. The ranges for the students were from -1.1 to +.5 wpm. The average comprehension percentage scores increased for all students, ranging from +6.2 to +19.3%. In summary, the students thrived after being placed in their readers.

DISCUSSION

The method used for placement described here has much to recommend it. For one thing, since the pupils in this study improved in reading throughout the year, we can assume they were appropriately placed. It should also be mentioned that throughout the year rather mild instructional techniques were used; progress was not the result of unusual or expensive teaching practices.

A second important aspect of this placement method is its generalizability. Although the Lippincott series was used in this report, the same procedures could be used with any basal series or, for that matter, with any collection of books. In this study three reading behaviors were measured that dealt with oral reading and comprehension. This same procedure for placement could be used with other reading behaviors. If, for example, a teacher wanted to place children in readers on the basis of their silent reading rates and their abilities to describe freely the events of a story, those aspects could be measured from several books for a number of days.

The method used here could certainly be improved and perhaps simplified. One improvement would be to use the same procedures during placement and instruction for assessing comprehension performance.

Our placement method could perhaps be simplified. We had the students read five times from each level. Although we strongly support the notion of frequent measurement, perhaps three or four measures would provide data as reliable as ours. Another modification could involve the selection of the reading segments. We had the pupils read from only the beginning of each book. Others could require pupils to read from various parts of the books.

These modifications notwithstanding, the method described here, which featured direct and frequent measurement, is assuredly a more reliable placement method than most of the others now in use. When the direct and frequent method is used the pupils, in effect, place themselves. They are placed in readers based on their performances not because of their ages, grades, or scores from indirectly or infrequently administered tests.

Using this method the pupil's chances for winning the important round one of the reading battle are increased. Furthermore, when direct and frequent procedures continue to be used for reading instruction, the likelihood is great that the pupil will remain in the ring for 15 rounds and emerge victorious.

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FOOTNOTES

[1]This research was supported in part by a National Institute of Education grant #OEG-0-70-3916(607), Project #572247.

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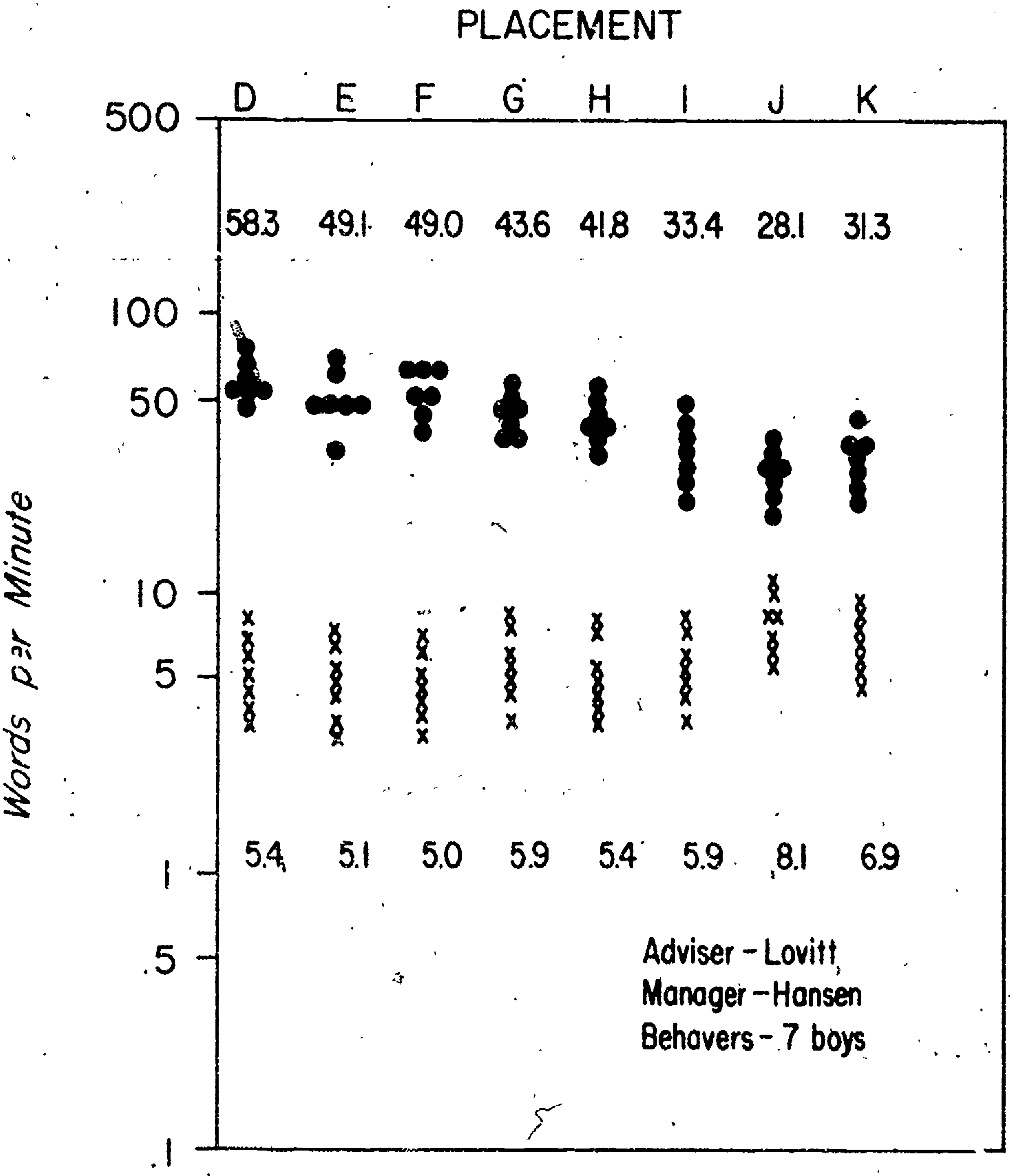
[3]Cheryl L. Hansen is the Head Teacher of the Curriculum Research Classroom, Experimental Education Unit, Child Development and Mental Retardation Center, University of Washington.

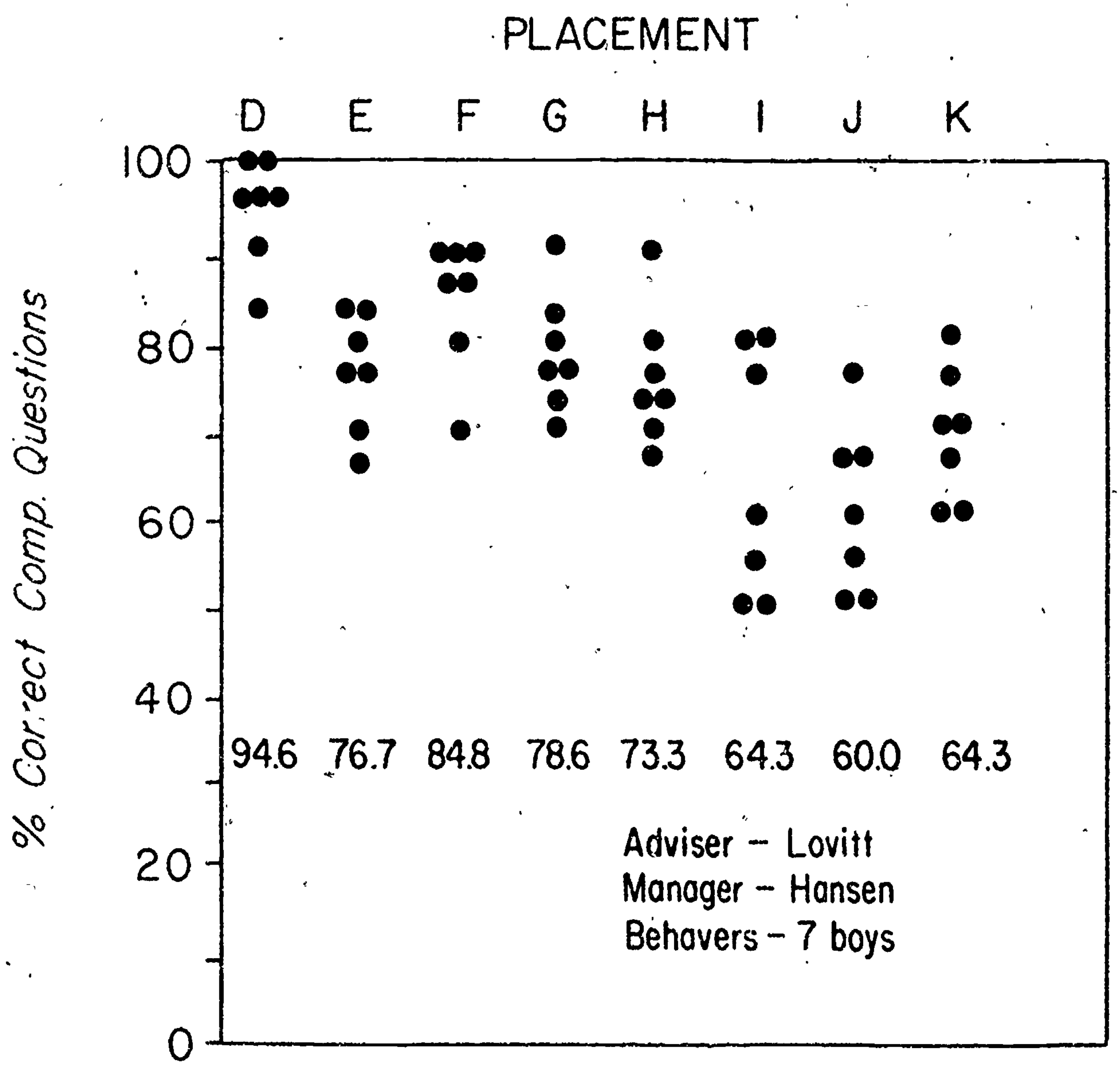
FIGURE CAPTIONS

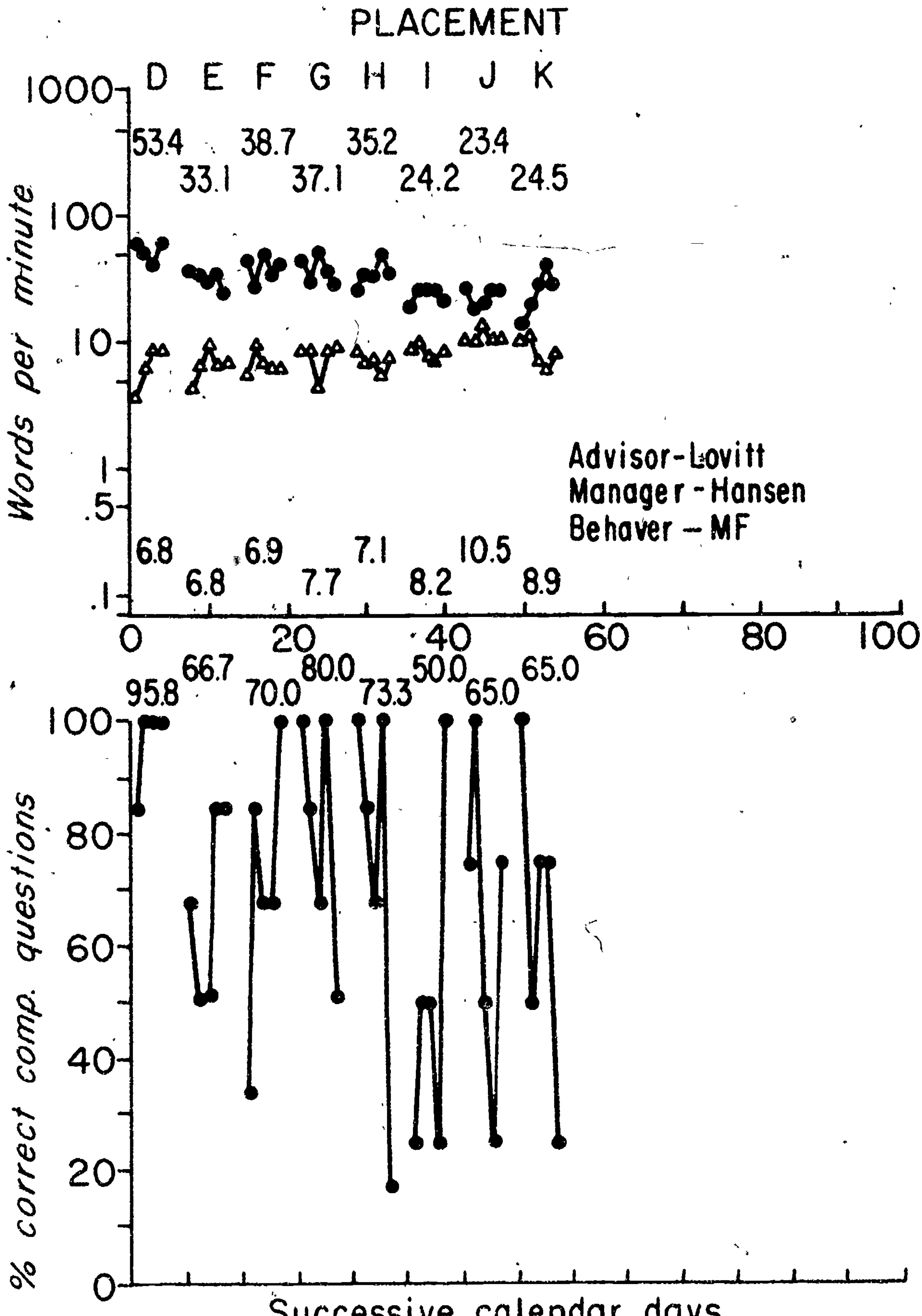
Figure 1. Each pupil's average correct and incorrect rates for eight Lippincott readers are shown. The numerals above the correct rates and below the incorrect rates are the mean of the means.

Figure 2. Each pupil's average comprehension percentages for eight Lippincott readers are shown. The numerals below each collection of scores are the mean of the means.

Figure 3. The top graph shows MF's daily correct and incorrect rates from eight Lippincott readers. The numerals above the correct rates and below the incorrect rates are means for each book. The bottom graph shows the daily comprehension percentages and means for the Lippincott readers.


PLACEMENT
D E F G H I J K
500
100
50
10
5
1
.5
.1
Words per Minute
58.3 49.1 49.0 43.6 41.8 33.4 28.1 31.3
5.4 5.1 5.0 5.9 5.4 5.9 8.1 6.9
Adviser - Lovitt
Manager - Hansen
Behavers - 7 boys


PLACEMENT
D E F G H I J K
100
80
60
40
20
0
% Correct Comp. Questions
94.6 76.7 84.8 78.6 73.3 64.3 60.0 64.3
Adviser – Lovitt
Manager – Hansen
Behavers – 7 boys



PLACEMENT
D E F G H I J K
53.4 38.7 35.2 23.4
33.1 37.1 24.2 24.5
6.8 6.9 7.1 10.5
6.8 7.7 8.2 8.9
Words per minute
1000
100
10
1
.5
.1
0 20 40 60 80 100
Advisor-Lovitt
Manager-Hansen
Behaver – MF
95.8 66.7 70.0 80.0 73.3 50.0 65.0 65.0
% correct comp. questions
100
80
60
40
20
0
Successive calendar days

THE USE OF CONTINGENT SKIPPING AND DRILLING TO IMPROVE ORAL READING AND COMPREHENSION

Thomas C. Lovitt and Cheryl L. Hansen

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ABSTRACT

In this study three reading behaviors were measured for several days: oral correct and incorrect rates and correct percentage for answering comprehension questions. Throughout a baseline phase neither an instructional nor a reinforcement technique was scheduled. During the second condition of the study, contingent skipping and drilling were involved. If, during this phase, a pupil's oral reading rates and comprehension score exceeded criterion levels, he was allowed to skip several stories in his assigned reader. If, however, he did not skip for several consecutive days, drilling procedures were arranged. Following this intervention period baseline conditions were reinstated. The data indicated that from first to second condition every student's reading improved in respect to correct rate and comprehension accuracy. The incorrect rate performances of four students also improved. When the intervention was removed, during the third phase, the performances of most students maintained. The average rates and comprehension percentages were, in fact, better during this condition than they were in the second condition. Subsequent studies were conducted in an effort to determine the effects of either component of the intervention, skipping or drilling. Only tentative remarks were made in this regard. Recommendations to teachers of reading are offered based on the results of this study.

THE USE OF CONTINGENT SKIPPING AND DRILLING TO IMPROVE ORAL READING AND COMPREHENSION[1]

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University of Washington

Once students are ready to read contextual material the first problem for the teacher of reading is one of placement. The teacher must place children in readers in order that they may, in time, become competent insofar as decoding and comprehending written symbols. In order to increase the probability that pupils will, in fact, learn to read, they must be placed in readers that are, for them, "just right," neither too easy nor too difficult. Pupils must be challenged to progress, but should not be frustrated by material that is too difficult.

Recently, we (Lovitt & Hansen, 1974) designed a procedure whereby children were placed in readers on the basis of their performance. Direct and daily measurement techniques were used, thus enabling us to place children in certain readers on the basis of their decoding and comprehending abilities.

Another major concern of teachers of reading is one of advancement. Once children have been placed in readers and instruction has begun, how should they proceed through the readers?

As is true of placement, several strategies are used by teachers to advance pupils through readers and from one reader to another. Back in the olden days when I "taught," I used a method for advancing pupils from one story to the next that is, I believe, still used by some teachers. I assigned all the pupils to various reading groups: jaguars, cougars, wolverines. The children in those groups took turns reading the same story; one child read a couple of paragraphs, the next child a few more, and so on until the story was completed. We then talked about the story. The next day a new story was assigned.

Since that time some reports have been published that describe methods for advancing pupils through stories and readers on the basis of pupil performance. Gormly and Nittoli (1971), for example, described a process whereby students were allowed to advance from one reading level to another if their comprehension scores for several stories were greater than 70%. Starlin (1970), in a doctoral dissertation, suggested that pupils should be advanced from one reading level to another when their correct oral reading rates were above 100 words per minute (wpm) and their incorrect rates were less than 2 wpm.

In our study we have combined the advancement criterion of those two reports. We allowed pupils to proceed from one section of a book to another on the basis of their comprehension scores and their oral reading rates. In fact, we allowed the pupils to skip several stories in their readers if, on the same day, their three scores--oral correct rate, oral incorrect rate, and comprehension percentage--were better than criterion levels.

In this study we also incorporated a provision for those pupils whose scores remained low, and they did not skip. For those pupils, drill techniques were scheduled.

Whether the pupils skipped material or were drilled, those features were contingent on their performance. Pupils were allowed to skip only when their reading abilities exceeded established levels, and were provided drill only when their reading abilities were inferior to the established levels.

METHOD

Subjects and Setting

The subjects for this research were seven boys, ages 8-12. They were categorized as learning disabled by their school district, and also, according to them, the boys were from one to three years retarded in reading.

The setting for the research was the Curriculum Research Classroom, Experimental Education Unit, University of Washington. The purpose of this classroom is to conduct educational research with elementary age children.

Materials

The Lippincott Basal Reading series (McCracken & Walcutt, 1970) was used during this project. Each reader in the series was divided into four sections (poetry and plays were excluded). The stories in each section were then divided into 500-word segments. In those stories where the last segment was over 225 words, that much was considered a separate segment. If the last segment was less than 225 words, those words were combined with the preceding 500-word segment.

The reason the books were divided into quarters will be explained later. The reason for subdividing the quarters into 500-word segments is that each day the pupils were required to read the same amount of material. It was necessary for the pupils to read the same amount of material each day in order that they could respond to an equal number of comprehension questions daily.

Comprehension questions were written for each 500-word segment. These questions were of four different types: recall, sequence, interpretation, and vocabulary. From the first- to third-grade readers, 10 recall, 10 sequence, and 10 interpretation questions were written. From the fourth- to sixth-grade readers, 5 recall, 5 sequence, 5 interpretation, and 5 vocabulary questions were written. Recall, sequence, and interpretation questions required short, written responses. A multiple choice format was used for the vocabulary questions.

Reliability

For oral reading, reliability checks were obtained an average of six times for each pupil. In order to conduct these checks certain oral reading sessions were tape recorded. A second teacher then listened to the tapes and counted correctly and incorrectly read words. Reliability was calculated by dividing the number of agreements between the two teachers by the number of disagreements plus agreements. This figure was then multiplied by 100. The average correct and incorrect rate reliability calculations were 98.8%.

Agreement for scoring answers to comprehension questions was determined by having a second teacher check a sample of 15 assignments for each pupil. The formula for calculating or. reading reliability was used. The average reliability for scoring comprehension answers was 99.6%.

Placement Procedures

The instructional reading level for each student was determined by using a systematic informal reading inventory (Lovitt and Hansen, 1974). Each student orally read five 100-word segments from all Lippincott readers between levels D and K (grades one through six). They also responded to comprehension questions from all these readers.

After these data were collected, the mean oral correct and incorrect rates, and mean correct percentage scores for answering comprehension questions, were calculated for each reader. Three scores, then, were calculated for all the pupils from the eight readers. These data were then used to place the pupils. Each pupil was placed in the highest reader in which his average oral correct rate was between 45-65 wpm, his oral incorrect rate was between 4-8 wpm, and his average correct comprehension percentage was between 50-75%. Using these criteria, one student was placed in Book D (1^2), one in Book E (2^1), three in Book F (2^2), and two in Book H (3^2).

Interventions

In this study there were two interventions, skipping and drilling. Both were arranged contingent on pupil performance.

Skipping. After a seven-day baseline, average correct and incorrect oral reading rates and average percent correct comprehension scores were calculated for each student. Desired performance levels were then calculated for the intervention phase based on these scores. Desired performance levels were defined as 25% improvement. For example, if, during the baseline, a pupil's average correct rate was 60 wpm, his average incorrect rate was 6 wpm, and his average correct comprehension percentage was 70, the desired scores for those corresponding behaviors throughout the intervention phase would be 75 wpm, 4.5 wpm, and 87.5%. This 25% improvement rule was used until the desired levels exceeded proficiency limits. Proficiency in oral reading was defined as 100 correctly read wpm or better, and 2.5 incorrectly read wpm or better. Our proficiency requirement for comprehension was 90% or better.

When the skipping provision was in effect the pupils were informed that they could skip all the remaining stories in a quarter of the book if, on the same day, all their scores equalled or exceeded the criterion scores. If our example boy's oral reading rates were better than 75 and 4.5 wpm, and his comprehension score was better than 87.5%, he would be allowed to skip the remaining material in the section he was assigned to read.

Drilling. Three types of drill were used, one for each measured behavior: oral correct rate, oral incorrect rate, and comprehension percentage. For the correct rate drill, a student was required to read the last 100 words from the previous day's assignment. He continued reading that passage until he could complete it at his criterion level.

When the incorrect rate drill was used, the teacher showed the pupil a list of the words he had mis-read during the reading session. These words were embedded in phrases from his reader. The student was required to rehearse that list of phrases until he could read all of them correctly to the teacher.

For the comprehension drill the pupil's answer sheet was returned to him with the incorrect responses checked. The pupil was then required to rework his answers until they were all correct.

PROCEDURES

As described earlier, each reader was divided into four parts. Before a pupil read from each part he was given an opportunity to skim through all the stories in that group. He then told the teacher the order which he preferred to read the stories. The reason for ordering the stories on the basis of preference was because during parts of the study pupi's could skip some stories if their performance surpassed a certain level. If some of their more preferred stories appeared at the end of a section, a pupil might want to read those stories and would, therefore, either hold back his efforts to avoid skipping, or would be disappointed if he did skip.

Throughout this study the students read 500 words orally each day. The only exceptions to this were those instances where the last segment of the story was less than 500 words. As was explained earlier, if this segment was less than 225 words, it was added to a 500-word segment; if more than 225, that amount constituted the assignment for that day.

The oral reading sessions were conducted in a small room off the main classroom. As the child read, if he mispronounced or was unable to pronounce a word, he was told that word. During the oral reading sessions the teacher counted each correct and incorrect response. Incorrect responses consisted of substitutions, omissions, additions, and hesitations of longer than four seconds. Throughout the study the children were intermittently praised for fluent and accurate reading.

When the oral reading session was completed the student was given a sheet of comprehension questions and asked to go to his desk and complete the assignment. A student could ask for help in reading the comprehension questions, but he could not refer to his reader to assist in answering the questions. The answers to the comprehension questions were checked by the teacher and the pupil was informed which ones he had incorrectly answered.

Data were kept pertaining to oral correct and incorrect rates and percentage of correctly answered comprehension questions. In oral reading, the data reported here were from the first two minutes, not from the time required to complete the total 500-word segment. The correct and incorrect rate data were obtained by dividing the number of correct responses by two, and the number of incorrect responses by two. In order to calculate the correct percentage for answering comprehension questions, the number assigned was divided by the number correctly answered, and multiplied by 100. The pupils who answered questions from books one through three were assigned 30 questions each day, whereas the pupils who read from books four through six received 20 questions daily.

Baseline[1]

This condition ran for seven days. The circumstances described above prevailed. No additional feedback, instruction, or reinforcement techniques were scheduled. At the end of this condition the 25% improvement scores were calculated.

Skip and Drill

Throughout this condition, which ran an average of 20 days, contingent skipping and drilling were arranged. As explained earlier, if, on the same day, a pupil's three scores were equal to or better than the desired scores, he could skip the remaining stories from a quarter of a book.

If a pupil went seven days without skipping, drill procedures were instituted. He received drill, however, on only those aspects of reading that were below the desired scores. A student could receive drill on any one component, any two, or for all three. The various types of drill were scheduled shortly after the reading session. Drill procedures were in effect only until a pupil skipped a section. When a pupil skipped, another seven days had to elapse before drill was again scheduled.

Baseline[2]

Skipping and drilling were not arranged throughout this condition. The circumstances were identical to those in effect throughout Baseline[1].

RESULTS

Baseline[1]

Throughout this condition the average oral correct and incorrect rates were 50.7 and 3.1 wpm. The average comprehension score was 65.9%. The ranges of these rates were from 39.0 to 65.8 wpm, from 2.1 to 3.9 wpm, and from 55.2 to 78.3%. Had the skipping provision been in effect during this phase, there would have been an average of .02 skips per day (total skips divided by total days of pupils in the condition). Table 1 is included to show the average oral correct and incorrect rates and average correct comprehension percentages for the pupils for the three conditions of the study.

Insert Table 4 About Here

Skip and Drill

During this condition the average and range of the correct and incorrect oral reading scores were 60.0 wpm (range from 47.7 to 72.9 wpm) and 2.9 wpm (range from 1.7 to 4.0 wpm). When these data were compared to the baseline scores it was apparent that the correct rates for all students improved and the incorrect rates for four students improved. The mean correct rate improvement was 9.3 wpm (range from 2.4 to 15.3 wpm), and the mean incorrect rate improvement was .2 wpm (range from +.5 to -.9 wpm).

Meanwhile, the average comprehension score during this phase was 77.8% (range from 63.4 to 84.9%). The comprehension scores of all the pupils improved throughout this condition. The average improvement was 11.9% (range from 5.7 to 16.1%).

Throughout this condition 33 skips were made, an average of .24 per day. The students spent an average of 4.7 days per section before skipping (range from 2.2 to 12); 42 % of the skips occurred on the first day of a section. On the average, when drill was instituted, 2.6 days elapsed before a pupil skipped.

Baseline[2]

When the skip and drill intervention was removed, the performance of the pupils generally maintained. In some instances performance actually improved.

Throughout this condition the average oral correct rate was 62.2 wpm with a range of 54.3 to 79.8 wpm. The average incorrect rate and range were 2.7 wpm, from 2.1 to 3.3 wpm. When these data were compared to the intervention phase, it was apparent that the correct rates of four students improved and the incorrect rates of four students improved.

The average comprehension percentage and range scores during this phase were 80.2%, from 71.0 to 89.7%. When these data were compared to those of the preceding phase, it was noted that five students improved. Had the skipping provision been in effect during this condition the number of skips per day would have been .16.

Figure 1 is included to show the daily oral reading and comprehension data from one pupil. All three aspects of this pupil's performance were influenced by the skipping and drilling interventions.

Insert Figure 1 About Here

DISCUSSION

The data indicated that the intervention--skipping and drilling--was effective for all the pupils in this study. From these data, however, we were unable to determine whether skipping or drilling, or the combination of the techniques, was responsible for the gains.

There is some possibility that the drill procedure alone could have been largely responsible for the improvements. Although our drill procedures were neither new nor different, they were related directly to specific reading problems and were contingently arranged. If, after seven days, for example, a pupil's correct rate was not fast enough, he received a correct rate drill. Similarly, if his oral incorrect rates were too high or his comprehension percentages were too low, he received drill for those features. It has been our experience that when simple instructional techniques are designed for specific problems and contingently arranged, improvement is immediate and significant.

Another possible explanation for the improvement of some pupils could be the threat of drill. For some students, drill could have been perceived as a punishing event, hence they sought to avoid it.

It is also possible that the improvement of the pupils was due mostly to the skipping feature. The pupils in this study were, at the beginning of the year, reading from one to three years below grade level. All of them knew the level at which they were assigned and the level at which they should be reading (in spite of the coding systems used by various reading series). They also knew that most of their friends were reading from more advanced books than they were. It is quite possible, then, that being able to skip through books and approach or reach grade level was very reinforcing for these boys.

During the next two academic quarters we conducted studies designed to sort out some of the specific effects of skipping and drilling. In the winter quarter we formed three "groups" of subjects. Following a baseline phase, three students were assigned to a skip-and-drill condition, just like the one in the experiment just described. Meanwhile, two students, following a baseline, were placed in a drill-only condition; and two other students were placed in a skip-only condition.

When these results were analyzed in regard to correct rate, it was revealed that the skip-and-drill and the skip-only groups gained more than the drill-only group. Both groups gained, on the average, 7.8 wpm. When incorrect rate improvement was studied, the skip-and-drill and skip-only groups faired the best. Average incorrect rates for both groups were lowered .1 wpm. When comprehension improvement was analyzed, the drill-only group showed the most improvement. The average gain for that group was 8.6%

During the spring quarter, two students who had been in the skip-and-drill condition during the winter quarter, continued in this condition. When these students' performances at the end of the spring quarter were compared to their efforts during the winter quarter, it was found that both their correct rates increased (2.9 and 3.9 wpm). The incorrect rate of one boy increased (.1 wpm), while for the other it decreased (.6 wpm). Both boys' comprehension scores increased (10.6 and 1.2%).

Although we ran these two additional studies we were still unable to make definitive statements as to the relative merits of the two procedures since too few subjects were involved. However, the opportunity to skip, of itself, did appear to be reinforcing. In the major study we described, the drill procedures were never used for some students. In fact, 70% of all skips occurred without the necessity of drilling.

Throughout the year every student improved in every respect. The average correct rate gain was 32.9 wpm from beginning to end of the year. The average incorrect rate improvement was 3.3 wpm; and the average percentage comprehension score gain was 18%. In addition, all the pupils were reading at grade level at the end of the year. They had, throughout the year, gained an average of 1.9 grade levels (range from 1.0 to 2.5). Furthermore, the students attained grade level in an average of 15.7 weeks. Teachers of reading should be encouraged by the fact that in spite of the short amount of time devoted to reading (average 25 minutes per student per day), all the students improved.

This procedure for teaching reading has several other features which should be considered by teachers. First, the idea of having pupils read about 500 words each day and answer several comprehension questions should be considered. By so doing, the teacher can measure progress in two important elements of reading.

A second matter for teachers to consider pertains to the interventions that were used. In this study, neither expensive nor time-consuming aching techniques or reinforcement systems were used. The drill procedures were very common; teachers have used those same techniques for years. The manner in which the drill procedures were used in this study was, however, somewhat unique. Drill was not scheduled every day, it was arranged only if a pupil's performance fell below a certain level.

As to the reinforcement technique, only a skipping provision was arranged. The teacher did not resort to an elaborate motivational system such as a token economy that could have required additional costs or personnel.

A third, and perhaps the most important feature of this study for teachers to consider was the manner in which pupils were advanced from one part of a book to another. In this study a student skipped from one quarter of a book to another only if his oral reading and comprehension scores were adequate. This same approach could be used for advancing pupils from one story to the next (if skipping is not desired), or from one reader to another. The significance of the approach is that advancement from one level to another is based on pupil performance, not on time, or that others in the group have passed, or other irrelevant factors. The method for advancement described here and the method used for placing students that was referred to should be seriously considered by teachers who want to individualize reading instruction.

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FIGURE CAPTIONS

Figure 1. The top graph shows the daily correct and incorrect oral reading rates for MF throughout the three phases of the study. The bottom graph shows his daily comprehension scores. The average rates and scores for the three conditions are included. The reason some data plots are not conne-ted is that data were not obtainea on some days (weekends, absences, field trips).

FOOTNOTES

[1]This research was supported in part by a National Institute of Education grant #OEG-0-70-3916(607), Project #572247.

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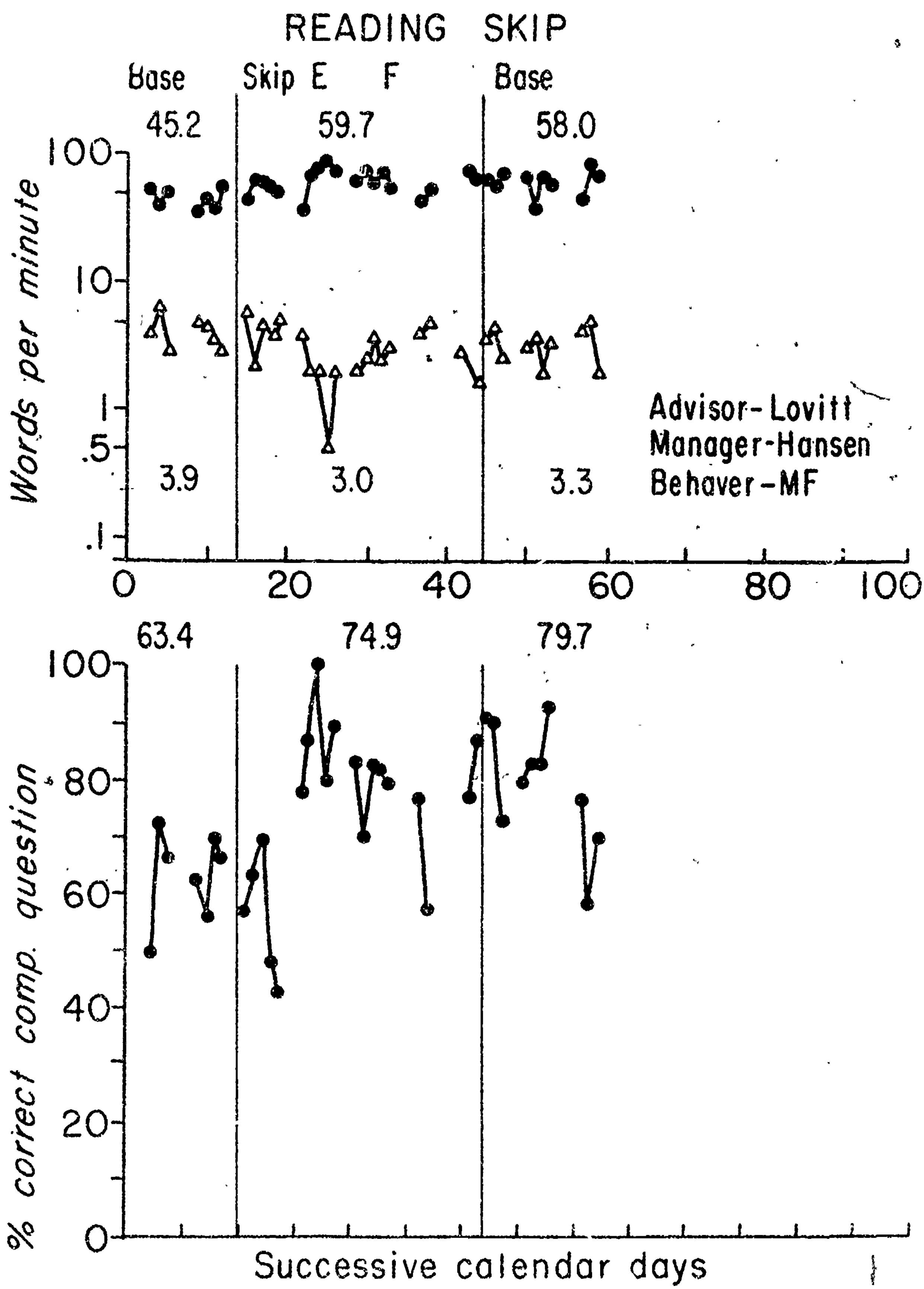
Table 1

Fall Quarter

$\bar{X}$ Correct wpm, Incorrect wpm & % Comprehension

Pupils		Base[1]	Skip & Drill	Base[2]
MF	c/e	45.2/3.9	59.7/3.0	58.0/3.3
	%	63.4	74.9	79.7
TG	c/e	59.3/3.9	61.7/4.0	65.8/2.9
	%	55.2	63.4	74.5
DH	c/e	65.8/2.3	72.9/2.8	79.8/2.8
	%	64.8	79.2	71.0
DP	c/e	44.9/2.1	60.2/1.7	59.1/2.1
	%	71.4	84.3	86.4
MS	c/e	39.0/3.8	47.7/3.1	54.3/2.7
	%	78.3	84.0	89.7
TS	c/e	53.0/2.7	58.8/3.1	58.1/2.9
	%	59.5	74.0	76.0
BW	c/e	47.7/2.9	58.8/2.3	60.6/2.1
	%	68.8	84.9	84.0
$\bar{x}$	c/e	50.7/3.1	60.0/2.9	62.2/2.7
	%	65.9	77.8	80.2


READING SKIP
Base
Skip E
F
Base
45.2
59.7
58.0
Words per minute
100
10
1
.5
.1
3.9
3.0
3.3
Advisor-Lovitt
Manager-Hansen
Behaver-MF
0
20
40
60
80
100
63.4
74.9
79.7
% correct comp. question
100
80
60
40
20
0
Successive calendar days

The Differential Effects of Reinforcement Contingencies on

Computational Arithmetic Performance

by

Deborah Deutsch-Smith and Thomas C. Lovitt

Abstract

The experimenters conducting this research investigated the differential effects of reinforcement contingencies in two different computational arithmetic situations--acquisition and proficiency. Seven, eight to eleven year old boys, participated as subjects.

Two experiments comprised the research. In Experiment I, the boys were presented with arithmetic problems which they could not compute accurately. Their baseline scores were all 0%. Contingent toy models were used unsuccessfully as the first intervention; their scores remained 0%.

In Experiment II, two types of reinforcement contingencies were applied--contingent-freetime and contingent-toy-models. During this experiment the boys' computational speed or proficiency needed improvement; in this instance the reinforcement contingencies were influential. The median improvement in their correct rate scores was 19% for both interventions.

This research demonstrates the importance of careful diagnosis of children's academic deficiencies. Once children's specific educational levels are determined, interventions must be selected which aim at specific types of performance. It is possible that many arithmetic interventions are effective with only certain types of performance. For example, in this research although reinforcement contingencies increased the children's computational proficiency, they were not effective in the acquisition situation.

The Differential Effects of Reinforcement Contingencies on Computational Arithmetic Performance[1]

by

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Reinforcement contingencies were introduced to classroom settings over 10 years ago (Staats, Staats, Schutz & Wolf, 1962; and Zimmerman & Zimmerman, 1962). Through the years these procedures have been refined for application with a variety of classroom activities. The use and frequent overuse of reinforcement contingencies has been well documented (Axelrod, 1971; Kazdin & Bootzin, 1972; Lipe & Jung, 1971; O'Leary & Drabman, 1971; and Stainback, Payne, Stainback & Payne, 1973). Although reinforcement contingencies have been applied to many different situations, little academic research has been conducted to verify the general use of those procedures for academic subjects like arithmetic, spelling, and reading. Occasionally, one hears ardent claims that if teachers use reinforcement contingencies all educational problems will be solved; undesirable behaviors will disappear and knowledge of academic subject matters will increase at record paces. Since some teachers have an affinity for applying contingencies, it is important to determine whether those procedures are appropriate in all teaching situations.

Research conducted in nonacademic areas indicates that reinforcement contingencies are not always influential. Ayllon and Azrin (1964), for instance, found that when mental patients' initial performance level of picking up appropriate eating utensils was nearly 0%, the application of reinforcement contingencies was not effective. When instructions were added the desired behavior increased immediately. Reinforcement contingencies were then used successfully to maintain the patients' ability to pick up the appropriate cutlery and eat in a socially acceptable manner. Apparently the initial reinforcement contingencies were not effective because the desired behavior did not occur and therefore could not be reinforced.

In another study, Hopkins (1968) found reinforcement contingencies to be initially ineffective. In this case, an institutionalized boy did not

[1]This research was supported in part by a National Institute of Research grant. (Grant #OEG-0-70-3916 [607], Project #572247)

smile. When candy reinforcement was initially scheduled, his smiling did not increase. Instructions had to be employed to increase the boy's smiling above a zero level. Since the desired behavior was not in his repertoire at the beginning of the study, the reinforcement did not alter his behavior. Once he acquired the behavior, however, the frequence of the boy's smiling was effectively increased when the candy reinforcement was rescheduled.

In both of these studies reinforcement contingencies were not initially influential because the desired behaviors were not in the repertoires of the subjects. In both cases, the desired behaviors had to be acquired before reinforcement contingencies were effective. Reinforcement contingencies served to increase and maintain satisfactory levels of performance.

When teaching academic subjects, a comparable instance occurs. In fact, classroom teachers are faced with three distinctly different situations: acquisition, proficiency and maintenance. The acquisition situation occurs when the desired behavior is not in the repertoire of the child; the child does not know how to perform the desired task. For instance, he cannot correctly solve a type of arithmetic problem. In the proficiency situation, the individual possesses the ability to accurately complete the task, but is unsure of the process and, therefore, is too slow at performing the task. In this case, a child's percentage scores indicate that he knows the substraction facts, but his correct rate scores indicate that he does not know the subtraction facts well enough to solve them quickly. Once a child has acquired a new skill and has become proficient in his performance of that skill, the teacher must insure that the student maintains this level of proficiency.

The purpose of this research was to determine whether reinforcement contingencies are effective in two of these three academic situations--acquisition and proficiency. Two experiments were conducted. In the first, reinforcement contingencies were scheduled when the children needed to acquire computational arithmetic skills. In the second experiment, reinforcement contingencies were applied when the children's computational proficiency needed improvement. Although the interventions used in the second experiment aimed at increasing proficiency, a maintenance condition was conducted to determine whether the children retained their improved performance levels.

General Methodology

In computational arithmetic there are many different types of problems; each requires the ability to use a slightly different set of rules. Before a child can become proficient at a computational task he must know the process involved in solving specific types of arithmetic problems. Merely memorizing the addition facts, for example, does not guarantee the correct solution to all problems which require addition. There are some general process rules (such as carrying) which must be followed to solve all the variations of addition problems.

If children compute arithmetic problems too slowly, they do not complete their work as fast as their classmates. As arithmetic assignments become more complex, these children often work even slower and complete fewer problems. Frequently the reason for these children's computational difficulty is their lack of proficiency in using the basic facts which are the rudiments of larger problems.

In the first experiment the children were presented with arithmetic problems which required process rules such as borrowing or carrying. They could not accurately compute these problems. In that case the children needed to acquire new arithmetic skills. In the second experiment, the children were presented with arithmetic-fact problems which they could compute accurately, but they did so too slowly. In both experiments reinforcement contingencies were used as the interventions.

Subjects

Seven learning disabled boys, who ranged in age from eight to eleven years participated in this research. Three of the boys were involved in Experiment I; all the boys participated in Experiment II. They were referred from one local school district to the Experimental Education Unit (EEU) for one academic year because of general academic deficiencies.

Setting

This research was conducted in the Research Classroom at the EEU of the Child Development and Mental Retardation Center at the University of Washington. The primary purpose of this classroom is the investigation of the efficacy of various curricular materials and teaching techniques.

Reliability

Reliability measures were obtained on timings, procedures, scoring, and graphing the data. Reliability scores were better than 99% on all measures.

Material Construction

Two types of arithmetic problems were selected for each child. Experiment I included problems which the child needed to learn how to compute. In order for those problems to be included in the experiment, the child had to score 0% on the problems for three consecutive school days.

Problems used in Experiment II were those which the child knew how to compute, but he was not proficient in arriving at the solutions. The criterion for selecting these problems was that the child's correct rate not exceed that of two-thirds of his peer group attending public school. Those rates were obtained by the authors before this research was conducted.

Once specific arithmetic problems were selected for each child, daily arithmetic pages were constructed. The procedures for constructing the pages were constant regardless of the problem type use. If, for example, in Experiment I a child needed to learn to solve subtraction problems which required borrowing from a zero in the units column $\left(\begin{array}{r} 890 \\ -127 \end{array}\right)$, only problems of that type were used for his daily arithmetic sheets. Through the use of a table of random numbers, five arithmetic pages were constructed for each problem type. No problem was used more than once. The child received a different version of his arithmetic pages each day of the week.

In Experiment II, arithmetic-fact problems were used. Since the number of fact problems available is smaller than that available for more complex arithmetic problems, the format for constructing these arithmetic pages varied slightly. For instance, if addition-fact problems which have one digit in both addends and two digits in the sum were used $\left(\begin{array}{r} 9 \\ +9 \end{array}\right)$, all problems of that type were identified. A table of random numbers was used to arrange the problems on the arithmetic sheets. Five different sheets were constructed for these problems. Since there are only 45 problems in this class, all problems were used more than once.

Design

Every study in both experiments followed an ABA design. Criteria for change of condition, however, differed for the two experiments. In Experiment I, the Baseline Condition lasted three days; all the scores during that condition had to be 0%. The intervention condition lasted at least seven data days and was to be concluded when the last three scores for that condition were 100%. The intention was to follow with a Maintenance Condition. That condition was also to run at least seven data days and to be concluded when the last three scores were 100%.

During Experiment II the children's correct rates, rather than percent correct scores, were used as the basis for changing conditions. Each condition during these studies ran at least seven data days and was concluded when the last four scores were either decelerating or accelerating at a median slope not greater than X1.2.[2]

General Procedures

Each day the children were required to work on a set of arithmetic pages. They received a different variation of the pages each day of the week. The children were allowed to work on the Experiment I page for two minutes and the Experiment II page for one minute. After the children put their names and the date at the top of the pages, the experimenter said, "Ready, start working." At the end of the allotted time, the experimenter said, "Pencils down." No other instructions were given. No feedback was provided the children regarding their performance during any of the research.

After the children computed the problems for the allotted time, the experimenter collected the sheets. She then corrected the pages, calculated percentage and correct and error rate scores, entered these on data sheets, and plotted the data. Partially completed and skipped problems were not counted as either correct or incorrect.

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[2] A median slope was calculated through those data points. It was obtained by calculating a line which allowed for the least amount of variance by using the unsigned medians. The median slope indicates the trend of the data. Scores indicating that a child's rates were becoming faster are prefaced by an "X"; if the child's rates were becoming slower, the median slope score is prefaced by a "÷".

Experiment I

Three studies were conducted during this experiment. In each, the students needed to acquire new computational arithmetic skills.

Procedures

Kyle, Brett, and Stephan participated in this experiment. Kyle was assigned three-digit multiplication problems which did not require carrying $\left(\begin{array}{r}231\\ \underline{\times 132}\end{array}\right)$. Brett computed subtraction problems which required borrowing from a zero in the units column $\left(\begin{array}{r}560\\ \underline{-327}\end{array}\right)$. Stephan solved multiplication problems which required carrying. Those problems had one digit in the multiplier and two digits in the multiplicand $\left(\begin{array}{r}57\\ \underline{\times\ 6}\end{array}\right)$.

Baseline. No instructions, feedback, or reinforcement contingencies were in effect during this condition.

Contingent toy. On the first day of this condition, before a child was given his arithmetic pages, he was allowed to choose a toy model from a large selection. After the boy made his choice, the experimenter wrote the child's name and the cost of the model (10 points) on an index card which was adhered to the model. He was able to purchase the toy model with points earned during arithmetic time.

Before the child received his arithmetic page for the day, the experimenter wrote "1: 1" on the top of his page. The experimenter then explained the ratio to him. She said, "For every problem you do correctly you will earn one point towards the model." The experimenter predicted that the child would compute no more than five problems correctly each day. The ratio, therefore, was established for the child to earn a model every two days.

After the child worked on the problems the experimenter collected the pages, corrected them, and reduced the cost of the model by the number of points the child had earned. Since none of the children solved any problems correctly during this condition, they earned no points and the cost of their models remained at ten points throughout the phase.

Demonstration. This condition was included in the experiment since the boys did not master the problem types presented to them when the contingency was in effect. During this condition, before the child received his daily arithmetic pages, the experimenter wrote a sample problem on an index card. Before the child computed his problems for that day, the experimenter went to the child's desk and demonstrated the appropriate process to follow as she worked the sample problem. After solving the problem, the experimenter left the child's desk and took the sample problem with her so the child did not have it to refer to as he computed the problems by himself.

Maintenance. It was originally planned for this condition to follow the Contingent-toy Condition. An additional intervention was required, however, for the children to master the problems presented to them. When the Maintenance Condition was scheduled, no instructions, feedback or contingencies were in effect.

Results

Since none of the children improved their computational performance when the contingent-toy tactic was in effect, another intervention was scheduled. Stephan's data were selected for display because they are representative of the other children (Figure 1). Table 1 summarizes the results from all the children who participated in this experiment.

Insert Figure 1 and Table 1 About Here

Baseline. All the boys scored 0% for the three days of this condition.

Contingent toy. This condition lasted seven days for each child. All of their percentage scores were zero while this intervention was in effect.

Demonstration. Each boy received a median score of 100% while the Demonstration Condition was scheduled.

Maintenance. During this condition baseline conditions were reinstituted. All the boys maintained their high level of performance and received median scores of 100% for this condition.

Discussion

During the Baseline Condition, the boys demonstrated they could not accurately compute the problems presented to them. When the Contingent-toy Condition was in effect, none of the boys improved their computational performance. Because the required computational performance was not within their repertoires, as indicated by their initial percentage scores of zero, they did not receive reinforcement. Reinforcement, by definition, increases the probability of a behavior occurring, but the behavior must occur before it can be reinforced.

Reinforcement contingencies, when used alone, will not positively alter behavior which must be acquired. Ayllon and Azrin (1964) and Hopkins (1968) arrived at similar conclusions when they unsuccessfully applied reinforcement contingencies to social behaviors which needed to be acquired.

The data from this experiment indicated that reinforcement contingencies are not appropriate to all teaching situations. Evidently, when new skills need to be acquired, interventions other than reinforcement contingencies should be scheduled.

Experiment II

During this experiment, children's computational proficiency rather than accuracy was the target. They had mastered certain computational skills, but needed to become proficient in performing these skills. Two types of reinforcement contingencies were used to increase the boys' computational speed on arithmetic-fact problems. The order of the interventions was the same for all the children. The first intervention was contingent-freetime. During this condition, the children earned points which were redeemable for time to spend in preferred activities. The second intervention was contingent-toy-models. Once again the children earned points for their computational arithmetic assignments, but now these points led to the purchase of toy models.

Procedures

During the experiment six boys computed addition-carry facts and one boy subtraction facts. Addition-carry facts are those problems which have single digits in both addends and two digits in the sum $\left(\begin{array}{r}8\\ \underline{+8}\end{array}\right)$. Subtraction facts are those problems which have single digits in the minuend, the subtrahend, and the remainder $\left(\begin{array}{r}5\\ \underline{-2}\end{array}\right)$.

The same procedures were used with all the children. After the Baseline Condition, the contingent-freetime intervention was scheduled, followed by the contingent-toy intervention. The studies were concluded with a return-to-baseline phase.

Baseline. No instructions, feedback or reinforcement contingencies were in effect.

Contingent freetime. While this condition was scheduled, the children earned freetime to spend as they desired. The amount of freetime earned was directly related to the number of correct problems they computed each day.

A ratio--correct problems to amount of freetime earned--was determined for each child before the condition was initiated. This ratio was established by calculating the median correct rate score for the Baseline Condition. This score was then divided by five--the amount of time a child would earn if his daily correct rate score during this condition equaled his correct rate median for the prior condition. The answer indicated the number of problems the child had to solve correctly to earn one minute of freetime. For example, if a child obtained a correct rate median of 10 problems during the Baseline Condition, 10 was divided by five. For every two problems the child computed correctly, he earned one minute of freetime. If this child solved 14 problems accurately, he earned seven minutes of freetime.

Daily, before a child received his arithmetic page, the experimenter wrote the ratio on the top of the child's page. Before the child computed the page, the experimenter came to his desk and explained the ratio to him. The only statement made to the child was, "For every two problems you do correctly you will earn one minute of freetime." No other instructions were given the child.

After a child worked on his assigned problems for one minute, he was told to stop working. The experimenter then came to his desk and collected his page of problems. After she corrected the problems and calculated the amount of freetime he had earned, the experimenter told the child how much time he was entitled to spend. That amount of time was also noted on a piece of paper which was posted in the front of the classroom. This was done to insure that the child spent only the amount of time he had earned. No praise was given the child for his performance.

Various activities were available for freetime. Some children worked on shop projects; others put puzzles together. Many different activities were chosen by the children as freetime activity. The children were permitted to spend their freetime when they desired, as long as it was not saved for more than a two-day period.

Contingent toy. When this intervention was scheduled, the children earned points which eventually led to the purchase of toy models. Before this condition began, the experimenter determined the ratio for points to number of correct problems by using the formula from the Contingent-freetime Condition. The toy models were priced for each child in this way: the median of the Contingent-freetime Condition was divided by the ratio multiplied by six. If in the previous condition a child obtained a correct rate median of 14 and the ratio used in that condition was 2: 1, two was divided into 14. The answer, seven, was then multiplied by six. The cost of this boy's model was 42. The division step in this formula indicated the average number of points the child earned each day during the Contingent-freetime Condition. If he retained his level of performance, the child earned his toy model in a reasonable length of time: six days. If he became faster in his computations, he earned his toy sooner.

On the first day of this condition, the child was allowed to select the toy model he wanted to purchase. Once he did, his name and the cost of the model was written on an index card and adhered to the model.

Each day, the child's ratio was written on the top of his arithmetic page. Before the child worked his page, the experimenter came to his desk and explained the ratio to him; no other instructions or feedback were provided the child. After the child worked the problems on that page for one minute, the experimenter collected the page, scored it, and calculated the number of points the child earned. She then went to the toy model and decreased the cost by the number of points the child earned. Once a child earned enough points to purchase his model, it was given to him and he selected another model to work for.

Return to baseline. Baseline procedures were reinstituted. No instructions, feedback, or reinforcement contingencies were scheduled.

Results

For this experiment medians, median slopes, and percent-of change scores were calculated for each child's correct and error rates for each condition. Median slope scores were calculated to determine whether a child was becoming faster or slower in his computations within a condition. The percent-of-change score was calculated to show the amount of change from one condition to the next. This indicated median to median changes. The following formula was used to obtain this score:

$$\frac{Md_2 - Md_1}{Md_1} \times 100 = \text{percent-of-change score.}$$

For example, if the baseline median was 10 and the median correct rate score for the next condition was 15, the difference between these two scores was five. The baseline median was then divided into five. The percent-of-change score in this instance is 50%.

The data from one child, Brett, were selected to display (Figure 2). His data were representative of the other children. A summary table is also included which indicates the correct and error median rates, slopes, and percent-of-change score of the seven children.

Insert Figure 2 and Table 2 about here

Baseline. The correct rate middle median for the seven children during this condition was 21.0 (range from 9.0 to 33.0). The error rate middle median was 0.0 (range from 2.0 to 0.0). Brett's median correct rate was 15.0; his error rate median was 0.0.

Contingent freetime. The correct rate middle median for the children was 21.0 (range from 13.0 to 36.0) and the error rate middle median for all was 0.0. The median level of improvement for all the children was +19% (range from 0% to 52%).

Brett obtained a correct rate median of 19.0 and an error rate median of 0.0. The amount of change from the Baseline Condition to this condition was indicated by the percent-of-change score. +27%.

Contingent toy. The median improvement noted for the boy's correct rate medians was 19% (range from 0% to 21%). The correct rate middle median was 26.0 (range from 16.0 to 39.0). The error rate middle median was 0.0 (range from 3.0 to 0.0).

Brett's correct rate median was 23.0; his error rate median was 0.0. His correct percent-of-change score was +21%.

Return-to-baseline. When the reinforcement contingencies were withdrawn, all of the children's correct rate medians decreased. The median child lost 9% of his correct rate (range from -6% to -25%). The correct rate middle median for the seven children was 23.0 (range from 12.0 to 36.0). The middle median error rate was 0.0 (range from 3.0 to 0.0).

Brett's correct rate median was 18.0. His error rate median was 0.0. Brett's correct rate median score decreased during this condition by the amount it increased in the prior condition, 21%.

Discussion

When the children had the opportunity to earn freetime for their arithmetic assignments, and the contingencies were aimed at increasing computational speed, most of the children's correct rate medians increased. One child's correct rate median score did not increase; it remained at the level of the baseline phase.

When the contingent-toy intervention was scheduled, all but one child showed increases in their correct rate medians. The median level of improvement was again 19%.

When baseline procedures were reinstituted, all of the children's correct rate medians decreased. All, however, concluded this experiment with a higher correct rate median than their initial levels. No appreciable rises in error rates were noted during this experiment. Although the children's correct rates improved, none obtained correct rates which indicated that they had become proficient in computing the problems presented to them.

Generally, both reinforcement contingencies were influential and stimulated increases in the children's correct rate scores. Each intervention brought the children's performances closer to the aim of 50 correct problems per minute. The interventions, however, did not produce identical results. Therefore, a comparison was made between the two reinforcement contingencies. The contingent-freetime tactic fared slightly better than the contingent-toy intervention. Although the median percent-of-change scores for both intervention conditions were equal, a wider range of those scores was noted when the Contingent-freetime Condition was in effect. The percent-of-change scores ranged from 0% to 52% while the contingent-freetime intervention was scheduled, and 0% to 21% for the contingent-toy intervention. Several children made greater gains when the contingent-freetime intervention was in effect.

There was one other advantage in using the freetime tactic. Although the boy's error rates were not considerable, no child had an error rate median score above 0.0 during the Contingent-freetime Condition. Several children had initial medians above 0.0, and some obtained higher error rate scores during the Contingent-toy Condition.

Discussion

Two different educational situations were studied in this research--acquisition and proficiency. In the acquisition situation the children did not know how to accurately solve various types of arithmetic problems. They did not know the appropriate computational rules required for solving the problems correctly. In the proficiency situation, the children knew how to solve the problems accurately, but they did so at a slow pace which might have impeded their future progress in computational arithmetic.

Reinforcement contingencies were applied in both academic situations. The results indicated that reinforcement contingencies will alter children's computational proficiency, but not acquisition. The major emphasis of this research was to demonstrate that some interventions are indigenous to certain educational situations and, thereby, are effective only in specific circumstances.

For teachers to select the appropriate interventions for their students, they must first determine each student's educational level. In computational arithmetic it is imperative that teachers identify the specific types of arithmetic problems their students cannot compute accurately. It is also important for them to determine which problem types their students are not yet proficient in solving. After this diagnostic process is conducted, teachers must then decide which intervention strategies they will employ to remediate their students' computational deficits.

This research indicated that at least one type of intervention strategy is not appropriate in all types of educational situations. Reinforcement contingencies were not effective when children needed to acquire new computational skills. In that case, an instructional tactic brought the children to mastery level of performance. When children's computational proficiency needed improvement, reinforcement contingencies influenced their computational speed. It is probable that other intervention strategies also have differential effects depending on the specific type of educational situation in which they are applied. It could be that there are varying levels of acquisition and proficiency which also influence the strength of the intervention strategies scheduled. Such information will only be discovered if educators clearly diagnose the educational situations before teaching tactics are implemented.

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FIGURE CAPTIONS

Figure 1. Percent correct for Stephan's problems assigned for Experiment I. Only successive school days are connected by lines. Solid vertical lines indicate change of condition.

Figure 2. Correct and error rate data for Brett's problems during Experiment II. Dots indicate correct rate scores and triangles represent error rate scores.

Table 1
Summary Data for Experiment I
Reinforcement Contingencies

Child's Name	Problem Type	Condition							
		Baseline		Contingent Toy		Demonstration		Maintenance	
		Median	Length	Median	Length	Median	Length	Median	Length
Brett	noo —xxx	0%	3	0%	7	100%	7	100%	7
Kyle	nn x xx	0%	3	0%	7	100%	7	100%	7
Stephan	cc x x	0%	3	0%	7	100%	7	100%	7

Table 2

Summary Data for Experiment II
Reinforcement
Contingencies

Subjects	Baseline				Percent of Change		Contingent Freetime				Percent of Change		Contingent Toy				Percent of Change		No Intervention			
	Median Rate		Median Slope				Median Rate		Median Slope				Median Rate		Median Slope				Median Rate		Median Slope	
	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E
Brett	15.0	0	÷1.1	x1.0	+27	—	19.0	0	÷1.0	x1.0	+21	—	23.0	0	x1.2	x1.0	-21	—	18.0	0	÷1.4	x1.0
John	[illegible]	0	x1.3	x1.0	0	—	21.0	0	x1.2	÷1.1	+21	∞	25.5	1.5	÷1.1	x2.0	-6	-33	23.0	1.0	÷1.1	÷1.1
Kyle	33.0	0	÷1.2	x1.0	+9	—	36.0	0	x1.1	x1.0	+7	—	39.0	0	÷1.1	x1.0	-8	—	36.0	0	x1.1	x1.0
Stephan	19.0	1.0	÷1.1	x1.0	+8	∞	20.5	0	÷1.1	x1.0	+21	—	26.0	0	x1.2	x1.0	-12	—	23.0	0	x1.1	x1.2
Rip	26.0	1.0	÷1.5	÷1.2	+19	∞	31.0	0	x1.0	x1.0	+6	∞	33.0	2.0	÷1.1	x1.0	-9	0	30.0	2.0	x1.0	x5.1
Rob	21.0	2.0	x1.1	÷2.7	+52	∞	33.0	0	x1.0	x1.0	0	∞	33.0	3.0	x1.0	÷1.5	-24	0	25.0	3.0	x1.3	÷1.4
Stewart	9.0	0	÷1.1	x1.0	+44	—	13.0	0	x1.0	x1.0	+19	—	16.0	0	÷1.1	x1.0	-25	—	12.0	0	÷1.2	x1.0

*-means zero divided into zero

**-means zero divided by or into a number

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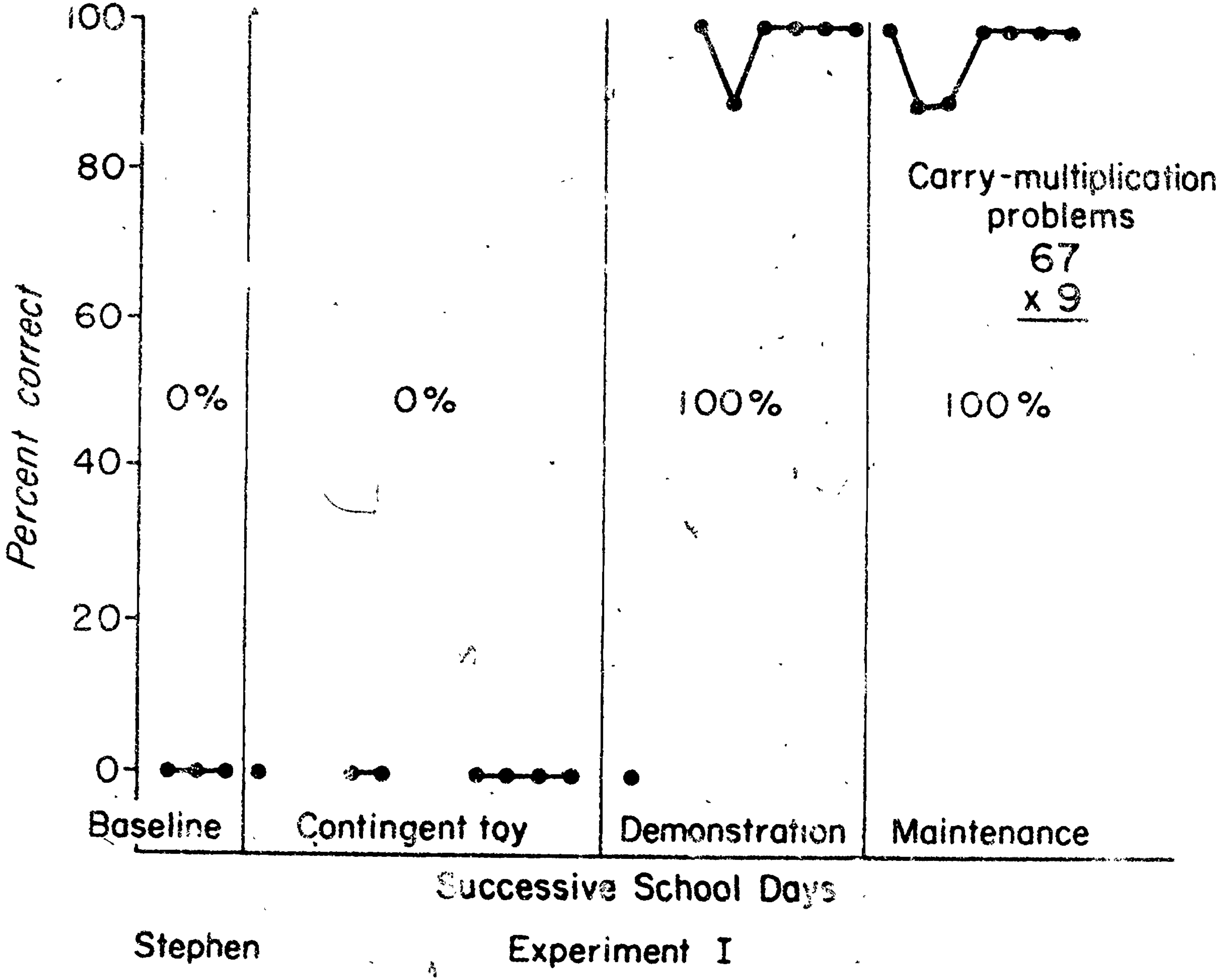
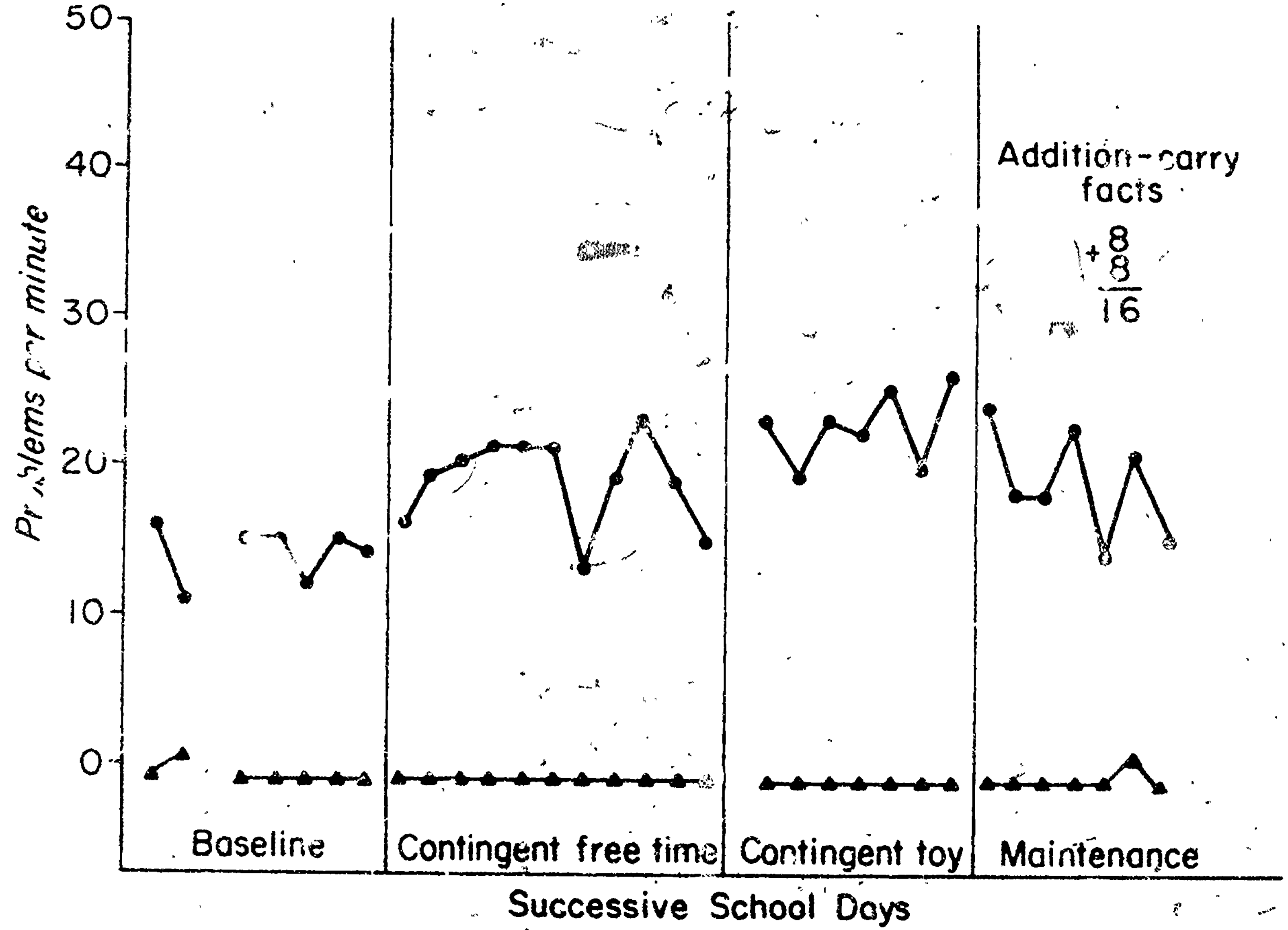

100
80
60
40
20
0
Percent correct
0%
0%
100%
100%
Carry-multiplication problems
67
x 9
Baseline
Contingent toy
Demonstration
Maintenance
Successive School Days
Stephen
Experiment I



Brett

Experiment II

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THE INFLUENCE OF INSTRUCTIONS AND REINFORCEMENT CONTINGENCIES ON CHILDREN'S ABILITIES TO COMPUTE ARITHMETIC PROBLEMS

by Deborah Deutsch Smith
and
Thomas C. Lovitt

Abstract

This research investigated three different methods to increase computational speed (proficiency)--instructions, reinforcement contingencies and a combination of the two. The subjects were seven boys, 8 to 11 years old.

This research involved three parts. In the first part, the influence of instructions was investigated. After the baseline period, the children were told to "go faster" before they computed the problems. The median improvement in correct rate for the seven boys was 24%.

In the second part the interventions were two types of reinforcement contingencies. After a baseline period, contingent-freetime was initially scheduled. The median increase in correct rates was 19%. Next, a contingent-toy was scheduled; the children earned points towards the purchase of toy-models. The median increase in correct rates during this condition was 19%.

In the third part, the instructions used in Part I were paired with the contingent-toy used in Part II. The median increase was 44%. The pairing of instructions with reinforcement contingencies influenced the greatest median improvement in the boy's computational speed.

THE INFLUENCE OF INSTRUCTIONS AND REINFORCEMENT CONTINGENCIES ON CHILDREN'S ABILITIES TO COMPUTE ARITHMETIC PROBLEMS[1]

by

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Since 1962, reinforcement contingencies have been systematically used in classroom settings (Staats, Staats. Schutz & Wolf, 1962; Zimmerman & Zimmerman, 1962). Often, when reinforcement contingencies were applied additional interventions were paired with the reinforcers. In programs utilizing reinforcement contingencies, the individual, is frequently given instructions regarding the desired behavior. After the individual performs the desired behavior he is rewarded.

This practice of combining intervention tactics in a research setting can confound the results and seriously limit the implications drawn from the research. Kazdin (1973) stressed the dangers of this practice.

> Studies in this area [applied behavior analysis (authors' addition)] have usually confounded instructions with contingent reinforcement. Typically, subjects are instructed as to what behaviors earn tokens and are reinforced accordingly. It may be that the behavior changes are due to instructions, reinforcement or their combination. [p, 63]

Reinforcement contingencies have positively altered children's computational arithmetic performance. Chadwick and Day (1971) studied the effectiveness of a token system on three measures: percent of time at work, problems completed per minute and correct percentage scores. This research indicated that all three measures increased as a result of reinforcement procedures.

Kirby and Shields (1972) and Ferritor, Buckholdt, Hamblin and Smith (1972) also demonstrated that reinforcement contingencies influenced arithmetic performance. In both studies, when points were arranged contingent on accurate responding, that aspect of performance was positively altered.

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As part of a dissertation, one of the authors of this research, Smith (1973), investigated the effects of reinforcement contingencies in an acquisition situation. During a baseline condition the pupils were asked to solve arithmetic problems. Their scores in this condition were invariably zero. Following this baseline, reinforcement contingencies in the form of points for freetime were scheduled. The contingencies were ineffective in all cases.

In a study not concerned with arithmetic computation, Hopkins (1968) also scheduled reinforcement contingencies in an acquisition situation. In an effort to increase a child's smiling, reinforcement contingencies were initially arranged. This arrangement resulted in no behavior change. Hopkins explained this lack of effect when he said:

> If the response never occurs, no reinforcement is presented. The behavior never comes into contact with the reinforcer. Therefore, the frequency of the response cannot be increased. [p. 125]

Such a statement could explain the absence of effects in our arithmetic pilot study. Accordingly, since the arithmetic performance of pupils in the first three cited studies were influenced by reinforcement contingencies, we must assume some arithmetic behavior was occurring prior to the reinforcement phase. The pupils were not in the acquisition stage. Further, since the performances of those pupils were amenable to change, they had not, prior to the involvement of contingencies, reached criterion. The pupils were in the proficiency stage.

The results of studies which used instructions (telling someone what to do) as interventions have yielded inconsistent results. Lattal (1969), for example, found instructions to be an ineffective tactic. His study dealt with eight delinquent boys who were deficient in self-care behaviors. The primary problem was their lack of dental hygiene. When the boys were told to brush their teeth daily, no more than two each day complied with the request.

Lovitt and Smith (1972), however, found instructions to be effective. The subject of their research, a nine-year-old boy was deficient in language abilities. Prior to instruction when he was asked to tell about some pictures, he replied with short sentences. Most of the sentences began with 'This is' and were made up of five words. When instructed to vary the beginnings of his sentences, the boy readily complied. When instructed to make his sentences longer, he spoke in longer sentences.

Instructions, unlike reinforcement contingencies, when used in acquisition situations, could influence the behavior of concern. Instructions, like reinforcement contingencies, are most apt to alter behavior in proficiency situations. Instructions, however, would probably be ineffective if used in a case where the subject did not want to perform the task, even though he was capable.

There have been a few studies designed to compare the effectiveness of instructions and reinforcement contingencies. Burgess, Clark and Hendee (1971), for example, conducted a study to evaluate the effects of certain interventions on picking up trash in a movie theater. When litter-bags were provided and the children were instructed to use them, the audience responded by returning a great deal of trash. When the audience was paid for returning litter, even more trash was collected. Although reinforcement contingencies were most effective in reducing the amount of litter left in the theaters, instructions positively influenced picking up trash.

The purpose of this research was to determine whether instructions, reinforcement contingencies and their combination would influence children's arithmetic performance. Further, we wanted to determine the differential effects of these interventions. Throughout this research the pupils were involved in proficiency situations. They could perform the arithmetic problems, but very slowly. Our decision to arrange proficiency situations was based on the preceding studies relevant to reinforcement and instructional interventions.

General Methodology

Rationale

Often, children know how to compute arithmetic problems, but do so very slowly. These children take too much time to complete their arithmetic assignments and are occasionally required to stay in from recess or remain after school until their work is finished. Although pupils such as these have acquired the skill for performing the problems, they are not proficient.

In many circumstances when individuals have recently acquired a skill they emit the behavior very deliberately. When a secretary, for example, first learns to take short-hand, she writes slowly and methodically. The secretary is not proficient. When a child first learns to compute arithmetic problems, he follows the same pattern. He first acquires the skill but a fair amount of time is required to answer each problem. Eventually, after he has responded to many problems in a reinforcing environment, his speed increases. He becomes proficient.

If a child does not increase his speed, his rates become more and more discrepant from his peers. In such instances, the teacher must arrange remediation tactics to help him gain proficiency.

In this research, composed of three parts, we investigated the effects of three interventions on arithmetic proficiency. In Part I the effectiveness of an instructional statement directed toward increased computational speed was investigated. In Part II reinforcement contingencies (contingent-freetime and contingent-toys) were studied. In Part III, instructions as used in Part I were paired with a reinforcement contingency used in Part II.

Subjects

Seven boys, ranging in age from eight to eleven, participated in this research. All were referred from a local school district to the Experimental Education Unit because of academic deficiencies. They had been labeled, at one time or another, as learning disabled.

Setting

This research was conducted in the Curriculum Research Classroom at the Experimental Education Unit of the Child Development and Mental Retardation Center at the University of Washington. This classroom exists for the primary purpose of conducting educational research: to study the efficacy of curricular materials and teaching techniques. Children are assigned to this classroom for one year, then they return to their home districts.

Reliability

Three types of reliability were obtained. The first dealt with timing. The subjects of this research timed their performances. Each child had a stop watch, turned it on when the experimenter said, "Start working" and turned it off when the experimenter said "Pencils down." The experimenter also timed every performance. Experimenter and pupil timings agreed 99.7% of the time.

The second reliability measure was concerned with accurate correcting. At the end of each week the experimenter gave a classroom teacher all the arithmetic pages the children had worked on during that week. The teacher randomly selected ten of these sheets to recorrect. Only two problems were found to be miscorrected during those checks.

The third reliability measure was concerned with accurate graphing. All data plots were rechecked using the raw data sheets. If data were graphed incorrectly, the plots were changed. The correct plots appear on the graphs used in this report.

Material Construction

The criterion for selecting problem types was that a child's correct rate not exceed two thirds of the rate of his peer group attending public school.[2] Once problem types were selected for each child, arithmetic sheets were constructed.

The specific arithmetic-fact problem types used are discussed in each part and are displayed in Table 1. The method used for constructing the arithmetic pages remained constant throughout this research. If, for example, addition-fact problems which yielded a two-digit answer $\frac{9}{+9}$ were selected, all of the one-column addition problems which give a two-digit answer were identified. Five different arithmetic pages were then constructed for the problems by the use of a table of random numbers. Since there are only 45 problems in this pool, problems were used more than once.

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Insert Table 1 About here
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[2]Three different populations of children were sampled to determine proficiency rates. This writer tested one school's third and fourth grade children on various fact problem types. Proficiency data were also gathered from two other sources: three special education classes and a group of fifth and sixth grade students. The mean correct rate for those groups on arithmetic-fact problems was 50.

Design

The data from seven children are included in each part of this research. Each experiment used an ABA design. The children's initial correct rates were no greater than two thirds the average speed of their peer group who attended regular public school. If a child performed a problem type at a speed above this level during the baseline period, new problems were arranged for him.

Each condition conducted in this research ran for at least seven data days and was concluded only when the last four data days were either decelerating or accelerating at a speed no greater than X1.2.

General Procedures

Every day each child was required to work on arithmetic pages for one minute. On successive days a different arrangement of problems was used. Each day the subjects were told to put their names and the day's date on the top of the first arithmetic page. Next, the experimenter said, "Ready, start working." At the end of one minute, the experimenter said, "Pencils down." The papers were then collected.

Next, the experimenter checked all the pages. Partially completed problems and skipped problems were not counted as being correct or incorrect. The number of correct and incorrect answers were entered on score sheets, and the data were graphed. Since one-minute timings were used, the number of correct and incorrect answers for each set of problems equaled the correct and error rates.

At the conclusion of each condition, medians, median slopes[3] and percent-of-change scores were calculated for each set of problems. A percent-of-change score was calculated to show the amount of change between conditions. This figure indicates the amount of change from the median (Md) of one condition to the median of another condition. This score is obtained by using the following formula:

$$\frac{Md_2 - Md_1}{Md_1} \times 100 = \text{percent of change score.}$$

For example, if the correct rate median of the baseline condition was 10 and the median correct rate score from the intervention condition was 15, the difference between the two scores was five. The difference between th two median scores is then divided by the median from the baseline condition . The percent-of-change score in this example is 50%.

Each part of this research employed slightly different procedures. These are discussed under the appropriate sections of each part.

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[3]The median slope for each condition was obtained by calculating a line through the data points which allows for the smallest amount of variance by using unsigned medians. These scores indicate the directionality or trend of the data. Scores indicating that the children were becoming faster in their computations within a condition are prefaced by an "X". A ÷ sign indicates that a child was computing his problems slower at the end of the condition than he was initially.

Part I

Instructions

Seven children participated in this study. The same intervention tactic was used with each child. The purpose of this research was to determine whether telling a child to solve arithmetic problems more quickly would positively alter his correct rate. This tactic was used effectively by Smith and Lovitt (1971) to increase a child's reading rate.

Procedures

All the children received the same problem types. These problems were the addition-carry facts; the top and bottom addends were single digits (ranged from one to nine), and the sum was a two-digit numeral (ranged from 10 to 18).

The same procedures were used with the seven children. A baseline-intervention-return-to-baseline format was followed. Specific procedures are discussed by condition.

Baseline. No instructions, feedback, or reinforcement contingencies were in effect. The children were told only when to start and stop working on their problems.

Instructions. During this condition the words, "Please do this page faster" were written on the top of each child's page of problems. Before the child worked his problems, the experimenter came to the child's desk, pointed to the page of problems and said, "Please do this page faster." No other statement was made by the experimenter.

Return to baseline. Baseline conditions were rescheduled.

Results

Table 2 shows median performance scores trends and median percent-of-change scores for the seven children for each condition of the study. Discussion of the results are presented by condition.

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Insert Table 2 About Here

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In addition, the data from one child were selected to report. Stephan's performance during this part was representative of the other six children. His data are displayed in Figure 1.

. . . .

Insert Figure 1 About Here

. . . .

Baseline. In the Baseline Condition, the median correct rate for the children was 15.5 problems per minute (ranged from 9.0 to 2[illegible]).

Four children obtained median error rates of 0.0. One child had a median error rate of 3.0 and two others obtained median error rates of 1.0 or lower.

Stephan, during this initial condition, obtained a correct rate median of 14.0 and an error rate median of 0.0. His correct rates ranged from 7.0 to 18.0 and his errors from 3.0 to 0.0.

Instructions. When instructions were given, the correct rates of all children increased. The percent-of-change scores ranged from 6% to 67%. The median change for the seven children was 24%. The error rates for two children increased. The error rates for the other children either maintained or decreased from the preceding condition.

Stephan obtained a correct rate median of 19.0 during the Instruction Condition. His error rate median was 0.0. His correct rate scores ranged from 15.0 to 20.0 and his error rate scores from 1.0 to 0.0. When comparing the Baseline and the Instruction Conditions his correct production increased by 35%.

Return to Baseline. When the instructions to work faster were discontinued, median correct rates of four children decreased. One child retained the median level of the prior condition and the correct rate medians of two children increased. The median percent-of-change score for the seven children was -3% (ranged from -11% to +14%).

During this condition none of the error rates increased. The error rates for two children decreased 75%. The error rate median for the seven children was 0.0.

During this condition, Stephan's correct rate median score (19.0) was the same as in the prior condition. His error rate median score rose to 1.0. His correct rate scores ranged from 17.0 to 21.0; error rate scores ranged from 3.0 to 0.0.

Discussion

Seven children participated in this research. An ABA design was used. Their initial performance levels indicated the pupils were too slow in computing arithmetic problems. In each case it was possible for the children to compute the problems twice as fast as they had initially.

All of the children's correct rates increased when they were told to solve problems more quickly. No appreciable rise in the error rates were noted. Although none of the children attained a proficient correct rate, the instructions influenced positive changes in the children's correct rates. Not only was this technique effective, it was inexpensive in teacher time (less than 30 seconds), and did not require the use of elaborate arrangements of reinforcement schedules. When the intervention was withdrawn, the correct rates of two children continued to improve. The correct rates for four children, however, declined during this condition.

Part II

Reinforcement Contingencies

Two intervention tactics were investigated in this part of the research. Both interventions were applied contingent on each child's correct rate of performance. The first intervention was contingent-freetime; the children earned time to spend as they desired. After the completion of the Contingent-freetime Condition, a second intervention was applied. During this intervention the children earned points which were redeemable for toy models.

Procedures

Addition-carry facts were used for all seven children. The same procedures were used for all of the children. After the baseline period the contingent-freetime intervention was scheduled. When that condition was concluded the contingent-toy intervention was applied. Following this, baseline procedures were rescheduled.

Baseline. No instructions, feedback or reinforcement contingencies were in effect.

Contingent freetime. During this condition, the children were allowed to earn freetime. The amount of time they earned was related to the number of correct answers.

A formula was used to calculate the ratio for each child. First, the median score for the baseline period was obtained. That number was divided by five, and that figure was used as the number of correct problems each child had to solve to earn one minute of freetime. If, for example, a child had a median correct rate score of 26.0 during the Baseline Condition, 26.0 was divided by five. This child had to solve five problems correctly to earn one minute of freetime. In this way, a child earned five minutes of freetime each day if his correct rate equaled the correct rate median of the prior condition. If he surpassed his correct rate median of the Baseline Condition, he earned more than five minutes of freetime.

Daily, before the arithmetic pages were given to the children, the experimenter noted this ratio in red ink on the top of his page of problems. Before the child worked the page, the experimenter came to his desk and explained the ratio to him. If 5:1 was written on the top of a child's page, the experimenter said, "For every five problems you do correctly, you will earn one minute of freetime." No other instructions were provided.

After the child computed the problems, the experimenter collected the page. She checked it and calculated the amount of freetime he had earned. The pupil was then told how much freetime was allowed. That number was entered on a sheet of paper posted in the room to insure that only the earned amount of time was spent. No praise was given a child for his performance.

Various activities were available only during freetime. The Freetime Room was a small room adjoining the classroom. In the room were many games and puzzles. In addition, two gerbils could be removed from their cage and played with in the Freetime Room. Some children brought items from home; others worked on shop projects. Once an activity was used during freetime, it was available only during that time. The children were permitted to spend their freetime when they desired. They could not, however, save time for more than two days.

Contingent toy. During this condition the children earned points which were redeemable for toy models. The ratio in effect during this condition was the same as the Contingent-freetime Condition. Toy models were priced for each child by using the following formula: median of the Contingent-freetime Condition divided by the ratio multiplied by six. If in the previous condition the correct rate median was 19.0 and the ratio was 4:1, 19.0 was divided by four . The answer, five, was then multiplied by six (5 x 6 = 30). The cost of this boy's toy model was 30. The division step in this formula indicated the average number of points the child earned in the Contingent-freetime Condition. If a child retained his level of correct performance, he earned a toy in six days. If he increased his correct rate scores, he earned the toy sooner.

On the day the contingent-toy-model intervention was initiated, the child was allowed to select, from a large number of toy models, the one he wanted to purchase. These toy models were of the unassembled variety. Various types of airplanes, cars and boats were included in the selection. The average cost of each toy model was one dollar. Written on an index card was the boy's name and the point cost of his model. After he selected his model, the index card and the model were placed on a shelf in the front of the classroom.

Each day, before the pages of problems were given to the child, the experimenter noted the ratio in red ink on the top of the child's page. Before the child worked the problems, the experimenter came to his desk and explained the ratio to him, as she had done in the previous condition.

After the child computed problems on the page, the experimenter took the page from the child, scored it and calculated the number of points he had earned. She then went to the boy's model and reduced the cost by the number of points he had earned that day. When the child earned all the points necessary to purchase the model, the model was given to him. He then selected another model and began working for it.

Return to baseline. No instructions, contingencies or feedback were scheduled during this condition.

Results

Table 3 displays the correct and error rate medians, trends and median percent-of-change scores for the seven children for each condition. A detailed description of the results for all of the children is found within the condition headings.

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Insert Table 3 About Here

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Since two intervention tactics were investigated during this part of the research, the data from two children were selected to display. One child showed greater gains during the Contingent-freetime Condition; the other child improved more during the Contingent-toy Condition. Stephan's data are displayed in Figure 2. Rip's data are shown in Figure 3.

. . . .

Insert Figures 2 and 3 About here

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Baseline. In this condition, the correct rate median for the seven children was 21.0 (ranged from 9.0 to 33.0). The error rate median was 0.0 (ranged from 2.0 to 0.0).

Stephan, during this condition, had a correct rate median of 19.0. His error rate median was 1.0. His correct rates ranged from 17.0 to 21.0, error rates ranged from 3.0 to 0.0.

Rip, during the Baseline Condition, obtained a correct rate median of 26.0 and an error rate median of 1.0. His correct rates ranged from 18.0 to 32.0; error rates ranged from 10.0 to 0.0.

Contingent freetime. The seven children received a correct rate median of 21.0 and an error rate median of 0.0 during this condition. Their correct rate medians ranged from 13.0 to 36.0. All the children obtained error rate medians of 0.0. The correct percent-of-change median was 19% (ranged from 0% to 52%).

Stephan's median correct rate was 20.5. his error rate median was 0.0. Stephan's correct rates ranged from 13.0 to 23.0; error rates from 0.0 to 1.0. When his correct rate in this condition was compared to that rate of the previous phase an 8% improvement was noted.

Rip increased his correct rate by 19% during the Contingent-freetime Condition. He obtained a correct rate median of 31.0. His correct rate scores ranged from 27.0 to 36.0. His error rates ranged from 0.0 to 2.0.

Contingent toy. The median level of correct rate improvement during this condition was 19% (ranged from 0% to 52%). The children received a correct rate median of 2(0 (ranged from 16.0 to 39.0). Three of the children increased their error rates. The error rate median, however, was 0.0 (ranged from 3.0 to 0.0).

Stephan's correct rate median was 26.0, an increase of 21% over the previous condition. His error rate median was 0.0. His error rates remained constant. Stephan's correct rates ranged from 22.0 to 29.0. His error rates ranged from 2.0 to 0.0.

Rip's correct rate median was 33.0. his error rate median was 2.0. His correct rate increased 6% when the contingent-toy intervention was in effect. His correct rate scores ranged from 27.0 to 36.0. His error rate scores ranged from 4.0 to 0.0.

Return to baseline. When the contingent-toy intervention was withdrawn, the correct rate medians decreased for all of the children. The median child lost 9%. The correct rate median for the seven children was 23.0 (ranged from 12.0 to 36.0). The median error rate was 0.0 (ranged from 3.0 to 0.0).

Stephan's correct production decreased by 12%. He obtained a correct rate median of 23.0 (ranged from 20.0 to 27.0). His error rate median was 0.0 (ranged from 2.0 to 0.0).

Rip's correct rate median decreased by 9%. His correct rate median was 30.0 with an error rate median of 2.0. His correct rates ranged from 22.0 to 34.0. His error rates ranged from 6.0 to 0.0.

Discussion

When the children could earn freetime for their correct performance most of the children's correct rates increased. Only one child's correct rate median score did not increase during this condition (as indicated by a percent-of-change score of 0%). When the contingent toy intervention was in effect, again, all but one child's correct rate increased. The median increase for both conditions was 19%. The gains made, however, when the contingencies were in effect were not as great as those made when the instruction tactic used in Part I was scheduled.

When baseline procedures were rescheduled, all the children's correct rate medians decreased. However, the children's correct rate medians during the Return-to-baseline Condition were higher than their initial correct rate medians. No appreciable rise in error rates were noted during the course of this part of the research. None of the children, however, obtained a median correct rate during any of the conditions which indicated they obtained proficiency on the problems presented to them.

Although the median correct percent-of-change scores for both intervention tactics was equal (19%), the percent-of-change scores had a wider range when the contingent-freetime tactic was scheduled. The percent-of-change scores ranged from 0% to 52% while the contingent-freetime tactic was applied, and from 0% to 21% when the contingent-toy intervention was scheduled. In other words, several children made greater gains when the contingent-freetime intervention was in effect. This might have happened, however, because the contingent-freetime intervention was scheduled first.

Part III

Instructions Plus Contingent-toy

In the first two parts of the research, the effectiveness of two types of interventions was investigated. In the first part, instructions were used with considerable effect. In the second part, two reinforcement contingencies were scheduled as interventions. Both the contingent-freetime and the contingent-toy tactics positively influenced the children's correct rates.

Frequently, the tactics investigated in this research do not occur in isolation. They are often paired. Several studies which stated that reinforcement contingencies were used, in fact, used reinforcement contingencies and instructions (Birnbrauer, Wolf, Kidder & Tague, 1965, Kale, Kaye, Whelan & Hopkins, 1968; O'Leary & Becker, 1967). Statements like, "Johnny, if you do this, then you can do that," are often heard in classrooms which employ applied behavior analysis techniques.

In this part of the research, the instructions in the first part were paired with the contingent-toy intervention used in the second part of this research. The purpose of this section was to determine whether pairing these two tactics would cause greater changes in the children's rates than did either intervention when used alone.

Procedures

Six children received the same problem types during this part of the research. These children received the subtraction-borrow facts. One child received the addition-carry facts.

The same procedures were used with all the children, regardless of the problem type assigned. An ABA format was followed. Specific procedures are discussed under the following headings.

Baseline. No instructions, feedback or reinforcement contingencies were in effect.

Instructions plus contingent toy. The instructions used in Part I and the contingent-toy procedures used in Part II were jointly scheduled during this condition. A point ratio was calculated for each boy using the formula described in Part II. After the ratio was established, a cost for the toy model was established in the same manner as previously explained.

On the first day of this condition, each child selected a toy model to purchase. After his selection, an index card with his name and the cost of the model was attached to the toy. Written on his page of problems were the words, "Please do this page faster." The ratio was also written on the top of his page. Before the child solved the problems on that page, the experimenter came to his desk and said, "Please do this page faster. For every (number) problem you do, you will earn one point towards the purchase of a toy model." Nothing else was said to the boy.

After the child solved the problems, the experimenter collected the page, scored it and calculated the number of points he had earned. She then went to the child's toy model and reduced the cost of the model by the number of points he had earned that day. No other statements were made.

If a child earned a toy model before the condition was concluded, he selected another toy model to earn.

Return to baseline. Baseline conditions were re-established. No instructions, feedback or reinforcement contingencies were in effect.

Results

As in the other parts of this research, a summary of the children's performances appears within the following headings. The data from a representative child were also selected to discuss. The correct and error rate medians, the median percent-of-change scores and the median slope scores for the seven children for each condition are included in Table 4.

Insert Table 4 About Here

Baseline. In the Baseline Condition, the children's correct rate median was 18.0 (ranged from 15.0 to 21.5). Their error rate median was 1.0 (ranged from 2.0 to 0.0).

Rip was selected as the representative child. His data are presented in Figure 4. During this condition, Rip's correct rate median was 18.0 (ranged from 11.0 to 21.0). His error rate median was 1.0 (ranged from 3.0 to 0.0).

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Insert Figure 4 About Here

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Instructions plus contingent toy. This intervention positively influenced the correct rates of all children. The median correct rate was 23.0. Their median correct percent-of-change score was 44%. The error rate median for this condition was 1.0.

Rip's correct rate median was 26.0 (ranged from 23.0 to 30.0), a gain of 44% from the Baseline Condition. His error rate median dropped to 0.0. (ranged from 1.0 to 0.0). He made errors on only two days.

Return to baseline. When the intervention was withdrawn, the correct rate of six children decreased. Their error rates remained near the levels of the previous condition. Three children's correct rate medians were lower than during the baseline period. Only one child continued to progress. The median correct rate loss during this condition was 30% (ranged from +5% to -70%.

During this condition, Rip's correct rate median was lower than his correct rate median for the baseline period. Those rates were 18.0 and 14.5. His correct rates during the Return-to-baseline Condition ranged from 11.0 to 18.0. His error rate median returned to its initial level (1.0). His errors during this condition ranged from 4.0 to 0.0. The decrease in correct rate (-44%) during this condition equaled the increase in his correct rate when the intervention was scheduled.

Discussion

Seven children participated in this research. An ABA design was used with each child. When interventions used in the first and second parts of this research were paired, the children's correct rate medians dramatically increased. No appreciable rises in error rate medians were noted. When the intervention was withdrawn, six children's correct rate medians decreased.

General Discussion

The children who participated in this research were not proficient in solving certain problem types. They knew the correct answers to the problems, but could not solve them fast enough.

Three intervention tactics were investigated during the course of this research. The first intervention tactic was to instruct the children to work more quickly. This positively influenced all of the children's correct rates. The boys' median increase was 24%.

In Part II, two reinforcement contingencies were studied. When the children earned freetime for correct computation, their correct rate medians increased by 19%. The same amount of improvement was noted when the boys worked for toy models. The correct rates of some children improved more when they worked for freetime; other children were influenced more by the contingent-toy intervention. Only one child's correct rate median was not influenced by the contingent-freetime tactic, and another boy's correct rate median was unaltered by the contingent-toy intervention.

In the final part of this research, the instructional tactic used in Part I was paired with the contingent-toy tactic used in Part II. The pairing of these interventions positively influenced the performance of each boy. On the average, the children increased their correct rates by 44%.

When attempting to discern whether the effects of the instructions alone or reinforcement contingencies alone were more effective, several factors must be considered: changes in correct and error rate medians from baseline to intervention conditions, and changes after the intervention was discontinued. When the three interventions used alone were compared, it appeared that the use of instructions was most influential. The amount of change in correct rate medians was most when instructions were in effect. The loss in correct rate medians was slightly less when comparing intervention and return-to-baseline medians. Although lower error rates were noted during the Contingent-freetime Conditions, five children obtained error rate medians of 0.0 when instructions were scheduled. It seems that using instructions is more powerful than the results from other studies have indicated (Lattal, 1969; and O'Leary, Becker, Evans & Saudargas, 1969).

One reason for attempting to discern the differential effects of the intervention tactics used alone was to determine whether certain elements of contingency management procedures were more influential. Many studies have utilized token reinforcement. Often, the subjects were instructed as well as reinforced for appropriate behaviors (O'Leary & Becker, 1967; Parsons, 1972, and Wolf, Giles & Hall; 1968). The important role of instructions is apparent in an acquisition situation (Hopkins, 1968). If the desired behavior is not within the repertoire of the subject, it does not occur; and, therefore, cannot be reinforced. The role of instructions in proficiency situations is not as apparent.

In Part III, instructions were paired with the contingent-toy tactic. The median change in the children's correct rate medians was 44%. Since this was the greatest amount of change noted when an intervention was in effect, apparently, both tactics (instructions and contingent reinforcement) contributed to the amount of gain made by the children. On first glance, it appears from the group data that each tactic contributed to the total amount of gain for this condition by the amount of influence they had when used separately. This occurs because the median gain of the Instructions Condition (24%) when added to the median gain of the Contingent-toy Condition (19%), closely approximates the median amount of change made when these tactics were paired (44%). The percent-of-change scores for individual children did not, however, support this notion. Some children made greater correct rate median gains when the interventions were used alone. Only one individual's data indicated that an additive-effect might have occurred. Whatever the interaction between the two tactics when used together, instructions-plus-contingent-toy intervention was the most effective for the seven boys.

There are several implications which can be drawn from the data gathered during this research. First, children's computational proficiency can be altered. Both instructions and reinforcement contingencies, when focused on computational speed, can be positively influential. The greatest amount of change in the children's correct rate medians occurred when instructions and the contingent-toy tactic were paired. Possibly, tactics which combine instructions and reinforcement contingencies should be used first by teachers when their students' computational proficiency needs improvement.

These implications, must be tempered by at least one limitation. No control for the order-effect was arranged in this research. The interventions were scheduled for all of the children in the same order. They first received instructions then contingent-freetime, contingent-toys, and, finally, a combination of instructions and contingent reinforcement. In addition, the interventions were scheduled for the children at about the same time of year. Christmas vacation might have confounded the results of the instructions and the end-of-the-school year, the combined tactic. Other studies which control for the possible order effect noted in this research should be conducted to determine more conclusively the differential effects of the interventions.

Figure Captions

Figure 1

Correct and error rate data for Stephan's arithmetic problems for Part I. Two types of data plots were used: dots indicate the correct rates, triangles the error rates. Plots placed on the solid horizontal line indicate a rate of one. Plots placed on the broken horizontal line indicate a rate of zero. Only successive calendar plots are connected by lines. Solid vertical lines mean that experimental conditions were altered.

Figure 2

Correct and error rates for Stephan's problems during Part II.

Figure 3

Rip's correct and error rate data for Part II.

Figure 4

Rip's correct and error rate data for Part III.

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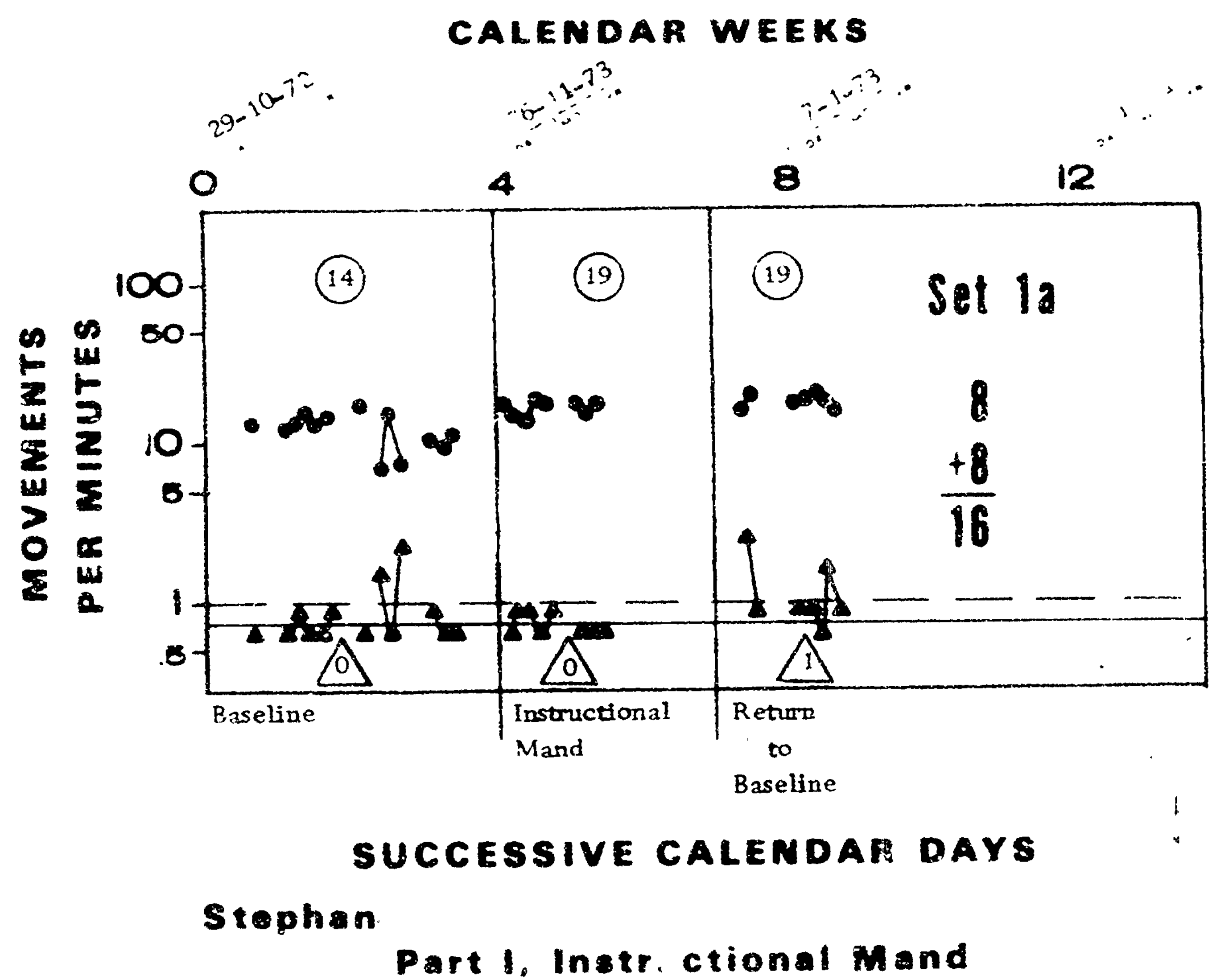

CALENDAR WEEKS
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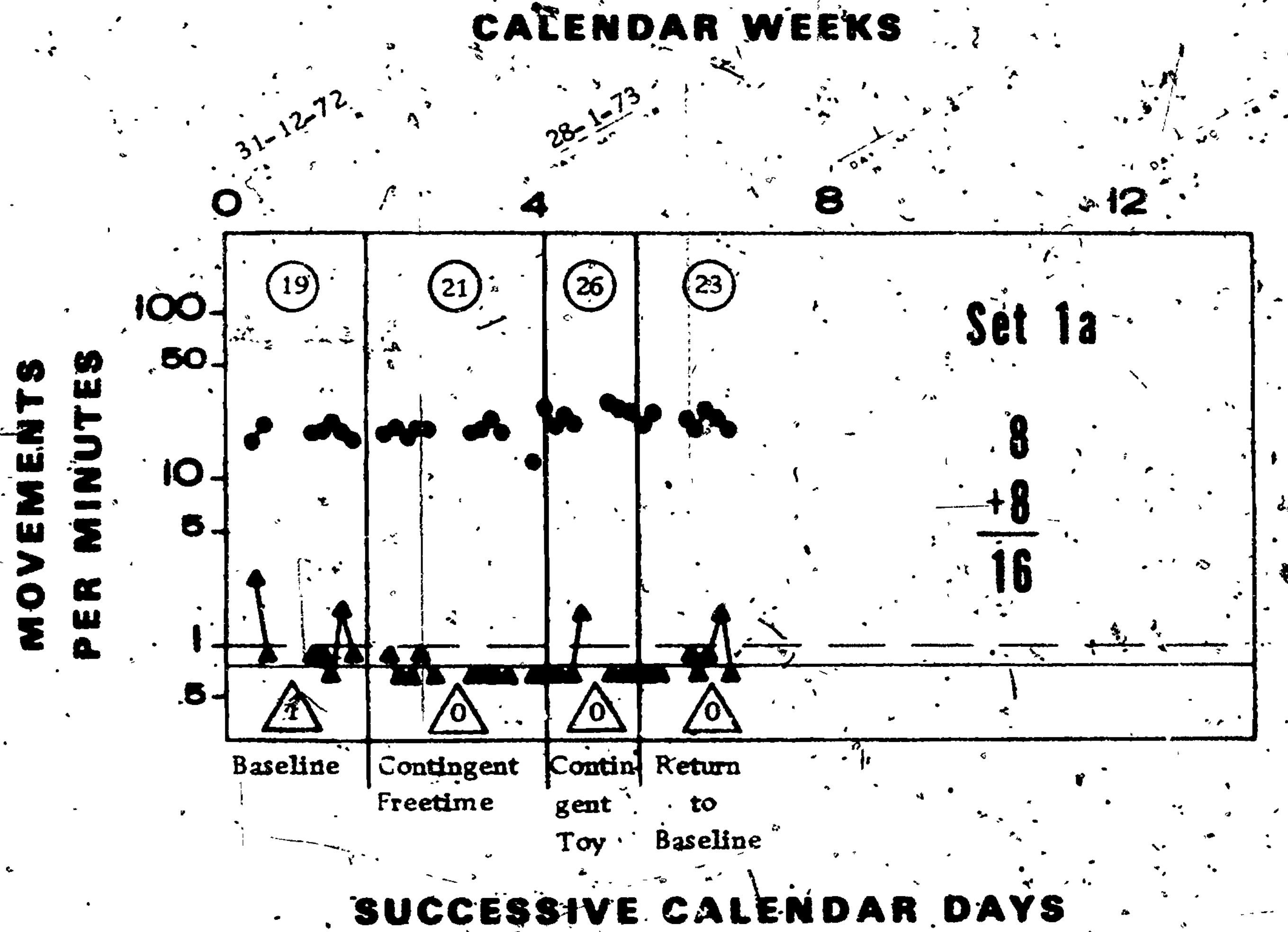

Stephan

Part II, Reinforcement Contingencies

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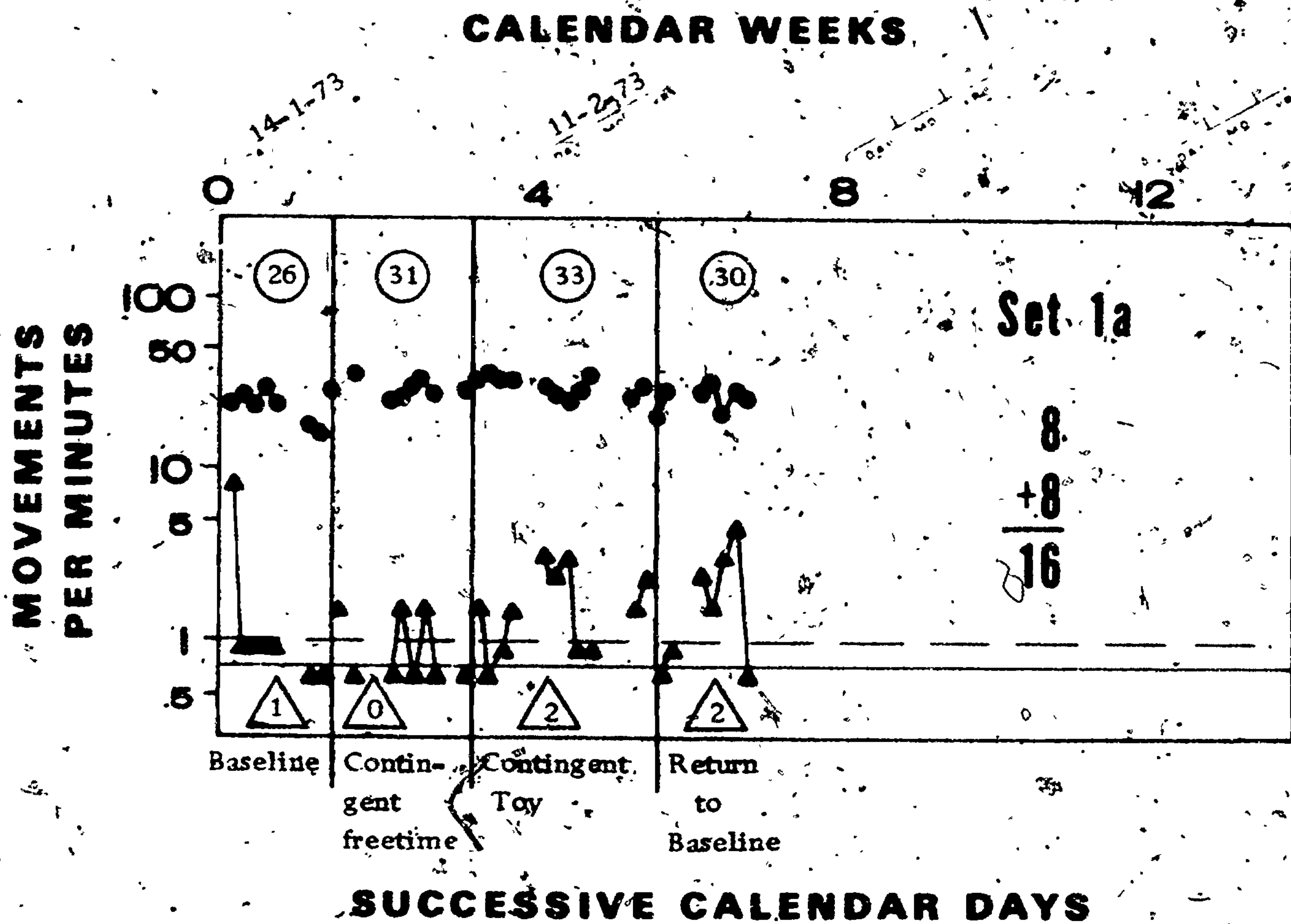
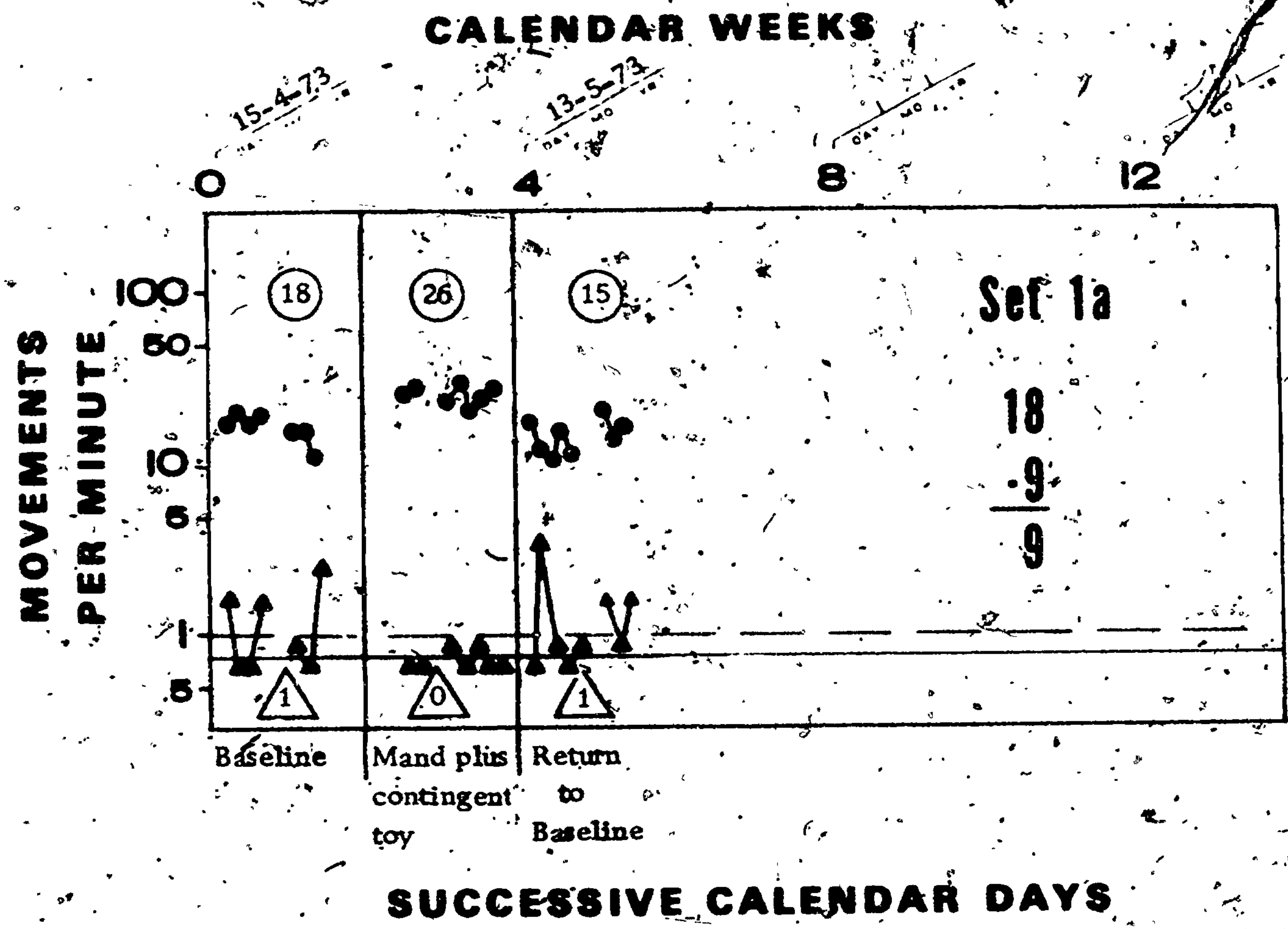


Rip

Part II, Reinforcement Contingencies



Rip

Part III, Instructional Mand plus Contingent Toy

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Table 1

Organization of Problem Types used in Proficiency Research

Problem Type	Description		Sample	Total
ADDITION-CARRY FACTS	Top Addend	one-digit (range from 1-9)	9 + 9 = 18	45
	Bottom Addend	one-digit (range from 1-9)		
	Sum	two-digit (ranged from 10-18)		
SUBTRACTION BORROW FACTS	Minuend	two-digit (ranged from 10-18)	18 - 9 = 9	45
	Subtrahend	one-digit (ranged from 1-9)		
	Remainder	one-digit (ranged from 1-9)		

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Table 2

Summary Data for Part I -- Instructional Mand

Subjects	Baseline				Percent of Change		Mand				Percent of Change		No Intervention			
	Median Rate		Median Slope				Median Rate		Median Slope				Median Rate		Median Slope	
	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E
Brett	11.0	0	x1.1	x1.0	+27	—	14.0	0	÷1.1	x1.0	+7	—	15.0	0	÷1.1	x1.0
John	15.5	1.0	x1.0	x1.1	+19	-50	18.5	0.5	÷1.2	x1.1	+14	∞	21.0	0	x1.3	x1.0
Kyle	20.0	0	x1.3	÷1.1	+67	—	34.0	0	x1.1	x1.0	-3	—	33.0	0	÷1.2	x1.0
Stephan	14.0	0	÷1.1	x1.0	+35	—	19.0	0	x1.0	÷1.1	0	—	19.0	1.0	÷1.1	x1.0
Rip	24.0	0	x1.1	x1.0	+17	∞	28.0	4.0	x1.0	x1.7	-7	-75	26.0	1.0	÷1.5	÷1.2
Rob	18.5	3.0	x1.2	x1.1	+24	+166	23.0	8.0	÷1.1	x1.0	-9	-75	21.0	2.0	x1.1	÷2.8
Stewart	9.0	0.5	÷1.3	÷1.1	+6	∞	9.5	0	x1.0	x1.0	-11	—	9.0	0	÷1.1	x1.0

— means zero divided into zero

∞ means zero divided by or into a number

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Table 3

Summary Data for Part II -- Reinforcement Contingencies

Subjects	Baseline				Percent of Change		Contingent Freetime				Percent of Change		Contingent Toy				Percent of Change		No Intervention			
	Median Rate		Median Slope				Median Rate		Median Slope				Median Rate		Median Slope				Median Rate		Median Slope	
	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E
Brett	15.0	0	÷1.1	x1.0	+27	—	19.0	0	÷1.0	x1.0	+21	—	23.0	0	x1.2	x1.0	-5	—	18.0	0	÷1.4	x1.0
John	21.0	0	x1.3	x1.0	0	—	21.0	0	x1.2	÷1.1	+21	∞	25.5	1.5	÷1.1	x2.0	-6	-33	23.0	1.0	÷1.1	÷1.1
Kyle	33.0	0	÷1.2	x1.0	+9	—	36.0	0	x1.1	x1.0	+7	—	39.0	0	÷1.1	x1.0	-8	—	36.0	0	x1.1	x1.0
Stephen	19.0	1.0	÷1.1	x1.0	+8	∞	20.5	0	÷1.1	x1.0	+21	—	26.0	0	x1.2	x1.0	-12	—	23.0	0	x1.1	x1.2
Rip	26.0	1.0	÷1.5	÷1.2	+19	∞	31.0	0	x1.0	x1.0	+6	∞	33.0	2.0	÷1.1	x1.0	-9	0	30.0	2.0	x1.0	x5.1
Rob	21.0	2.0	x1.1	÷2.7	+52	∞	33.0	0	x1.0	x1.0	0	∞	33.0	3.0	x1.0	÷1.5	-24	0	25.0	3.0	x1.3	÷1.4
Stewart	9.0	0	÷1.1	x1.0	+44	—	13.0	0	x1.0	x1.0	+19	—	16.0	0	÷1.1	x1.0	-25	—	12.0	0	÷1.2	x1.0

Table 4

Summary Data for

Part IV -- Instructional Mand plus Contingent Toy

Subjects	Baseline				Percent of Change		Mand plus Toy				Percent of Change		No Intervention			
	Median Rate		Median Slope				Median Rate		Median Slope				Median Rate		Median Slope	
	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E
Brett	18.0	0	÷1.3	x1.0	+11	—	20.0	0	÷1.3	x1.0	-70	—	6.0	0	x1.0	x1.0
John	18.0	1.0	x1.1	x2.1	+44	0	26.0	1.0	÷1.1	x1.0	-27	+100	19.0	2.0	÷1.2	x3.4
Kyle	21.5	0	÷1.4	x1.0	+44	—	31.0	0	÷1.1	x1.0	-39	—	19.0	0	x1.0	x1.0
Stephan	19.0	2.0	÷1.1	÷2.0	+11	0	21.0	2.0	x1.0	x1.0	-5	-50	20.0	1.0	÷1.1	x1.0
Rip	18.0	1.0	÷1.4	x1.2	+44	[illegible]	26.0	0	÷1.1	x1.0	-44	[illegible]	14.5	1.0	x1.2	x1.4
Rob	16.0	2.0	x1.4	x1.4	+47	-50	23.0	1.0	x1.1	÷2.9	-30	+100	16.0	2.0	x1.4	x2.2
Stewart	15.0	0	x1.2	÷1.1	+47	—	22.0	0	÷1.0	x1.0	+5	—	23.0	0	x1.1	x1.0

OH! THAT THIS TOO TOO SOLID FLESH WOULD MELT (THE EROSION OF ACHIEVEMENT TESTS)

Tom Lovitt and Marie Eaton

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Abstract

In this article the use of achievement tests to measure academic development, particularly in regard to reading, is examined. Direct and Daily measurement is recommended as a replacement for the achievement test approach. The two systems are compared in regard to three uses of measurement: for placement, evaluation and communication. In order to make these comparisons, achievement test scores and Direct and Daily measurement were obtained from 13 children over a two-year period. In this report both sets of data--achievement test scores and Direct and Daily measurement--from three pupils are described in order to compare the two systems.

OH! THAT THIS TOO TOO SOLID FLESH WOULD MELT
(THE EROSION OF ACHIEVEMENT TESTS)

Tom Lovitt and Marie Eaton
University of Washington

At the beginning of the school year many elementary schools throughout the country administer achievement tests. In others they are given in the spring, near the end of the year. Some elementary schools administer them in the fall and spring.

The scores from these tests are generally used for three purposes: for placement, for evaluation and for communication. In some schools a child's achievement test score is the primary data considered for his placement in a particular teaching environment. Often achievement test scores are used to evaluate reading programs. In many parts of the country they are used, along with other academic information, to indicate the scholastic development of children.

Although there are many achievement tests which are used to measure several academic behaviors, this report is concerned with only two achievement tests and the measurement of reading. Hopefully many of the remarks here, although derived from two tests and the measurement of reading, will be pertinent to other achievement tests and the measurement of other subjects.

There have always been individuals who raised at least moderate criticisms against the use of standardized achievement tests to measure the development of reading skills. Teachers, from time to time, have expressed some disenchantment regarding the results of achievement tests. They have noted that such tests do not always measure the reading skills that were taught. Some parents, when shown the test scores of their children, have been uncertain as to how to interpret the data. Reading experts have occasionally expressed dissatisfaction with achievement tests. For example, Strang (1968) suggested that the time and money spent in developing, administering and scoring achievement tests could be better used in training teachers to observe the daily performances of their pupils.

Recently, criticism about the use of achievement tests has been more widespread and certainly more impassioned. Many of today's arguments are more than rhetorical. Much of the criticism concerning the use of achievement tests stems from the fact that scores from those tests are now being used to determine the effectiveness of reading programs in many cities. The case of the evaluation of the reading program in New York City is representative of the reading evaluation dilemma faced by several school systems.

Yearly in that city, Metropolitan Achievement Tests are administered to children in elementary and intermediate grades. For the past few years, according to the norms of those tests, more and more New York City children were reading below average. According to the 1973 test results, 66.3% of the elementary children and 71.3% of the intermediate children were reading below their grave level. These data indicated that in 16 of the city's 31 decentralized community school districts, at least half of the intermediate pupils were reading two or more years below grade level.

Naturally, there were reactions to the reporting of those data. The Fleischman Commission, which recently completed a study of education in New York State, used the achievement test data to support the following recommendations regarding the instruction of reading: a) districts should screen teaching candidates for competence in teaching reading; b) "experienced" teachers should receive additional training in reading; c) reading specialists should be hired; d) reading should be emphasized in other subjects, e.g., science; and e) flexible reading programs should be developed. Implicit in these recommendations is the assumption that the method for evaluating reading--achievement tests--should not be changed.

Albert Shanker, President of the United Federation of Teachers in New York City, responded in behalf of the teachers he represents in regard to the low achievement test scores. He said that pupil mobility accounted in large measure for the low test scores. He pointed out that in New York City the mobility of pupils is so great that in many instances fewer than half the children tested one year in a given grade, school or district were in those same locations the year before. He contended that the low scores could have occurred because several thousand high-achieving students moved out and were replaced by low-achieving students. One of Shanker's recommendations was that more money should be devoted to reading instruction. Apparently, Shanker, like the Fleischman Commission, was willing to continue to use achievement tests to measure reading development.

Shanker's explanation for the low scores elicited, in turn, a reaction from Professor Kenneth B. Clark. Clark, a member of the State Board of Regents, remarked that the city's school budget had risen by more than 300 percent since 1954, while reading scores over the same period had steadily declined. Clark believed the low city-wide scores were "directly a function of the fact that these children are not being taught, and they're not being taught because they're not respected as human beings--they are regarded as subhumans, as noneducable. They are expected to fail." New York Times, December 3, 1973). Judging from those comments, Clark is also apparently an advocate of the use of achievement tests to monitor reading growth.

Meanwhile, an alternate viewpoint was offered. Herman LaFontaine, head of bilingual education for the New York City schools, expressed his sentiments about achievement tests by taking some liberties with Hamlet's soliloquy:

> To test, or not to test, that is the question. Whether 'tis nobler in the mind to suffer the slings and arrows of outrageous measurement, or to take arms against a sea of standardized tests and by opposing end them. (New York Times, March 25, 1973)

It is quite obvious that LaFontaine, unlike the Fleischman Commission, Albert Shanker or Kenneth Clark, was displeased with the use of achievement tests to evaluate reading. According to his parody, however, it is not clear whether he favors our continuing to use the current measurement system, or wishes to oppose this system by developing a counter-approach.

In the remainder of this article we would like to accept LaFontaine's final alternative in regard to achievement tests, "to take arms against a sea of standardized tests and by opposing end them." In addition to criticizing the current measurement system, we will, throughout this paper, offer an alternative measurement system.

This alternative approach, often referred to as Direct and Daily measurement, has a rich heritage. The research literature regarding the use of this system to measure academic performance, although recent, is quite substantial. More will be said throughout this paper about the elements of Direct and Daily measurement; so for the time being, we will provide only a brief explanation of the terms "direct" and "daily." "Direct" simply means that if reading orally from a Lippincott reader is the behavior of concern, measurement would be obtained as the pupil read orally from a Lippincott reader. "Daily" means that measurement would be obtained, if not daily, very often.

Relevant to the topic of this paper, many studies using Direct and Daily measurement have been reported where various reading performances were evaluated. Sidman (1 measured several components of pre-reading, such as visual and auditory discrimination. Staats (1964) measured several reading behaviors, among them identifying letters and answering comprehension questions. We (Lovitt, 1973) have conducted several studies where oral and silent reading and answering comprehension questions were measured.

In order to present Direct and Daily measurement as an alternative evaluation system, that method will be compared to the achievemer test system. The two approaches will be contrasted in regard to the three purposes for obtaining measurement: placement, evaluation and communication.

SETTING AND SUBJECTS

The setting was the Curriculum Research Classroom in the Experimental Education Unit, University of Washington. The Experimental Education Unit comprises 14 classrooms for exceptional children ranging in age from 5 to 18. The primary purpose of this unit is to investigate materials and procedures that are currently used to educate exceptional children. A further purpose is to design new approaches for the education of these children. The specific purpose of the Curriculum Research Classroom is to investigate techniques used with elementary and intermediate age children with specific learning problems.

The subjects in this report were 12 boys and one girl, pupils in the Curriculum Research Classroom. Six were in the class of 1970-71, seven in the 1971-72 class. Their ages ranged from 9 to 12. The pupils were generally characterized as being learning disabled. More specifically, they achieved academically from one to three years below the majority of children in their regular classes. Their families were middle or upper class. None of the pupils had perceptible neurological, physical or social problems.

PROCEDURES

Three types of procedures will be explained here: procedures for placing pupils in readers, procedures for daily reading instruction, and procedures for obtaining achievement test scores.

Placement Procedures

For five days the pupils were required to read orally from several basal readers. During the 1970-71 placement period, the pupils read daily from three readers from one to three series; they read from three to nine books. During the 1971-72 year, each pupil read from three readers from the Lippincott, Ginn 360 and Bank Street series. If, for example, it was believed that a pupil could read fairly well from a 2^1 reader, he was required to read from 1^2, 2^1 and 2^2 readers from each series. The 1971-72 children read daily from nine readers.

Each day, throughout this placement period, the pupils from both classes read orally from each reader for one minute. The teacher tallied each correct and incorrectly read word. After the pupil had finished reading, the teacher graphed a correct and error rate score for each reader. If on one day a pupil read 65 words correctly and 5 words incorrectly, a plot on the graph was made at 65 and another at 5.

As mentioned, this procedure lasted for five days. At the end of this period the teacher calculated a range for all of the readers. If a pupil read from three books from three basal series, there were nine sets of ranges: a correct rate range and an error rate range. The teacher also calculated a set of median scores for each reader: a correct and an error rate median. The median was the middle score of each group of five scores. Following placement for the class of 1970-71, the teacher selected from one to three readers for each child. These choices were based on median correct and error rates. The reader or readers where the pupil's correct rates were highest and his error rates the lowest were selected.

If the pupil was barely able to read orally, only one book was selected. He subsequently received oral reading instruction from that book. If the pupil was more advanced, two readers were chosen. Throughout his instructional period one text was used for oral reading, the other for silent reading. If the pupil was still more advanced, three readers were selected. He was placed in one for oral instruction, another for silent instruction, and simply read orally in the third without receiving instruction. The readers the 1970-71 pupils were actually placed in are included in Table 1.

TABLE 1 ABOUT HERE

At the end of the placement period for the class of 1971-72, the pupils were all placed in three readers. Each child was placed in one reader from the Lippincott, Bank Street and Ginn 360 series. In every case these selections were based on the highest median correct and lowest median error rate scores in the three series. During their subsequent period of instruction, the pupils received oral reading instruction from the Lippincott series, silent reading instruction from the Ginn 360, and no instruction from the Bank Street reader. The readers the 1971-72 pupils were placed in are included in Table 2.

TABLE 2 ABOUT HERE

It should be emphasized that whether the pupils were placed in one, two or three readers, placement decisions were based on their relative performance in a set of readers over a period of time.

Instruction Procedures

Following the placement of the pupils in readers using Direct and Daily measurement, reading instruction commenced. For those beginning formal reading instruction, they read orally for five minutes each day. As a pupil read, the teacher counted each correct and incorrectly read word. If the pupil could not pronounce a word or mispronounced a word, the word was pronounced by the teacher. These were the basic procedures in effect for the pupils from both classes.

As mentioned in the placement section, some pupils from the 1970-71 class read silently from a reader. Those pupils read for five minutes each day. The pupil who read from a third book simply read orally from that text; no instruction was scheduled for that book. It should also be mentioned that the pupils who read orally and silently were asked to answer comprehension questions each day.

Each pupil in the class of 1971-72 read from three readers. They read orally from a Lippincott reader for five minutes, then answered some comprehension questions. Next they read silently for five minutes from a Ginn 360 reader and answered some comprehension questions. Finally, they read orally for five minutes from a Bank Street reader and answered some comprehension questions. They received no instruction as they read from this latter series.

The reason for using the non-instructed reader in this class and for one pupil in the class of 1970-71 was to secure material for another research study. The non-instructed reader served as a control; instruction was never associated with that reader. Instruction was always focused on another reader. When such a design is used, if gains are noted in the instructed reader but not in the other, those gains can be attributed with some confidence to the scheduled instructional technique.

Most of the pupils in both classes read orally, silently and answered comprehension questions. Daily data were obtained on all those skills. However, for the purpose of this report only the oral reading data are included.

Achievement Test Procedures

For both classes two achievement tests were administered in the fall and repeated again in the spring. All the pupils were given the Wide Range Achievement Test (WRAT) and the Metropolitan Achievement Test (MAT).

Since there is only one form of the WRAT (Jastak, Bijou and Jastak, 1965), that form was administered to all the pupils. Several MAT forms are available (Metropolitan Achievement Test, 1959, 1961, 1965). The pupils in the 1970-71 class were administered either the primary, primary^2, elementary or intermediate battery, depending on their abilities. All the pupils in the 1971-72 class were given the intermediate battery.

For the class of 1971-72, portions of the MAT were administered twice after the post-test. One week after the post-test the word knowledge and word discrimination portions of the test were given. These subtests were administered again two weeks later.

COMPARATIVE DATA

The reading performance of the pupils in the two classes was measured in two ways: by achievement tests and by Direct and Daily measurement. Achievement tests were used to measure performance at the beginning and the end of a year. Meanwhile, Direct and Daily measurement was used every day throughout the year.

In order to compare the two measurement approaches with respect to placement, communication and evaluation, both types of data for three pupils will be presented.

For the first pupil the two measurement approaches were at odds regarding the gains made in reading throughout a year. According to one achievement test he regressed in reading from the beginning to the end of the year. Meanwhile, Direct and Daily measurement indicated rather significant improvement. For the second pupil the opposite was indicated. According to one achievement test, sensational growth was observed. When Direct and Daily measurement was used, progress was also indicated, but the change from beginning to end of the year was far less spectacular. The third case was selected to illustrate that occasionally the amount of growth reported by both methods, achievement tests and Direct and Daily measurement, is about the same.

<u>Case Number 1 - Paul</u>

Paul was an 11-year-old boy. When he was given the MAT (Primary[2] Battery) and the WRAT in September 1970, his reading scores were 1.0 and 2.7. (Throughout this report only one MAT score is given. That score is the composite of the several subtest scores.) When Direct and Daily measurement placement procedures were used his best scores were in the Palo Alto Book 3 (first grade level) and a Bank Street primer. Thus, when placed according to Direct and Daily scores, he was placed in lower readers than he would have been had achievement test scores been used.

Figure 1 shows the progress Paul made in reading from the Bank Street series throughout the year using Direct and Daily measurement. In September, when initially placed in a primer, he showed correct rates of about 30 words per minute and error rates of about 2 words per minute. During this time the only instructional procedure in effect for oral reading was a form of feedback for errors. If he mispronounced or did not pronounce a word, he was told that word.

FIGURE 1 ABOUT HERE

The reader will note that after a period of 14 days the conditions were changed. This instructional change is indicated on the figure by a vertical line. Since, during the first condition, his correct rates were not improving and his error rates were climbing slightly, an instructional procedure was changed by scheduling a contingency. For each ten correctly read words he received one point (10:1). Points were redeemable for minutes of free time. When the data throughout this phase were studied, a positive influence on correct rate was indicated. Therefore, during the third phase the ratio was increased. Each point required 15 correctly read words. Throughout this phase his correct rate increased and his errors declined.

Throughout the fourth condition the contingency was withdrawn. Surprisingly, his correct rate maintained. During this condition, however, his error rates began to increase. Therefore, in the fifth condition a contingency was scheduled which was designed to decrease errors. Throughout this phase if the pupil achieved a correct rate above 50 and an error rate below 2, he was awarded points on a 25:1 ratio; that is, for each 25 correctly read words he earned one point. This proved to be an effective procedure in that his error rate dropped and his correct rate increased.

In the final condition, the requirements that he read correctly at a rate above 50 and make errors at a rate less than 2, remained in effect. The ratio of this phase was extended, however, so that he now had to read 30 correct words for each point. Throughout this phase his correct rate remained about the same as during the preceding phase and his errors fell slightly until the end of the term.

By studying this boy's graph from September to June, the reader will note that his correct rates improved from a fall median of 29.6 words per minute to a spring median of 65.8 words per minute. Error rates during this same period changed from 2.0 to 1.0 words per minute. Thus, correct and error rates doubled in improvement from fall to spring.

Not only did Paul read faster and more accurately as the year progressed, he read from more difficult material at the end of the year than in the beginning. He was initially placed in a 1^1 reader and by the end of the year was reading from a 2^2 text.

Although he made obvious progress, as is indicated by the graph, these gains were reflected on only one achievement test, the MAT. According to that test, he read at 1.0 level in the fall and 2.7 in the spring. The WRAT revealed that he deteriorated throughout the year. On that test he received a score of 2.7 in the fall and a 2.5 score in the spring. On the evidence of these data, which disclosed a decay in performance throughout the year, Paul might well be referred to as a non-achiever. In future years, if these achievement test scores were seriously considered, he might not be expected to learn anything. If he did improve in a future setting, as he did this year, that development might be attributed to a super effort on his part.

Even though the placement recommendation of the MAT and the evaluation of progress by the MAT were similar to the placement recommendation and evaluation of progress when Direct and Daily procedures were followed, great discrepancies appear between the two systems when it comes to communicating the pupil's progress. In this regard, if information from the MAT were used, the pupil's parents or next year's teacher could be told only that he had one score in the beginning of the year and another score at the end. In contrast, when Direct and Daily measurement is used, the parent and receiving teacher can be informed as to when progress was made, how much was made and to what it was attributed. This latter information would be particularly informative to his next year teacher. Not only would she know which reader to begin Paul with (assuming she was interested in integrating the teaching from one year to the next), but she would know which procedures to use in order to be most effective.

One reason for going into some detail about Paul's graph has been to illustrate that progress throughout a year is not always steady. Although Paul gained in every respect from fall to spring, his development was not smooth. Throughout the year four instructional procedures were scheduled, some were more effective than others.

Case Number 2 - John

John was nine years old. In September when the achievement tests were given, his score on the MAT was 1.1. He scored at the seventh month of kindergarten on the WRAT. When Direct and Daily procedures were used, John's best scores were from reading a Lippincott pre-primer. In this case Direct and Daily placement procedures agreed more with the WRAT than with the MAT.

As to the evaluation of John's reading throughout the year, we will first describe his progress using Direct and Daily measurement, then according to the achievement tests. During the first three weeks of school John's median correct rate was 45.0 words per minute with a median error rate of 1.8 words per minute. His reading rates fluctuated widely from one day to the next: correct rates ranged from 21.0 to 100.0 words per minute, and error rates ranged from 1.2 to 9.0 words per minute.

Throughout this initial period the procedures during the oral reading sessions were very simple. If John was unable to pronounce a word or mispronounced a word, he was told that word. No additional teaching techniques or reinforcement procedures were scheduled. As the year progressed, a few instructional changes, as was the case with Paul, were made along the way. These changes were always based on John's data. If his error rates began to increase, techniques intended to improve that aspect of performance were scheduled; correspondingly, if his correct rate was not increasing, techniques were arranged for that aspect of performance.

By the end of the year John was reading from a 2[1] Lippincott book. His median correct and error rates were 75.0 and 2.2 words per minute. At this time his daily performances were much more stable than during the first part of the year.

When it comes to evaluating progress using Direct and Daily measurement, John's correct rate nearly doubled from beginning to end of the year, his error rate went up slightly, and he moved from a primer to a 2^1 text. When achievement tests were used to evaluate progress throughout the year, a 2.9 grade level increase was noted by the MAT, and an eight-year increase was indicated by the WRAT.

The remarkable improvement reflected by the WRAT was probably due to the phonics approach used with John throughout the year. Since he read from a phonics reader and one of the instructional techniques used during the year was phonics drills, John became adept at decoding words. And since the reading evaluation on the WRAT simply requires the pupil to say isolated words and he was able to say them within the time limit on the test, John was able to pronounce many difficult words.

This possible explanation for his impressive growth on the WRAT is offered to illustrate what can happen when indirect measurement is used. Since John's teacher wanted him to read in context from a reader and was not particularly concerned about his ability to say isolated words, a more accurate assessment of this skill was provided as he read material from Lippincott texts than from identifying a series of unrelated words.

In regard to the reporting of John's progress to his parents or to a receiving teacher when either system is used, the same points discussed for Paul are again applicable. That is, if Direct and Daily measurement is used, the people who receive the information can be told about correct and error rate changes across time and about advancement through readers, in this case a preprimer to a 2^1 text. Further, the receiving teacher can be told which instructional techniques were effective and which ones were not. She will not have to begin the year searching for effective instructional techniques.

If a receiving teacher used the previous spring's WRAT score for John's placement, the consequences to his future development could be disastrous. If he was placed at the beginning of the year in an 8.7 reader, the probability is great that he would fail miserably. If this happened he could be sent to a psychologist or other diagnostician. They could be requested to explain the reason for the huge discrepancy between his current classroom performance and his last spring's achievement test score. Many hypotheses for this disparity could be advanced: a stressful school situation, uncooperative parents, poor reading method, inappropriate material; lack of motivation. John could be labeled an underachiever. There is a great chance he would never reach the pinnacle of that one day in May when he scored so well on the WRAT. With such a label John could spend more time in the waiting rooms of diagnosticians than actually being helped to read.

Case Number 3 - Jim

Jim was ten years old. When the achievement tests were administered in the fall, he scored at the 2.2 level on the WRAT and 3.0 level on the MAT (Table 2). When Direct and Daily procedures were used, his best scores were obtained when he read from a primer. In reference to placement neither achievement test agreed with Direct and Daily measurement. Had he been placed according to an achievement test, he would have begun in material two or three years beyond his actual abilities.

Figure 2 is provided to display Jim's achievement as measured by Direct and Daily procedures throughout the year. At the beginning of the year Jim read from a primer (Lippincott Book B), and by the end of the year he was reading from a 1^2 (Book D) book. During the first few weeks of school his correct and error rate medians were 23.8 and 4.5 words per minute. By the end of the year those rates were 63.0 and 3.5 words per minute.

FIGURE 2 ABOUT HERE

Jim's year of reading consisted of seven conditions. During the first condition, a baseline, the instructional procedures were the same as those used with Paul and John. If he could not pronounce a word or mispronounced a word, he was told that word. Throughout Condition 2, he was required to rehearse his errors. As he read, the teacher noted each error word. Following each reading session he was drilled on those words for ten minutes.

Condition 3 was a return to baseline conditions. Throughout the fourth condition the pupil read the story orally before he again read it orally. The first reading was the practice period; he was stopped periodically and coached on certain troublesome words. When he read the second time, the conditions were like those during the baseline. The data from the second readings were graphed.

Throughout the fifth condition no instruction was scheduled. The conditions were like previous baselines. During the next condition oral pre-reading was again instituted. The final condition was a return to baseline conditions for the fourth time.

Jim's progress, like that of the other boys, was not smooth throughout the year. His correct and error rates were variously responsive to the instructional techniques that were used. As is apparent in the graph, his correct rates did not steadily increase from beginning to end of the study. Neither did his error rates steadily decrease.

The data throughout the year indicate how one instructional technique can be compared with another. During the first three conditions, the error drill procedure was assessed. The effects of that technique can be determined by comparing the data from the second condition, when the intervention was used, to the data from the first and third phases, when the intervention was not used. As the graph indicates, his best performance, in respect to correct and error rates, was during the third phase when no error instruction was used. This might seem to indicate that Jim would have progressed in spite of the error drill. An alternate explanation might be that error drill facilitated change in the second phase, then, when the intervention was removed, Jim had progressed to the point where other variables continued to influence his reading.

Throughout Conditions 3 through 7 the second technique, oral pre-reading, was evaluated. The effects of this technique can be ascertained if the conditions where pre-reading was used are compared to adjacent conditions where it was not scheduled. That is, Condition 4 should be compared with Conditions 3 and 5, and Condition 6 should be compared with Conditions 5 and 7.

When correct rate comparisons are made, it is obvious that reading performance here was significantly better during pre-reading circumstances, Conditions 4 and 6. Correct rates, during pre-reading conditions, were about 50% higher than during conditions when pre-reading was not scheduled.

Such a clear-cut advantage was not apparent for error rates when compared across conditions. However, during the final four conditions the error rate medians were lowest in the two phases where the pre-reading technique was used.

When the effectiveness of the two techniques--error drill and pre-reading--is compared, there is little doubt as to the winner. Clearly, for Jim, oral pre-reading was a much more influential technique than error drill.

When Jim's progress was evaluated according to the achievement tests, the MAT indicated a 1.3 year gain, and the WRAT, a gain of 1.5 years. These gains were about the same as those revealed by Direct and Daily measurement, which illustrated a chan-e of about a year and one-half. It must be pointed out, however, that although all measures agreed as to the amount of change, that change occurred at different levels. According to the MAT, Jim moved from 2.2 to 3.5. The WRAT reported change from 3.0 to 4.5. His actual progress, according to Direct and Daily measurement, was from a primer to a 1^2 reader.

As to the type of information from either system that could be conveyed to another person, the same features discussed in the previous cases are evident. Jim's parents and his next year's teacher could be told about his correct and error rates and which readers had been covered. His next year's teacher could be informed with great confidence that oral pre-reading is an effective technique for him.

DISCUSSION

We have, in this paper, attempted to illustrate how the data obtained from achievement tests and those obtained from Direct and Daily measurement differ. We have discussed differences in regard to three functions: placement, evaluation, and communication. In order to show differences between the two systems we used three cases, each illustrating certain disparities between the two systems. Over a period of two years we compared the two approaches with 13 pupils. The data from those pupils indicated the same discrepancies discussed in this report and others.

We would like to summarize several differences between the two systems that were not discussed earlier. First (and this is a within-system comment), the two achievement tests did not agree. When the fall tests were compared, the WRAT score was higher 10 of 13 times. When the spring scores were compared, the WRAT scores were higher 9 of 13 times.

When the higher achievement test score in the fall was compared to Direct and Daily measurement as related to placement, children would have been placed higher 13 of 13 times had the achievement test score been used. Had the lower score in the fall been used for placement, the pupils would have been placed too high 10 of 13 times. The Direct and Daily system clearly indicated the children were unable to read at those higher levels.

When gain scores from fall to spring were compared between the two achievement tests, children gained more according to the WRAT 6 of 13 times, and more according to the MAT 6 of 13 times (one tie was noted). As to amount of gain, the two agreed within one-half year of each other only 6 of 13 times.

When gains according to Direct and Daily measurement were compared to those indicated by achievement tests, Direct and Daily scores agreed within six months with both the MAT and WRAT 4 of 13 times. When these comparisons were made, Lippincott data were used from the 1971-72 class and the starred reader in the class of 1970-71. These were the readers used for oral reading instruction.

It must be pointed out that although these gain scores were the same about one-third of the time, gains were often noted at different levels. As was evident with Jim, although the two systems reported similar amounts of growth, that change occurred at different levels. This type of discrepancy was noted more often between the WRAT and Direct and Daily measurement than when the MAT and Direct and Daily procedures were compared.

In regard to placement and evaluation, the MAT agreed more closely with Direct and Daily measurement than did the WRAT. Relatively, then, the MAT composite score was more directly related to the oral reading achievement of the pupils in this report than was the WRAT score.

In addition to the issue of directness, we were also concerned with frequency of measurement, so an achievement test was given repeatedly. As explained in the procedures section, subtests of the MAT were given three times at the end of the year. (These additional two tests were given to six boys.) These data revealed rather interesting findings. First, when the three word-knowledge scores were compared we found that: a) the second score was higher than the first, 2 of 6 times; b) the third score was higher than the second, 2 of 6 times; c) the third score was higher than the first, 2 of 6 times; and d) the variability from first to last score ranged from -.7 to .5 of a year. Second, when the word-discrimination scores were compared, we found that: a) the second score was higher than the first, 3 of 6 times; b) the third score was higher than the second, 1 of 6 times; c) the third score was higher than the first, 3 of 6 times; and d) the variability from first to last score ranged from -.8 to .7.

This analysis of the word-knowledge and word-discrimination scores point out that, contrary to the views of some who warned that scores would rise because of repeated exposures to the test, scores did not always increase from first to third test. More importantly, confronted by the wide variability of scores on both tasks, the interpreter of any one test score should be extremely cautious when stating that a single score reflects the true performance of a child.

Although this paper is not intended as a technological treatise on how to use Direct and Daily measurement, such a measurement system is not difficult to explain or use. First, the teacher should identify what she wishes to teach (in this case oral reading), then define that behavior as to correctness and incorrectness in order that both may be counted. Second, a situation must be arranged so that the pupil can respond. The many environmental occurrences and circumstances during these sessions should be consistently arranged. Third, correct and error rate data should be graphed each day. The teacher should then, of course, study these data in order to determine whether or not the child is progressing. Fourth, if progress is not occurring, something should be changed; a different instructional variable must be scheduled. The evaluator of the data should then continue to monitor the effects of the intervention.

This last point brings out a fourth advantage of Direct and Daily measurement over the achievement test method. In addition to being a valid and reliable measurement system in regard to placement, evaluation and communication, the instructional process is more vividly brought into focus under Direct and Daily procedures. When this approach to measurement is used, and when the teacher scrutinizes the data each day, she is informed continually about the pupil's success or failure. As is explained in the preceding paragraph, if the current instructional procedure is not effective, a change can quickly be made. In contrast, achievement tests can never serve such a function. Were they used to prompt instructional change, the teacher would be able to switch procedures only in September and May.

In this paper we have reported on only oral reading data. As indicated in the paper, we also kept data on silent reading and on various comprehension skills. Oral reading data were presented to make a point of comparisons. Data in regard to the other reading behaviors would have made the same point, that Direct and Daily measurement and achievement tests do indeed furnish different views of reading development.

Many teachers of reading would argue that reading is more than oral reading, more than oral and silent reading and answering comprehension questions. We would agree; however, we maintain that the three behaviors cited are, for developing readers, important elements of the reading process.

But whatever the reading skill, if it is defined it can be measured and graphed. If this can be done it can possibly be improved. So whatever the reading behavior, be it writing resumes of stories, integrating currently read material with past stories, defining words or writing literary criticism, the Direct and Daily system is appropriate. Because of the advantages advanced in this paper, it is certainly a more suitable system than the use of achievement tests.

The reasons for using Direct and Daily measurement rather than achievement tests should be carefully considered, for the future development of individuals is at stake. Two potential misuses of achievement tests have been discussed here. In Paul's case, had only achievement test scores been seriously considered, he might well have been labeled an overachiever or perhaps a nonachiever. The consequences, if the latter label persisted, would be that teachers might not attempt to teach him. If this happened he would quite likely become more and more discrepant from his peers.

In John's case, if achievement tests alone were considered, he might have been given another label, an underachiever. Such a label, if it stuck, could result in a great deal of mental anguish. If he were over-placed in subsequent years and could not produce, his teachers might continually harp at him and his parents about how they knew he could achieve if he just tried. These are but two examples of the misuse of achievement test scores. There are many others.

Direct and Daily measurement does not result in a label. Even if a child was called an 85.9-2.5 (his correct and error rate in reading for a day), these scores would change (hopefully for the better) the next day. Direct and Daily measurement is by definition a dynamic system that reports growth, unlike the achievement test system that provides an indirectly relevant score that is a static misrepresentation of progress.

Obviously, our recommendation to reading teachers in New York City and elsewhere is that they use Direct and Daily measurement. I sympathize with Mr. LaFontaine who so eloquently condemns achievement tests, and I agree with Ms. Strang, who has contended that more time should be spent in teaching than in developing achievement tests.

Although achievement tests have for decades been acclaimed as the yardsticks by which to measure educational progress, recent criticism has led to a breach of the once-impregnable system. If the reader will tolerate one last bow to Hamlet, we will let our noble prince pronounce the final obsequies to achievement tests and hail their replacement, Direct and Daily measurement.

> Alas, poor achievement tests! I knew them,
> WRAT and MAT: fellows of infinite jest,
> of most skillful delusion: they have
> borne evaluators on their backs for decades;
> and now, how eagerly in my imagination
> it is! My hope rises at it. Here, hung
> on those bannisters of schoolrooms that
> I have so oft seen, are strung the withered
> testing kits. Where be your stanines now?
> your subtests? your administrator's guides?
> your indirect attempts to evaluate, that were
> wont to report pupil gain? your infrequent assays
> of pupil progress? Now the multitude mocks your
> simplistic and fraudulent measurement attempts.
> Now get you into the principal's trash, and lie there,
> let him dump other waste on your sheets, to this
> end you will come. But none too soon, for countless
> souls have been misrepresented. Prithee, you
> measurers of skills, tell me one thing--that you
> will forevermore use the Direct and Daily form.

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FIGURE CAPTIONS

Figure 1: Direct and Daily measurement of words read orally throughout the 1970-71 year for Paul. Separations in the data points indicate absences, weekends or vacations. The five vertical lines indicate when different instructional procedures were in effect. The circled numerals below the correct rate plots are the median correct rates for each phase; the numerals in the triangles are median error rates. Two medians were figured for conditions which included vacation periods. The numbers along the top of the graph indicate which Bank Street readers were being used.

Figure 2: Correct and error rate data throughout the school year for Jim. Correct rate medians for each condition are enclosed in circles; error rate medians are enclosed in triangles. The six vertical lines separate the seven conditions of the year. The Lippincott readers used throughout the year are indicated along the top of the graph.

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TABLE 1

Achievement Test Scores and Placement According to Direct and Daily Measurement (1970-71)

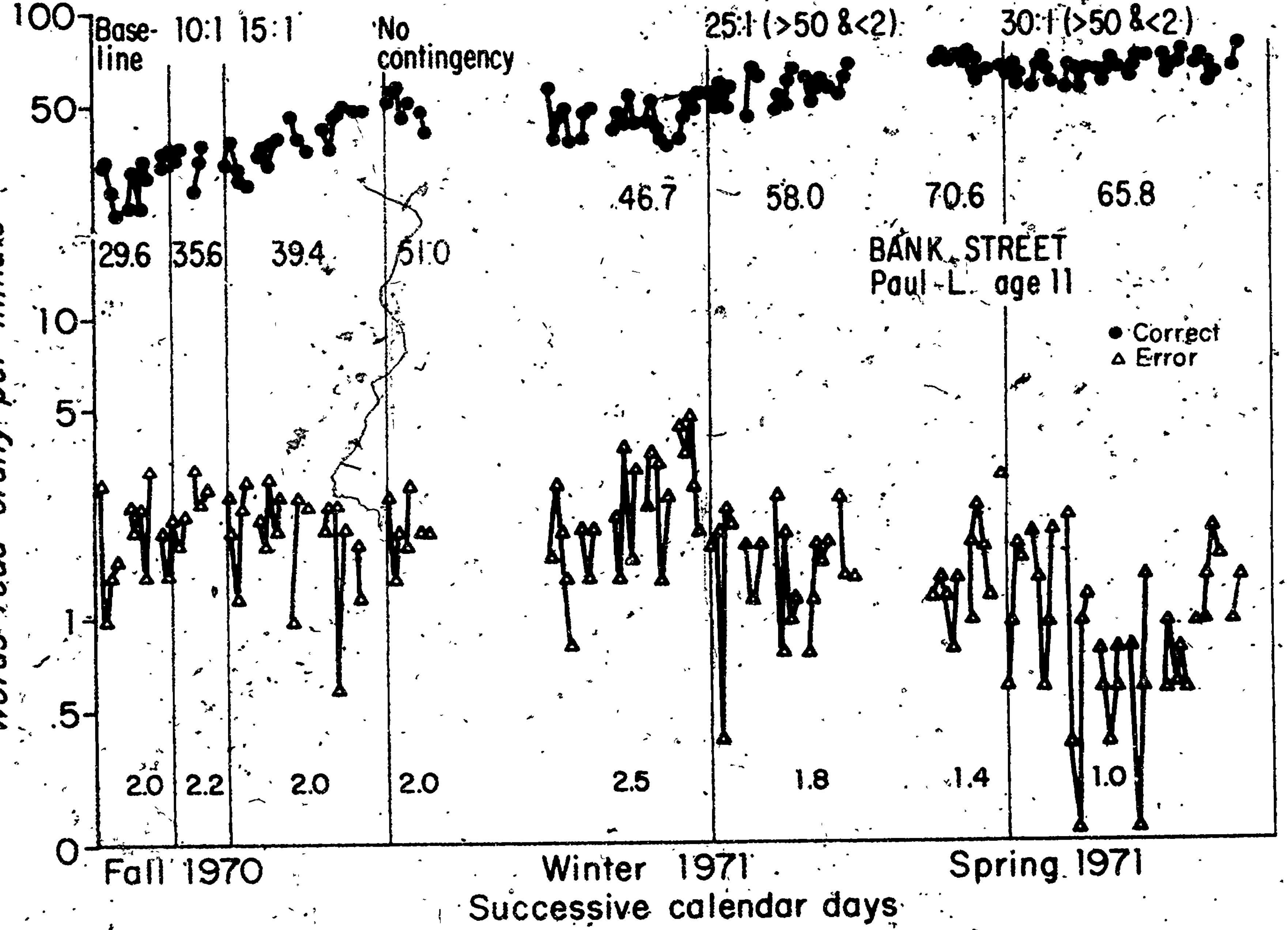
Child	Metropolitan Achievement Test		Wide Range Achievement Test		Direct and Daily Placements		
	Fall	Spring	Fall	Spring	Book	Fall	Spring
Paul L.	1.0 P^2	2.7 E	2.7	2.5	Lippincott Palo Alto *Bank Street	-- Book 3 Primer	2-2 2-2
Paul R.	2.6 E	4.0 I	2.5	2.5	*Bank Street Scott Foresman	2-1 2-1	3-1 4-1
John	1.1 P	4.0 E	KG 7	8.7	*Lippincott Palo Alto	Pre-Primer --	2-1 Book 11
Fred	1.6 E	2.5 E	1.9	1.9	Merrill *Bank Street	-- Primer	Book 5 2-2
Jenni	2.4 E	6.8 I	4.4	4.8	Lippincott Laidlaw *McMillan	3-1 3-1 3-1	Book 5 Book 5 Book 5
Phil	None Low Enough	1.7 P	KG 5	1.9	*Lippincott Bank Street	Pre-Primer --	1-1 1-1

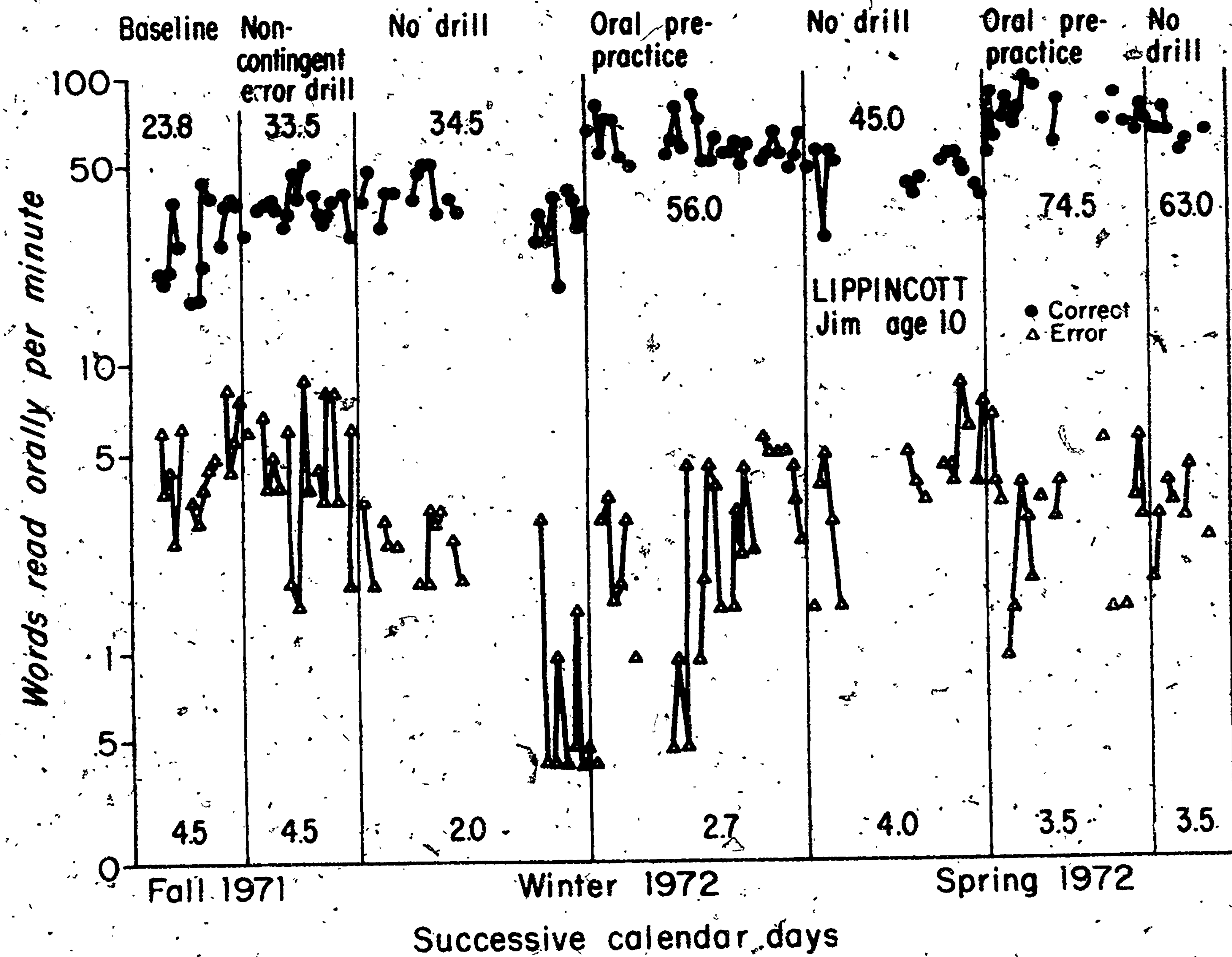
P = Primary Battery
P^2 = Primary^2 Battery
E = Elementary Battery
I = Intermediate Battery
* = Reader used for oral reading instruction

TABLE 2

Achievement Test Scores and Placement According to Direct and Daily Measurement (1971-72)

Child	Metropolitan Achievement Test		Wide Range Achievement Test		Direct and Daily Placement		
	Fall	Spring	Fall	Spring	Book	Fall	Spring
Jack	2.2	3.5	2.5	3.8	Lippincott	Primer	2-1
					Bank Street	1-1	1-2
					Ginn 360		2-1
Jim	2.2	3.5	3.0	4.5	Lippincott	Primer	1-2
					Bank Street	Primer	1-2
					Ginn 360	Primer	1-2
Erin	3.0	3.8	4.5	4.4	Lippincott	1-2	2-2
					Bank Street	2-1	2-2
					Ginn 360	1-2	3-1
Philip	2.4	2.7	2.2	3.5	Lippincott	Primer	1-2
					Bank Street	Primer	1-2
					Ginn 360	1-1	1-2
Randy	3.4	3.1	3.3	3.5	Lippincott	1-1	1-2
					Bank Street	Primer	1-2
					Ginn 360	Primer	1-2
Ted	2.3	2.8	3.5	4.2	Lippincott	Primer	2-1
					Bank Street	1-2	2-1
					Ginn 360	1-1	2-1
Dwight	1.7	2.5	3.5	4.5	Lippincott	Primer	1-2
					Bank Street	Primer	1-2
					Ginn 360	Primer	2-1


Base-line
10:1
15:1
No contingency
25:1 (>50 &<2)
30:1 (>50 &<2)
29.6
35.6
39.4
51.0
46.7
58.0
70.6
65.8
BANK STREET
Paul L. age 11
Correct
Error
2.0
2.2
2.0
2.0
2.5
1.8
1.4
1.0
100
50
10
5
1
.5
0
Words read orally per-minute
Fall 1970
Winter 1971
Spring 1971
Successive calendar days


Baseline
Non-contingent error drill
No drill
Oral pre-practice
No drill
Oral pre-practice
No drill
23.8
33.5
34.5
56.0
45.0
74.5
63.0
4.5
4.5
2.0
2.7
4.0
3.5
3.5
LIPPINCOTT
Jim age 10
● Correct
▵ Error
Words read orally per minute
100
50
10
5
1
.5
0
Fall 1971
Winter 1972
Spring 1972
Successive calendar days

THE RELATIONSHIP BETWEEN QUESTION TYPE AND MODE OF READING ON THE ABILITY TO COMPREHEND

Cheryl L. Hansen and Thomas C. Lovitt

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ABSTRACT

A year long study of oral reading and comprehension was conducted with a class of seven boys aged 9 - 12 who had been labeled learning disabled. This report deals with two aspects of that study: a) the relative performance of the pupils on three types of comprehension questions (recall, sequence, and interpretation), and b) the relationship between mode of reading (oral or silent) and ability to comprehend.

Three findings relevant to types of comprehension questions are reported: a) comprehension ability was highest on recall questions and lowest on interpretation questions; b) the ability to comprehend all types of questions improved during the year, this improvement varied by type of question; and c) one instructional technique (correction of comprehension errors) resulted in improved performance on all types of comprehension questions.

Two findings relevant to the relationship of mode of reading and ability to comprehend are reported: a) pupils' abilities to comprehend were influenced by mode of reading; comprehension performance was always higher when material was read orally, and b) the ability to comprehend material read both orally and silently improved during the year. The disparity between comprehension performance from one mode to the other remained unchanged from beginning to end of the year.

THE RELATIONSHIP BETWEEN QUESTION TYPE AND MODE OF READING ON THE ABILITY TO COMPREHEND[1]

Cheryl L. Hansen[2] and Thomas C. Lovitt[3]
University of Washington

During the 1972-1973 school year, we conducted a study designed to explore certain relationships between oral and silent reading and the ability to comprehend. More specifically, we had four aims: a) to study the relationship between oral reading and its comprehension; b) to study the direct effects of an intervention on oral reading, and the direct effects of an intervention on the comprehension of orally read material; c) to study the indirect effects of an intervention on oral reading and the comprehension of orally read material when the intervention was scheduled for the alternate behavior; and d) to determine whether silent reading and the comprehension of silently read material would be influenced by interventions scheduled for oral reading and its comprehension.

In order to obtain data relevant to these questions, our class of seven boys was divided into two "groups." Daily records were kept on the rate of oral and silent reading, and the percent of correctly answered comprehension questions for both types of reading. Throughout the year, interventions were alternately focused on either oral reading or the comprehension of orally read material. Interventions were never arranged for silent reading or its comprehension.

The design of the study is presented in Figure 1. Throughout the year there were nine phases. During the baseline phase, no intervention was arranged for either group. During the second phase, an intervention for oral reading was arranged for group 1, and for the comprehension of orally read material for group 2. As indicated by the figure, the interventions were alternated throughout the year for the two groups.

Insert Figure 1 About Here

The intervention technique used for oral reading and its comprehension was about the same. When the technique was associated with oral reading the students were required to pronounce correctly all the words they had incorrectly pronounced during the oral reading session. When the technique was scheduled for comprehension, the pupils were asked to refer to the book and correctly answer each comprehension question that was initially answered incorrectly. Three major findings were reported from this study. One, the greatest performance changes were noted in skills in which the intervention was directly focused. For instance, when the intervention was scheduled for the comprehension of orally read material, performance on that skill improved more than performance in oral reading. A second finding was that when the intervention was directed toward either oral reading or its comprehension, positive changes were noted on all other measures. A third finding was that when performance increases on all measured behaviors were studied, as a function of either intervention, the gains were more pervasive when the intervention was scheduled for the comprehension of orally read material (Hansen & Lovitt, 1973).

In this report we will discuss two other findings from that study: a) the relative performance of the pupils on three types of comprehension questions, and b) the relationship between the ability to comprehend material read orally and material read silently.

The relative difficulty of various types of comprehension questions before training has been the subject of a few investigations. Feinman (1972) reported that second and third grade students were more able to comprehend literal comprehension questions than inferential questions. Davis (1969) reported a similar finding with students in the middle grades. In two other studies (Bickley, Weaver, & Ford, 1968; Rystrom, 1970) it was reported that factual questions were easier to answer than other types of questions.

The effects of incentives on factual and inferred questions were investigated by Fraze (1971). His results indicated that incentives positively influenced comprehension performance and concluded that factual questions were more easily answered than inferential questions.

All those studies dealt with the ability to comprehend before training. We were unable to locate any research that dealt with the effects of some training procedures on the ability to answer various types of comprehension questions.

Although oral vs. silent reading has been discussed for many years at the primary school level, the relationship between mode of reading and the comprehension of material read by either mode has apparently not been investigated. Two studies, using adults as subjects, investigated the relationship between oral and silent reading and the comprehension of questions from both modes. These studies concluded that adults exhibited better comprehension abilities from silently read material (Poulton & Brown 1967; Weaver, Holmes, & Reynolds, 1970).

METHOD

Subjects and Setting

This study was conducted with seven learning disabled boys, ages 9 - 12. At the time of referral all the students were performing between one and three years below their peers in reading, spelling, and arithmetic. The boys lived in upper middle class homes in the suburb of a large metropolitan area, and were of average intelligence.

The project took place in the Curriculum Research Classroom at the Experimental Education Unit, University of Washington. The students were placed in this class for one year of remedial instruction.

Materials

Two basal reading series were used in this project: Lippincott Basic Reading (McCracken & Walcutt, 1970), and Ginn 360 (Clymer, 1969), Levels 2-1 to 3-1. Each book was divided into 500-word segments (excluding plays and poetry).

Three types of comprehension questions were identified from each book: recall, sequence, and interpretation. A recall question dealt with facts given in the story, for example, "Who lived under the bridge?" Sequence questions were like the following, "After the goat got over the bridge, what did he do? Interpretation questions required many different skills including translation, inference, and synthesis. An example question was, "Why did the troll keep letting himself get tricked?"

Thirty comprehension questions per each 500-word segment were written (or three per 50 words). These included 10 recall, 10 sequence, and 10 interpretation questions.

The students were required to answer these questions with brief, written statements. Each answer was counted as either correct or incorrect. If the student wrote an answer to a recall or sequence question which differed from that expected, but was equally pertinent to the story, it was counted as correct. The criteria for acceptability of interpretation responses was that they be logical and suited for the question. An interpretation response was counted as incorrect if the student answered with a generality such as, "Because he wanted to," or "Because he liked him."

Procedures

Every day during the school year, the students were required to read 1,000 words from the two basal series and answer 60 comprehension questions. The students read orally in one series and silently in the other. The order of reading silently and orally varied each day. Oral reading was conducted individually in a small room off the main classroom. The boys read silently and responded to both types of comprehension questions at their desks. Comprehension questions were answered immediately after each reading session.

The students were allowed to ask for help in pronouncing unfamiliar words as they answered comprehension questions and read silently. The teacher also provided assistance in pronouncing unfamiliar words and corrected the reading errors of the children during oral reading sessions. Daily records for each student were maintained on the rate of oral and silent reading, and percent of correctly answered comprehension questions.

Intervention

Similar interventions were designed for both oral reading and the comprehension of orally read material. Interventions were never scheduled for silent reading or answering comprehension questions following silent reading.

When the intervention was scheduled for oral reading the student was required to practice phrases composed of the reading errors he had committed during the oral reading session, if he did not equal or exceed a predetermined rate of reading. The student practiced all the phrases until he could correctly read them to the teacher. These error word phrases were written on a sheet of notebook paper.

When the intervention was associated with the comprehension of orally read material, the student was required to correct each incorrectly answered comprehension question if his comprehension score did not meet or exceed a predetermined rate. The student was allowed to refer to the book as he corrected his work, and could discuss his answers with the teacher.

The desired rates for oral reading and comprehension were based on each pupil's median performance scores during the phase preceeding the intervention. The desired rates increased slightly each day until maximum levels of performance were reached: 100 correct orally read words per minute and 4 correctly answered questions per minute. Desired rates were not established for incorrect orally read words. Each intervention was in effect twice for all students (refer to Figure 1), for approximately four weeks duration per condition.

Reliability

Agreement in scoring the answers to comprehension questions was determined by a second teacher who checked 1/3 of each student's answers. Reliability was calculated by dividing the number of agreements of the two teachers by the number of agreements plus disagreements, multiplied by 100. The average reliability for scoring comprehension answers was 99.1%. Reliability for scoring each type of comprehension answer was quite high: recall, 99%; sequence, 98%; and interpretation, 97%.

Reliability for calculating words read incorrectly during oral reading was determined once weekly for each student by tape recording those sessions. A second teacher listened to these recordings and counted reading errors. Using the same formula for calculating the comprehension reliability, the average error rate reliability was 96.1%; the average correct rate reliability was even higher.

RESULTS

Comparing Performance Related to Types of Questions

In order to compare the performance changes of the pupils from the beginning to the end of the study for the three types of comprehension questions, each pupil's score for answering questions from orally read material during Phase 1 was compared with his combined scores of Phases 8 and 9. Phases 8 and 9 were combined to equalize the effects of the last two interventions across subjects. Table 1 shows the average percent correct and range of the pupils for each type of comprehension question during Phase 1 and Phases 8 and 9, the difference scores between the two periods and percent change throughout the year.

Insert Table 1 About Here

During Phase 1, the average correct percent comprehension score for the group was 57%. The highest level of comprehension performance for all students was in answering recall questions, average 68%. Interpretation questions were the most difficult to answer, average 48%. The average comprehension score for sequence questions was 55%.

The overall correct percent comprehension score for the group improved during the school year, from 57% to 73%. Each student's score for all types of questions improved; however, the relationship between different types of comprehension questions remained essentially unchanged. The scores for recall questions remained highest for six students, averaging 81%. The lowest average comprehension score was for interpretation questions, 66%. The average for answering sequence questions was 71%.

The amount of change for each type of comprehension question varied by student. The greatest improvement for three students was in answering interpretation questions. Two students gained the most in answering sequence questions, while the remaining two students improved most in responding to recall questions. In general, recall questions were less amenable to change than either sequence or interpretation questions. The percent change for recall questions between Phase 1 and Phases 8 and 9 averaged 19%. The percent change for answering sequence questions was 29%, and for interpretation questions, 38%.

Comparing Modes of Reading

Ability to comprehend was compared as a function of two modes of reading: oral and silent. Table 2 indicates the group mean and individual ranges for answering comprehension questions from orally and silently read material at the beginning (Phase 1) and end (Phases 8 and 9) of the school year.

Insert Table 2 About Here

The average ability to comprehend orally read material was higher than the comprehension performance of silently read material during Phase 1. The average score for comprehending orally read material was 57% (range 49% to 61%). The average score for answering silently read material was 48% (range 38% to 61%). During Phase 1, the difference in answering comprehension questions from the two modes averaged 9%. Six students had higher comprehension scores after reading orally, while one student had the same level of comprehension performance for both modes of reading. The individual range of differences between mean oral and silent reading comprehension scores was zero to 17%.

All students improved in answering both oral and silent reading comprehension questions during the year. The average improvement for answering oral reading questions was 16% (range 5% to 33%): from a Phase 1 average of 57% to a Phase 8 and 9 average of 73%. Improvement for answering silently read questions averaged 17% (range 5% to 38%), from an average of 48% correct during Phase 1 to an average of 65% during Phases 8 and 9. All students exhibited higher oral reading comprehension scores than silent reading comprehension scores at the end of the year. The average difference was 8% (range 2% to 12%).

Percent change between Phase 1 and Phases 8 and 9 was computed for answering questions from orally and silently read material. The percent change was greater for answering silent reading questions (average 35%) than for answering oral reading questions (28%).

DISCUSSION

In this study we found that the ability to answer comprehension questions was affected by type of question and mode of reading.

As to type of question, the data indicated that recall questions were more easily answered than either sequence or interpretation questions. This finding is consistent with other studies (Bickley, Weaver, & Ford, 1968; Pystrom, 1970; Feinman, 1972; Davis, 1969). The emphasis placed on recall questions in most classrooms may have attributed to these findings.

According to Spache and Spache (1969), different types of comprehension are not acquired simultaneously by students; rather, each type must be taught separately. In our study all three types of comprehension improved, although some types of comprehension were more affected than others. The ability to answer interpretation questions generally improved more than performance on recall or sequence questions. In some instances, the ability to answer recall questions was negatively affected by the intervention.

In reference to mode of reading, the comprehension of orally read material was generally higher than comprehension of silently read material. Differences between the abilities to comprehend orally and silently read material toward the end of the study might be expected, since interventions were only associated with oral reading. The initial difference obtained between the two modes, however, cannot be easily dismissed. Our finding in this regard contradicted the evidence of other studies which compared oral and silent reading comprehension with adult populations (Poulton & Brown, 1967; Weaver, Holmes, & Reynolds, 1970).

Many aspects of comprehension merit further investigation. For one, the abilities of pupils to answer other types of comprehension questions should be investigated. For instance, questions that require judgmental and inferential skills should be used. A second research area might pertain to mode of response, either oral or written. In this study, the mode of reading influenced comprehension ability. Conceivably, mode of responding could be an influential factor.

The format of comprehension questions might also influence performance. Investigations could be conducted to compare pupil performance as a function of the following formats: multiple choice, true and false, free responses, and cloze procedures.

Our plans for future reading comprehension research are two-fold. First, research will be conducted to investigate further the comprehension abilities of pupils as a function of oral and silent reading. We intend to replicate the present study by measuring oral and silent reading and the ability to comprehend both modes of reading. In addition, we will alternately schedule an intervention. Second, we will study the effects on performance of other types of comprehension questions. We will identify at least two "higher levels" of comprehension, write questions representative of the types, then measure performance. Interventions will then be scheduled for the various types of questions.

At least three implications for teachers of reading may be derived from this study. One, each day the pupils read 1000 words and answered 60 comprehension questions. The time required to complete such an assignment was about 30 minutes. This was apparently a reasonable amount of instructional time, since all the pupils improved in reading and answering questions during the year.

Two, the simple instructional technique used in this study should be used by teachers. The drill technique, although it required little time, resulted in positive changes for all the pupils. There are perhaps two reasons to account for this: a) drill was scheduled only if performance was poor, and b) when drill was used the procedures were consistent from one day to the next.

Three, the idea of presenting uniform types of comprehension questions to assess performance in that regard should be considered. Throughout this project the pupils responded to questions that related to three types of comprehension; these questions were developed by the teacher. We knew, therefore, how the students could perform over a period of time on each type of question. Commonly, when comprehension abilities are assessed, students are asked to respond to several types of questions in various ways.

The implications could be emphasized and summarized by recommending that teachers: a) pinpoint the reading behaviors they want to teach, e.g., oral reading; b) arrange a situation where these behaviors can occur daily; c) measure the pupils' performance on each of these behaviors; d) schedule, if necessary, simple interventions to increase the pupils' competencies; and e) continue to measure pupil performance in order to ascertain the influence of teaching.

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FOOTNOTES

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Research Design-Reading 1972-73

	Fall 1972			Winter 1973			Spring 1973		
Group 1	No Intervention	Oral Read	No Intervention	No Intervention	Comp.	No Intervention	No Intervention	Oral Read	Comp.
Group 2	No Intervention	Comp.	No Intervention	No Intervention	Oral Read	No Intervention	No Intervention	Comp.	Oral Read

Table 1

Correct Percentage for Answering Oral Reading Comprehension Questions

Type Question		Phase 1	Phases 8-9	Diff.	% Change
Recall	$\bar{X}$	68	81	13	19
	rg	(56-74)	(71-89)		
Sequence	$\bar{X}$	55	71	16	29
	rg	(35-64)	(62-78)		
Interp.	$\bar{X}$	48	66	18	38
	rg	(33-63)	(51-86)		
All	$\bar{X}$	57	73	16	28
	rg	(49-61)	(66-84)		

Table 2

Correct Percentage for Answering Comprehension Questions After Oral and Silent Reading

Mode		Phase 1	Phases 8-9	Diff.	% Change
Oral	$\bar{X}$	57	73	16	28
	rg	(49-61)	(66-84)	(5-33)	
Silent	$\bar{X}$	48	65	17	35
	rg	(38-61)	(60-76)	(5-38)	
Diff.	$\bar{X}$	9	8		
	rg	(0-17)	(-2 to -12)		

ABSTRACT

The effect of one type of feedback on the ability of students to compute three kinds of arithmetic problems, and the effects of three types of feedback on one kind of arithmetic problem, were investigated. Three problem types were identified for each student prior to the baseline condition. Initial Acquisition (IA) consisted of problems that the students could not compute; Advanced Acquisition (AA) problems were those the pupils computed between 40-60% accuracy; and Initial Proficiency (IP) problems were those computed by the students with a high degree of accuracy, but at a rate less than half of normal. The subjects were seven boys between the ages of nine and eleven.

The first type of feedback, Correct and Incorrect Notation, when scheduled for IA problems, was not effective in increasing accuracy for any student. When this type of feedback was applied to AA problems, the performance of only one student improved. The application of the same type of feedback to IP problems resulted in minimal increases in correct rate for two students.

Two other types of feedback were used with IA problems--Correct Answers to Erred Problems and Correct Explanation for Erred Problems. Neither type of feedback greatly influenced accurate computation.

THE MINIMAL EFFECTS OF THREE DIFFERENT TYPES OF FEEDBACK IN THREE DIFFERENT ARITHMETIC SITUATIONS[1]

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One of the main goals of a mathematics curriculum is to teach students to compute accurately and rapidly. In order to teach these skills, classroom teachers use many techniques. They use modeling procedures by showing pupils how to perform the problems. They use instructional aids such as cuisinare rods, the abacus, and the numberline. Sometimes various types of reinforcement contingencies are scheduled.

Perhaps the technique most widely used, however, to facilitate arithmetic computation is some form of feedback. Feedback, or knowledge of results, has been defined as, "providing the student with information (knowledge) about the adequacy (results) of his response" (Anderson & Faust, 1973, p. 271).

We conducted an informal survey which suggested that teachers provide students knowledge of results in several ways. The three most common types of feedback were giving comments such as "good work," noting the correct score, and checking incorrect problems. Teachers indicated that they frequently combined feedback types.

The predominant areas of research on feedback have been concerned with its effect on performance in programmed materials (Anderson & Faust; Geis & Chapman, 1971), and on simple motor tasks (Annett, 1969). A few studies have investigated the effect of feedback on academic tasks.

Kirby and Shields (1972) used a combination of praise and feedback. Correct answers were noted, but the student was neither shown where he had made an error in computation nor how to solve erred problems. The feedback plus reinforcement condition resulted in an increased rate of correct responding as well as increased attending. However, the effect of feedback alone could not be separated from praise.

Hillman (1970) compared the effectiveness of immediate knowledge of results (KR), KR plus token reinforcement, and delayed KR with no token reinforcement. According to Hillman, immediate KR amounted to the teacher verbalizing the correct answer following the solution of each problem by the class. As for delayed KR, the teacher read the previous day's correct answers to the students before they began the daily assignment. Hillman concluded that immediate KR and KR plus reinforcement procedures were superior to delayed KR. No significant difference was found between KR and KR plus token reinforcement. In his study the effect of feedback alone could not be determined because all treatment groups received instruction as well as feedback.

The effect of feedback in the absence of instruction has been investigated (Smith, 1973). In her study two problem types were identified. One type, acquisition, pertained to problems the students could not compute. Another type, proficiency, referred to problems the students computed accurately, but too slowly. In her investigation two kinds of feedback were employed: Checking Correct and Incorrect Problems and Providing the Correct Answer to Erred Problems. Neither type of feedback served to increase accuracy or rate in either the acquisition or proficiency situation.

Smith suggested that another investigation should focus on the effect of feedback on a more advanced stage of acquisition, one where the accuracy scores of students were about 50%. In the research presented here three performance levels were identified. As in the Smith study, acquisition and proficiency problems were included. A third skill level was also included--

advanced acquisition--which referred to problems computed between 40 to 60% accuracy.

The purpose of this research was to determine the effects of one type of feedback on students' ability to compute three kinds of arithmetic problems, and the effects of three types of feedback on one kind of arithmetic problem. The effect of one type of feedback across all performance levels was initially investigated. Correct and Incorrect Notation was applied first to initial acquisition (IA), then to advanced acquisition (AA), and finally to initial proficiency (IP) pages. Two other types of feedback were then applied to the IA pages.

METHOD

Subjects and Setting

Seven boys from nine to eleven years of age participated in this study. The setting for this research was the Curriculum Research Classroom of the Experimental Education Unit, Child Development and Mental Retardation Center, University of Washington.

Preliminary Procedures

Prior to the baseline condition, extensive placement testing in the four basic computational operations was scheduled. On the basis of this testing, which ran for three days, three problem types were identified for each student.

The criterion for selecting the IA problems was that the pupil should score from zero to 10% on a set of problems for five consecutive days. For the AA problems the student should score from 40 to 60% correct for five days. The IP problems were those which were answered 90 to 100% correctly, but at a rate less than half of normal. In this study the normal correct rate was 50 per minute; the normal error rate was zero errors. These rates were derived from an informal study of the rates in the four computational operations of regular public school children.

Design

A multiple baseline design was used. Our original plan was to schedule first one type of feedback on an IA page. The same type of feedback was then to be applied in successive phases to AA and IP pages. Next, we planned to schedule the second type of feedback on an IA page (if the first type had not been successful), then on an AA page, and next on an IP page. Then, we intended to schedule, if necessary, the third type of feedback across the three types of problems. Since the first type of feedback was so ineffective when it was applied to IA, AA, and IP sheets, we decided not to abide by our original plan of scheduling all three types across the three situations. Instead, we decided to use all three feedback types with only the IA problems. Then, if one of the feedback types proved successful, it would be re-scheduled for other types of problems. One student's accuracy on IA pages increased substantially during a feedback condition. With him the same type of feedback was scheduled next for his AA page. Table 1 shows the order of experimental conditions throughout the research.

Insert Table 1 About Here

Following the baseline condition, Correct and Incorrect Notation was scheduled on IA pages. This technique was then applied in successive conditions to AA and IP problems. Correct Answers to Erred Problems followed by Correct Explanation for Erred Problems was then scheduled for IA pages during the next two conditions. When a feedback condition was in effect it was arranged for only one type of problems at a time.

Materials

For each student, 25 problems were selected for each of the three problem types. A set of five forms was developed for each type. The student's daily assignment consisted of dittoed pages of three problem types, or according to the procedure, one problem type daily and three problem types every other day. The order in which the problem types were presented varied, e.g., on some days pupils began with an IA page, on other days with an IP sheet.

The composition of each student's pages varied according to individual placement performance. As to the IA problems, three students were assigned division facts, one was given multiplication facts, one received two-digit-by-two-digit subtraction problems with borrowing [33] [-14], one was assigned three-digit subtraction problems with no borrowing [989] [-938], and another worked on two-digit-by-two-digit multiplication problems with no carrying [11] [x19]. In regard to the AA pages, five students were assigned multiplication facts and one student, subtraction facts. An appropriate AA situation could not be determined for one student, he either knew the problems or he did not. As to the IP pages, five students worked on subtraction facts, one on add facts, and one on division facts.

Behaviors Measured

Both percentage of correctly computed problems and correct and error rate data were charted daily for each student on all three pages. A problem was counted as an error if a pupil wrote an incorrect answer or if he placed a check next to it, which indicated he did not know the answer.

Procedures

Math pages were presented to the students as either their first or second assignment of the morning. The students were asked to answer each problem, but if they did not know an answer, they could place a check [√] next to it. No other instructions were given. Each student used a stopwatch to time his own work. When a student finished each page he raised his hand to have his time verified by the teacher.

Baseline. During the baseline period neither instruction nor feedback was provided for any of the pages.

Correct and Incorrect Notation ($CIN^{1,2,3}$). When CIN^1 was in effect each student was presented with all three pages. During CIN^2 and CIN^3 the pages which did not receive feedback were presented every other day.

The problem type which was scheduled for the intervention was corrected and returned immediately to the student. The teacher informed the student she had placed a "check" by incorrect problems and a "c" by correct problems. She then asked the student to look over his corrected page.

No feedback was given on the other pages. The intervention was first arranged for the IA page (CIN^1), then the AA page (CIN^2), then the IP page (CIN^3).

Correct Answers to Erred Problems (CAE^1). Each student was presented with an IA page daily; AA and IP pages were scheduled every other day. The IA page was corrected and returned immediately to the student. The teacher informed the student that she had placed a "check" by incorrect problems and a "c" by correct problems. The teacher wrote in the correct answer for incorrectly answered problems and asked the student to look over his corrected page. No feedback was given on the other pages.

Correct Explanation for Erred Problems (CEE). Each student was presented with an IA page daily; AA and IP pages were scheduled every other day. The IA page was corrected and returned immediately to the student. The same information provided in the previous condition was given.

In addition, the teacher pointed out each incorrectly answered problem and gave a verbal explanation regarding the correct process for solving the problem. For the three students who were assigned multiplication or division facts, the relationship between families of problems was explained, e.g., 5 x 8 = 40 is related to 8 x 5 = 40. For the students who were assigned problems that required a special skill such as borrowing, that particular feature was explained, e.g., they were shown how to cancel out some numbers and shift numbers across columns. After the teacher explained the process to be used for each erred problem, she asked the student to look over his corrected page.

Correct Answers to Erred Problems (CAE^2). This type of feedback was scheduled for one student, because his accuracy on IA problems increased substantially when CAE^1 was scheduled. The student was presented with an AA page daily and an IA and IP page every other day. Information provided to the student was the same as in CAE^1, but directed toward his AA page.

Change Criteria

A baseline condition was scheduled for the first five days of the study. Each condition thereafter ran at least six days. After six days a decision was made whether to continue the condition or to change. In order to make this decision on IA and AA pages, the mean percentage correct score of the first three days was compared to the mean of the last three days. If the mean percentage of the last three days was less than 30% higher than the mean for the first three days, the condition was discontinued. If the mean percentage correct score of the last three days was more than 30% higher than the mean of the first three days, the condition continued for three more days. At the end of that time a comparison of the mean for the second and third three-day periods was made with the mean of the first three-day period. The criterion for continuing or discontinuing the condition was based on the same 30% figure. At no time, during successive three-day mean comparisons, was a condition allowed to continue if the percentage correct score was less than it had previously been. Because it is not possible to calculate 30% of zero, a 12% score was considered to be the minimum acceptable score on IA pages with a mean of zero.

The change criterion on IP pages was based on correct rate improvement, since IP problems were those which were computed accurately, but at less than half the normal rate. As was true with IA and AA pages, successive three-day periods were compared and procedural decisions were based on those evaluations. If a student did not improve his correct rate by 30% across successive three-day periods the condition was discontinued. If correct rate improved more than 30%, the condition continued and was evaluated following another three-day period.

A condition would be terminated when a student met criterion performance for three consecutive days. Criterion performance was defined as 100% on IA and AA pages, and a correct rate of 50 per minute and zero errors on IP pages.

Reliability

Reliability was taken on teacher procedures, timing, and paper corrections. Reliability scores on each measure were obtained by dividing the number of agreements by the total agreements plus disagreements and multiplying by 100.

Reliability on teacher procedures was taken on four occasions. An independent observer was given a copy of the feedback procedures, whereupon the observer checked the accuracy of the teacher's comments to students under each feedback condition. On each occasion, according to the written procedures, the feedback provided by the teacher was correctly administered.

Timing reliability was obtained by requiring both the teacher and observer to note independently the elapsed time on the students' stopwatches. Timing reliability was taken on four occasions. Reliability was 95% for the 30 stopwatch readings taken by the teacher and observer.

An independent observer recorrected five pages of each problem type selected at random from each student's file. The observer noted the number of correct and incorrect problems, calculated correct and error rates, and percentage correct scores. A measure of reliability was obtained by comparing the observer's corrections with the permanent record written on top of each page. Reliability on paper corrections was 100%.

RESULTS

In general, the three types of feedback were not effective in increasing accuracy or rate of performance for the students. There were exceptions, however. In the few instances where feedback was effective, individual data are presented.

In order to discuss the effects of feedback, we chose to present magnitude of change as being "slight," "minimal," and "substantial." Slight changes were those where the percentage score difference between baseline and intervention was less than 5 percentage points. Minimal change was if the gain ranged from 6 to 19 percentage points, and substantial if the gain exceeded 20 percentage points.

Baseline

The mean performance of the group during baseline on IA was 1.8% and 46.4% on AA. The mean correct rate on the IP pages was 12.0 movements per minute; the mean error rate was .6 movements per minute.

CIN^1

When Correct and Incorrect Notation was applied to IA pages, it resulted in a slight average increase in accuracy: .6 percentage points. The accuracy of two students increased slightly and the accuracy of two students decreased slightly during this condition. Three students maintained their previous baseline scores of zero. Table 2 shows the pupils' scores on the IA problems during this phase and throughout the experiment.

Insert Table 2 About Here

CIN^2

When Correct and Incorrect Notation feedback was associated with the AA pages, the mean percentage correct score for that type problem increased 5.4 percentage points over the prior two conditions. The performance of two pupils was slightly affected, while a minimal increase was noted for a third student. Two students' accuracy decreased during this condition. Table 3 shows the pupils' scores on AA problems throughout the experiment.

Insert Table 3 About Here

Individual data are presented in Figure 1 for D.H. since his performance was influenced more than the others by this type of feedback and continued to improve after this condition was no longer in effect.

Insert Figure 1 About Here

CIN[3]

When Correct and Incorrect Notation feedback was applied to IP pages, the mean correct rate increased 2.4 problems per minute; the error rate increased an average of .1 problems per minute. Table 4 shows the pupils' scores on the IP problems.

Insert Table 4 About Here

Five of the students' correct rates increased less than 2 problems per minute, while the correct rates of two pupils, D.P. and B.W., increased by 6 problems per minute. Since B.W.'s correct rate was affected more than the others during this condition, his data are shown in Figure 2.

Insert Figure 2 About Here

CAE[1]

When Correct Answers to Erred Problems feedback was applied to IA pages it resulted in a mean increase of 15.3 percentage points over the previous two conditions. During this condition the accuracy of two students increased slightly, while a third student's scores showed minimal improvement. The scores of two students maintained at the previous baseline level of zero.

The performance of M.S. was substantially increased by this type of feedback; his accuracy rose from zero to 89% correct. Although M.S. attained scores of 100% during this condition, he failed to meet criterion performance of three successive 100% scores.

CEE

Providing Correct Explanation for Erred Problems feedback on IA pages resulted in increases in each student's accuracy. Three students' percentage scores increased slightly over the prior feedback condition, while one student's scores showed minimal improvement.

One student, M.S., met criterion performance when this type of feedback was scheduled. However, Correct Explanation for Erred Problems feedback was never in effect for him since he scored 100% during the first three days in this condition. M.S. made his greatest gain during CAE and it was decided to apply that type of feedback to his AA page.

Two students made substantial improvement while this condition was in effect. During this period, D.H.'s accuracy increased by 68 percentage points over the previous feedback condition. He did not attain criterion during this condition, however. Another student, B.W., who had zero correct during prior conditions, increased his accuracy to 72% during this condition, but he did not attain the desired level of performance. Data for B.W. are shown in Figure 3.

Insert Figure 3 About Here

CAE[2]

When Correct Answers to Erred Problems feedback was applied to M.S.'s AA page, his accuracy increased by .2 percentage points over the prior conditions of baseline. The application of this type of feedback resulted in decreases in both correct and error rate compared to the prior baseline conditions.

DISCUSSION

Research in programmed instruction suggests that it is better to note errors than to ignore them (Anderson & Faust, 1973). In our study Correct and Incorrect Notation resulted in an average percentage gain of only .6 points in IA situations, 5.4 points in AA situations, and increased correct rate on IP pages by an average of 2.4 movements per minute. Errors were ignored during the baseline conditions and were noted during the $CIN^{1,2,3}$ conditions. Unlike the suggestion of Anderson and Faust, the effects of CIN on three levels of performance were very unimpressive.

Anderson and Faust also stated that when a student must select an answer from a large set of alternatives, knowing that an answer is wrong will not be helpful in determining the correct answer. This explanation is especially relevant to the IA situations when only the CIN^1 feedback was scheduled. Although the students knew when they had erred, this information was not sufficient for them to correctly compute their problems. In these instances our findings agreed with Anderson and Faust.

The accuracy of one student, D.H., increased on AA problems when CIN^2 was in effect. His improvement may have been related to the type of problems on his AA page; 7 of the 25 multiplication problems contained a zero. Prior to the CIN^2 phase, D.H. consistently erred on this type of problem by writing a numeral other than zero as the answer. During CIN^2, he generally computed problems involving a zero correctly. If D.H. had computed all problems containing a zero consistently he would have gained 28 percentage points. As it was, he improved 25 percentage points. Thus, CIN^2 probably helped D.H. learn a rule that could be generalized to a set of problems.

Anderson and Faust concluded that it is better to provide the correct answer than to check correct and incorrectly computed problems. When this technique was applied in IA situations the class mean rose by 15.3 percentage points. The scores of two students remained at zero. Our data in this regard are not strongly supportive of the Anderson and Faust claim. M.S.'s accuracy increased substantially during the CAE[1] condition. His increased accuracy during this condition may be related to the type of error he made. His IA problems and answers were of the type,

$$\begin{array}{r} 938 \\ -921 \\ \hline 017 \end{array}$$

. His error pattern was obvious; he placed an unnecessary zero in the hundreds column. Once the teacher provided the correct answer, his accuracy immediately increased. This same type of feedback was then applied to M.S.'s AA page which consisted of multiplication facts. Quite different results were obtained; M.S.'s accuracy increased by only .2 percentage points in contrast to a gain of 89 percentage points when CAE[1] was applied to his IA page.

Two other students, D.H. and B.W., also computed problems which were more advanced than those assigned to the other students. However, when they were provided CAE feedback for problems of the type

$$\begin{array}{r} 33 \\ -14 \\ \hline 21 \end{array} \text{ (correct answer 19)} \qquad \begin{array}{r} 11 \\ \times 19 \\ \hline 99 \\ 11 \\ \hline 110 \end{array} \text{ (correct answer 209)}$$

their performances did not improve. Contrary to the claims of Anderson and Faust, CAE did not substantially improve performance. Those students who were working fact problems, and those who were making process errors (of the type made by D.H. and B.W.), were not aided by the application of CAE. Providing a student with the answers to 25 fact problems would require him to memorize many answers; while providing answers when a student is making process errors does not give him sufficient information to compute problems correctly.

CEE feedback resulted in the highest percentage gains by all students. The accuracies of the three students who were assigned advanced computations substantially increased when CEE was provided. The accuracies of four students who were assigned fact problems increased less than 8 percentage points, which indicated the acquisition of only two unknown problems.

In this study, the three types of feedback investigated had minimal effects on students' accuracy and rate of computation. Certainly a great deal more research should be arranged to explore the effects of other types of feedback on other types of performance.

Feedback studies should be conducted with pupils of different types. The pupils in this study had experienced failure. In the past when their papers were returned to them perhaps all the feedback was negative. Perhaps these pupils learned to ignore feedback since it was generally aversive and as a consequence this form of instruction was ineffective. It might be discovered that a tolerance for feedback must first be developed before various feedback procedures are effective. At any rate, teachers, particularly of academically retarded children, should consider carefully the style of feedback they arrange for their children. Certainly the results from this study could not be used to support the currect widespread use of feedback procedures in schools.

FIGURE CAPTIONS

Figure 1: Percentage correct for D.H.'s problems under all conditions.

Figure 2: Correct and error rate data for B.W.'s IP pages during all conditions. Dots indicate the correct rates, triangles the error rates. An appropriate AA situation could not be determined for this student, therefore, Condition 3 was never in effect.

Figure 3: Percentage correct for B.W.'s IA problems. An appropriate AA situation could not be determined for this student, therefore, Condition 3 was never in effect.

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Table 1

Research Design for All Problem Types

Problem Types	Conditions						
	1	2	3	4	5	6	7
IA	B	CIN[1]	B	B	CAE	CEE	B
AA	B	B	CIN[2]	B	B	B	CAE[2]
IP	B	B	B	CIN[3]	B	B	B
No. of Students	6	6	6	6	6	6	1

Table 2

Pupils' Mean Scores Throughout 5* Conditions on IA Problems

Subjects	Baseline			CIN[1]			Baseline*			CAE			CEE		
	C	E	%	C	E	%	C	E	%	C	E	%	C	E	%
M.F.	.1	32.1	.7	:0	32.5	.0	.0	35.0	.0	.0	46.5	.0	.1	42.3	3.3
T.G.	.0	21.5	.0	.1	28.4	.7	.9	70.3	1.3	8.0	47.7	12.9	8.0	46.1	16.4
D.H.	.0	10.3	.0	.0	16.0	.0	.4	17.5	2.0	.7	14.3	5.3	4.7	2.0	73.3
D.P.	1.0	16.3	6.4	1.4	25.3	6.0	1.2	28.3	4.0	2.5	36.0	6.7	2.3	19.6	12.0
M.S.	.0	3.5	.0	.0	9.2	.0	.0	54.0	.0	4.8	4.2	89.1	4.8	.0	100.0
T.S.	.6	14.0	5.6	1.2	11.3	9.8	1.4	12.0	11.4	1.5	10.4	12.0	1.6	10.7	14.7
B.W.	.0	3.9	.0	.0	4.6	.0	.0	4.9	.0	.0	68.3	.0	3.8	7.7	85.0
Mean	.2	14.5	1.8	.4	18.1	2.4	.6	31.7	2.7	2.5	32.5	18.0	3.6	18.3	43.5

* The second baseline includes data from Conditions 3 and 4.

Table 3

Pupils' Mean Scores Throughout 3* Conditions on AA Problems

Subjects	Baseline*			CIN^2			Baseline*			CAE^2		
	C	E	%	C	E	%	C	E	%	C	E	%
M.F.	3.9	4.8	45.1	5.9	7.1	44.0	5.7	7.0	44.9			
T.G.	9.4	7.6	55.0	15.6	12.3	55.3	23.0	18.8	55.0			
D.H.	6.8	7.6	48.0	12.1	4.5	73.0	14.3	2.3	87.2			
D.P.	5.6	10.0	38.1	6.0	9.9	37.3	8.2	15.0	35.1			
M.S.	4.8	7.5	39.4	6.6	8.7	43.3	6.0	8.2	41.8	4.1	5.6	42.0
T.S.	7.9	7.4	53.0	10.8	7.8	58.0	9.2	6.6	62.2			
Mean	6.4	7.5	46.4	9.5	8.4	51.8	11.1	9.6	54.4			

*The first baseline includes data from Conditions 1 and 2. The second baseline includes data from Conditions 4, 5, and 6. Only one student experienced the CAE^2 condition.

Table 4

Pupils' Mean Scores Throughout 3* Conditions on IP Problems

Subjects	Baseline*			CIN3			Baseline*		
	C	E	%	C	E	%	C	E	%
M.F.	12.3	.7	94.3	13.0	.4	97.3	13.2	.4	97.3
T.G.	16.6	1.7	91.1	16.8	1.3	92.7	19.3	2.8	87.6
D.H.	17.0	.6	96.2	18.8	1.4	93.3	19.4	2.3	89.1
D.P.	11.0	.5	96.2	16.7	.3	98.0	15.0	1.0	94.0
M.S.	5.6	.2	97.5	6.7	.2	97.3	5.2	.1	99.0
T.S.	9.6	.5	95.6	10.9	.9	92.0	9.4	.3	97.3
B.W.	12.0	.1	98.8	17.8	.1	99.3	15.4	.3	97.6
Mean	12.0	.6	95.7	14.4	.7	95.7	13.8	1.0	94.6

*The first baseline includes data from Conditions 1, 2, and 3. The second baseline includes data from Conditions 5 and 6.

Figure 1

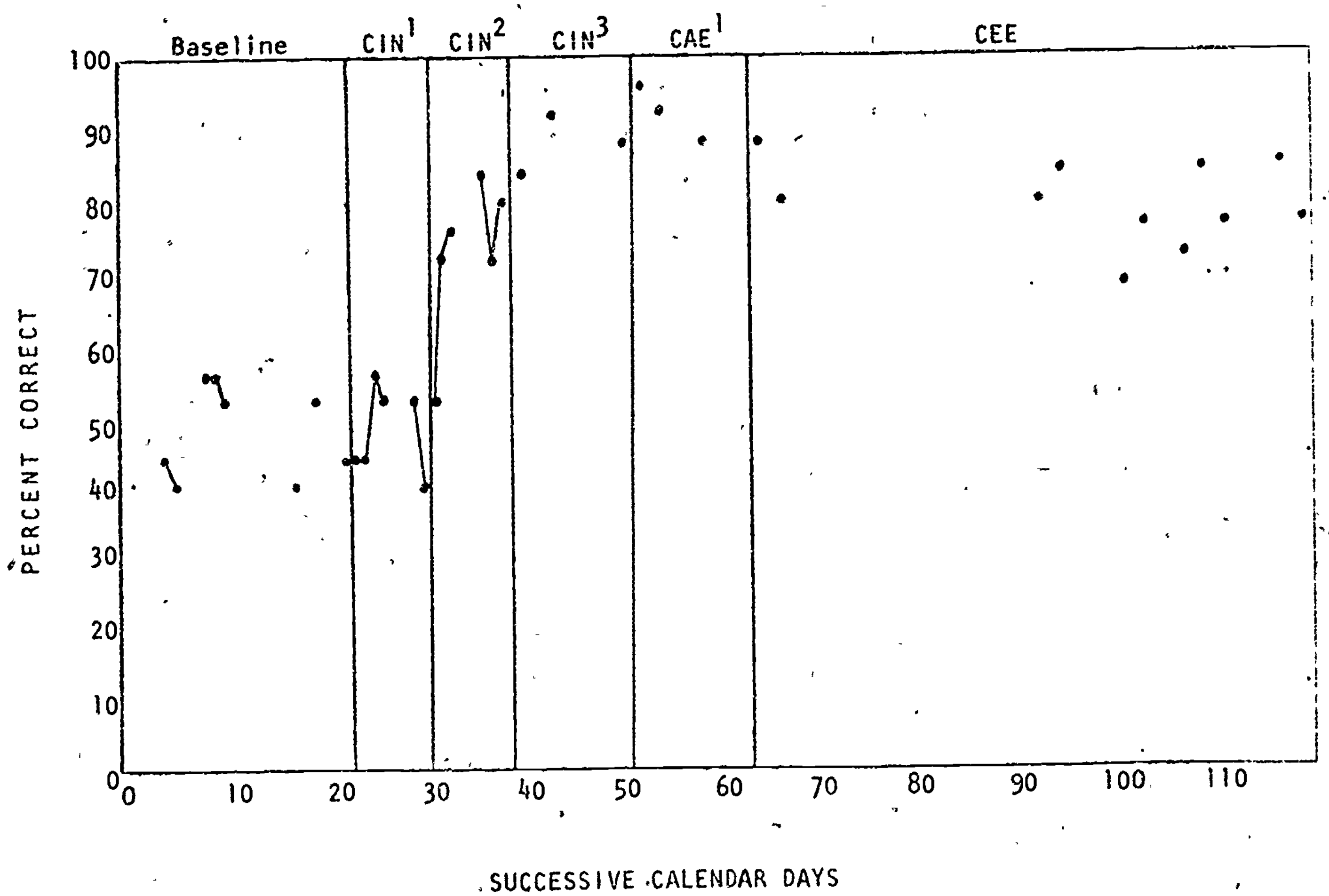
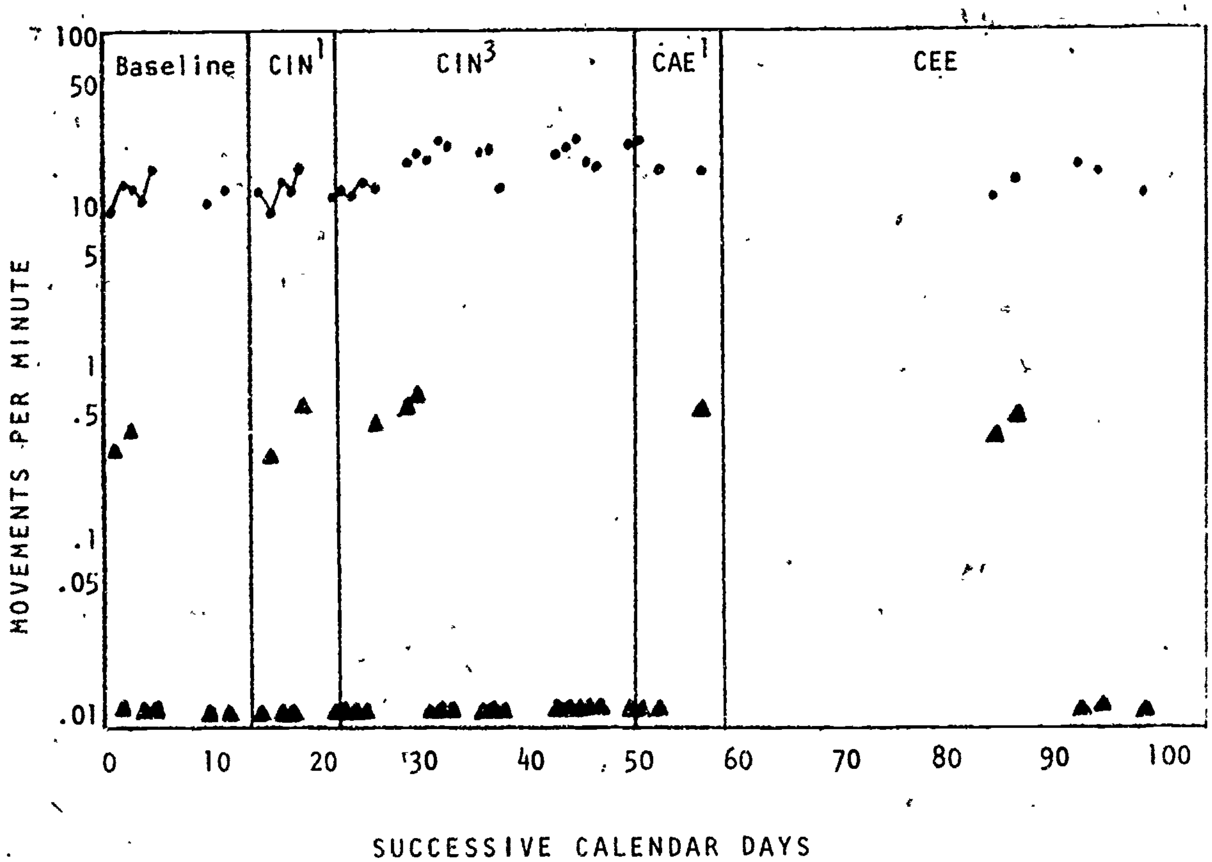
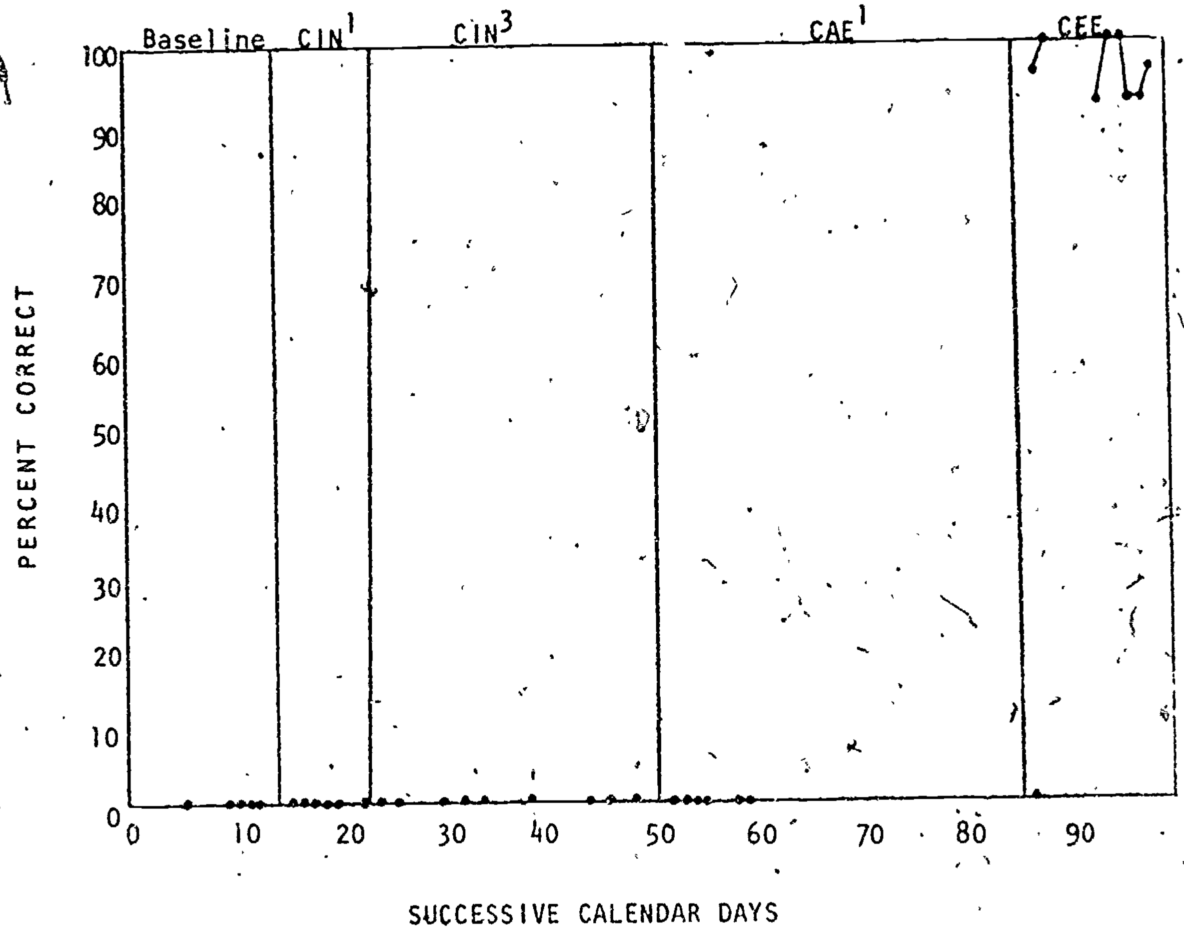

Baseline
CIN¹
CIN²
CIN³
CAE¹
CEE
PERCENT CORRECT
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
110
SUCCESSIVE CALENDAR DAYS

Figure 2



Baseline
CIN1
CIN3
CAE1
CEE
100
50
10
5
1
.5
.1
.05
.01
MOVEMENTS PER MINUTE
0
10
20
30
40
50
60
70
80
90
100
SUCCESSIVE CALENDAR DAYS

Figure 3



Baseline
CIN1
CIN3
CAE1
CEE
100
90
80
70
60
50
40
30
20
10
0
PERCENT CORRECT
0
10
20
30
40
50
60
70
80
90
SUCCESSIVE CALENDAR DAYS

FOOTNOTES

[1]This research was supported in part by a National Institute of Education grant, #OEG-0-70-3916(607), Project #572247.

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TEAM II:

ASSESSMENT, INSTRUCTION, AND INTEGRATION OF HANDICAPPED CHILDREN

Introduction

There has been an increasing local and national emphasis in the past five years on the effective instruction of handicapped children and their expedient return to school and vocational settings in the community.

The efficient remediation and return of these handicapped youngsters to more normal settings requires systematic referral, assessment, remediation, return, and evaluation procedures (subsequently referred to as the referral-remediation-reintegration process). In the past two years Team II has focused on those components of the total referral-remediation-reintegration process necessary to successfully return handicapped children to programs as close to regular education programs as possible.

Some of the essential elements in such a process are:

I. A measurement system which will give educators the necessary information to make good decisions about the effects of instructional, curricular, and measurement variables on their pupils' progress toward proficient performance.

II. An information storage and retrieval system which enables administrators to retrieve precise information about any pupil and evaluate how efficiently he is progressing toward performance levels necessary for successful reintegration.

III. Intake, return, and follow-up procedures which allow for a) accurate assessment and placement of children upon referral, b) expedient return to a community setting (e.g., special education class, regular class, vocational program, sheltered workshop) after remediation, and c) follow-up processes which can monitor the child's performance once he is returned to the community setting.

IV. Prodedures for establishing long range criteria for each student and measuring proficient performance at each intermediate step toward the long range goal.

V. Precise and efficient instructional and management procedures which allow for the rapid remediation of the child's academic and social problems.

Work done in each area will be reviewed and summarized in narrative in the following report. Full project reports are available upon request.

Area I: Measurement

Rationale

Any program designed for prompt remediation needs a measurement system which efficiently provides information sufficient to make educational decisions. Educators are beginning to realize that traditional educational measurements, such as standardized or norm-referenced tests, do not give teachers or researchers the necessary information to make good decisions about the effects of curricular, instructional, or environmental changes on pupil performance (Eaton & Lovitt, 1972). A system of daily, direct measurement which does provide adequate and prompt feedback about the effects of any change in pupil performance has been developed (Lindsley, 1964). However, as with any new system, refinements are needed. Team II has investigated various aspects of this system as it relates to the needs of both the classroom teacher and the researcher.

Progress 1973-1974

Team II investigated three major areas during 1973-1974:

1. Program changes based on data,
2. The adequacy of non-continuous data, and
3. The effects of self-charting on pupil performance.

The results of the studies in each area will be summarized below.

Decision-making rules. The procedures for collecting direct and daily measurement are currently being used in numerous classrooms and centers throughout the United States and Canada. Centers such as the Experimental Education Unit are continually in the process of revising and refining the data collection procedures.

As more data are collected by teachers and administrators, methods for precise and efficient data analysis become increasingly important. Teaching data collection procedures without concurrently teaching techniques of data analysis is like handing someone the key to a car without teaching him to drive. Therefore, Team II summarized data decision procedures currently being used at the Experimental Education Unit in a format which could be used for dissemination. This summary includes sections which outline the rationale, procedures, and exceptions or cautions for the following areas:

1. Daily rate data

    a. Medians
    b. Lines of progress
    c. Start rate, end rate
    d. Minimum acceptable progress
    e. Minimum acceptable performance levels
    f. Minimu . days at criteria performance

2. Daily percent data

   a. Medians
   b. When to change instructional plan
   c. Record floor

The adequacy of non-continuous data. While periodic assessment of pupil performance undoubtedly remains the most common method of classroom evaluation, that portion of the educational community which works within a Precision Teaching framework has advanced persuasive arguments for the employment of continuous (daily) measurement. Such arguments have appeared in both journal articles (Gaasholt, 1970; Eaton & Lovitt, 1972) and texts (Haring & Phillips, 1972; Kunzelmann, 1970). In general, these works emphasize the utility of continuous measurement in ongoing decision making and planning. Continuous measurement allow for a description of pupil progress at any given point in time and provides a basis for the prediction of future levels of pupil performance (White, 1972).

While the advantages of daily measurement in terms of effective pupil evaluation have been well articulated, the question of teacher time-cost has been largely ignored. It is obvious that continuous measurement, under most conditions, requires a greater expenditure of teacher time and energy than periodic measurement. There seem to be at least three ways in which time consumed in continuous measurement might be reduced.

First, the amount of measurement time each day may be decreased; that is, rather than measuring pupil performance on a given subject for, say, thirty minutes each day, one minute samples (or probes) might be taken and subsequent evaluations be based upon data obtained during those one minute samples. Unfortunately, the usefulness of such short samples for either descriptive or predictive purposes has not been firmly established. In addition, the results of a recent study by Billingsley and Swenson (1973) have suggested that short samples may not provide a satisfactory assessment of pupil performance in programmed reading texts.

Second, teachers may train their pupils to become skilled in data collection and recording (see self charting section in this summary, p. 5). This would seem to be a highly satisfactory technique, assuming that pupils can collect reliable data. Children can also be trained to collect data for each other. The information collected could be entered into the computerized systems which are currently being developed in the field of education (see p. 7).

A third method would involve making measurement "less continuous"; that is, data would be collected often, but not on a daily basis. If less than daily measurement is to be considered a viable alternative, then the results of this type of measurement should be shown to closely approximate those obtained from continuous daily measurement in terms of descriptive and predictive properties. It is this question which was addressed by the following study.

An Examination of the Adequacy of Non-Continuous Data

Felix Billingsley

This study examined the extent to which median slope lines-of-progress (trend lines) and median rates obtained from frequent, but non-continuous, classroom correct rate data would approximate those obtained from data collected on every available class day. Data for analysis were taken from phases containing at least eleven data points. Of the twenty phases employed, ten contained absences and ten contained no absences. All phases involved performance on academic materials. Lines of progress and median rates for the original phases, and for the same phases with every third and every other datum point omitted, were determined. Agreement coefficients were computed between the values obtained for the original phases and for the phases with data points omitted. A high degree of agreement was observed between lines of progress and between median rates; in the case of lines of progress, however, slightly lower measures of agreement resulted from the omission of every other datum point. It seems, then, that data collected often, but not daily, can give an educator accurate information regarding median performance, but is not as accurate in calculation of the line of progress.

The influence of viewing charts and self-charting on pupil's performance. A second method for reducing the amount of teacher time required to take direct and daily data is to have the children themselves take some of the responsibility for correcting and charting their work. Swenson (1973) demonstrated that self-correcting of academic materials results in a considerable time savings for teachers. Self-charting might also result in a saving of time.

In addition, self-charting or self-correction might have beneficial effects for the pupil as well. A long range goal of education is to enable children to live independently and manage their own affairs. One way to prepare children for independent living is to teach them basic skills. People who can add and subtract accurately have the initial skills for balancing a checkbook. People who can read proficiently are usually able to inform themselves about events and knowledge which affect their daily lives. A second and much neglected way to prepare children to live independently is to give them experience managing some aspects of their own environment. Lovitt and Curtiss (1969) suggested that the properties of self-management might include assessing one's own competencies, setting one's own behavioral objectives, and arranging contingencies for oneself to achieve selected objectives. Lovitt (1973) further delineated the properties of self-management as selecting a skill to be achieved; scheduling a time for learning; presenting stimuli to which an individual can respond; confirming the responses made to the stimuli; reinforcing appropriate responses; recording relevant data about the responses; and evaluating the individual's performance. Lovitt presented a number of projects whereby different self-management activities were assigned to pupils. For example, self-scheduling of subjects, self-correcting of answers, self-counting and recording of data, self-charting, and self-selection of contingencies were among the intervention activities delegated to children.

The systematic replication of self-management interventions is a needed element in self-management investigations. Team II conducted two studies to investigate the influence of self-charting on academic performance.

The Influence of Viewing Charts and Self-Charting on Pupil's Oral Reading Performance

Dale Gentry, Georgia Adams, and Lestra Hazel

The purpose of the first study was to ascertain, for eight different children, the influence on reading rates of two different self-management interventions, namely viewing their own oral reading charts, and charting their own reading rates. An equally important goal was to teach the children to chart and to become more personally involved in the use of data. Median performances, correct trends, or error trends considered separately did not indicate that self-charting or viewing their charts had a beneficial effect on pupil performance. Specifically, only for one pupil were the correct medians higher during experimental phases than during baseline conditions. No pupils had consistently lower error medians during experimental conditions compared to baseline. And, while four of the pupils had better error trends (i.e., errors were decelerating faster) for self-charting and self-viewing phases, no pupils had consistently better trends (i.e., where correct scores were accelerating faster) during self-charting and self-viewing phases.

Only when the relationship between correct and error trends (improvement ratio) was considered did one of the experimental conditions, self-charting, appear superior to other conditions. The improvement ratio for six of the eight subjects was superior to other conditions during the self-charting phase. For a seventh subject the improvement ratio was better during the self-viewing phase.

A favorable improvement ratio (x) indicates an increase in accuracy within a phase. The subjects in this study showed the greatest increase in accuracy within the self-charting phase. For one subject this was primarily becasue correct performance increased while errors remained stable. For another subject the errors decreased while the correct rate remained stable. Errors decreased and the correct performance increased for four other subjects.

It is reasonable to ask why only the improvement ratio, and not medians or trends alone, indicated the superiority of self-charting over self-viewing. It seems probable that children who see their charts or who chart their own data might focus on different aspects of the data. Perhaps some children are eager to increase their speed, other want to decrease their errors, while yet others desire improvement in both correct and error responses.

The second study was prompted from the results of the first study. Since charting correct and error rates did not seem consistently to affect correct and error performance, the authors felt that perhaps charting only correct or only error rates would have a consistent effect on the rates charted. Therefore, the purpose of the second study was to assess the effects of pupil self-charting only correct rates or only error rates.

Median performance in the second study was the best indicator of the effect of self-charting on pupil performance. For all pupils, self-charting of errors resulted in a definite decrease in the median error rate. It is apparent, but not as definite, that self-charting of correct rates resulted in higher median correct performance. It is possible that children were already performing near their practical upper limits, since reinforcement contingencies were already in effect for correct performance.

Curricular changes, that is, children's advances to new stories, occurred according to preset criteria and were independent of self-charting phase changes. This confounded the interpretation of performance trends and improvement ratios. A subsequent investigation of this confounding effect will be conducted.

The results of the second study show that not only is self-charting an effective tactic in changing pupil performance, but also show that charting specific performances (correct or error) yields a desirable effect on the performance charted. It is likely that other self-management studies will need to focus on specific self-management components.

Considering that pupils were already under effective reinforcement conditions, and that the stories read daily were somewhat variable in difficulty, the results seem impressive. Self-viewing and self-charting area advantageous over no pupil involvement with performance charts. However, self-charting was clearly superior to all other conditions, and self-charting of correct or error performance yielded a clear improvement in the particular performance charted. If such a small step as self-charting has such desirable effects, then perhaps other self-management activities, such as selections of consequences, could have even more notable effects.

Area II: Administrative Management Decision System

Rationale

Decision making is one of the most important processes that educators undertake. Teachers decide what specific objectives pupils should work towards, whether pupil progress toward those objectives is adequate, and when pupils should advance to new objectives. Administrators determine pupil placement, evaluate overall pupil progress, judge the effectiveness of programs and procedures, evaluate teacher competence, select interventions to improve teacher competence, decide which supplies and services to purchase with available funds, and even evaluate their own performance.

The range of decisions an administrator makes is large. But the systematic information he can use to make decisions is usually limited to items such as the cost of resources and the number of pupils served. Traditionally, he has not had available the most important source of information and criteria for the efficacy of his decisions -- the performance of pupils themselves. The past decade has seen the evolution of a measurement technology that allows educators to assess pupil performance data precisely each day. Of foremost importance is the use of those daily performance data to make direct classroom interventions that help pupils progress in their own skills. In addition, the same data can be used to make administrative decisions about processes both in and out of the classroom.

If daily pupil performance data are used to make administrative decisions, some general requirements should be met. First, the collection of such data should result in no appreciable increase in demands on teacher time and energy. Second, the data should provide information for making decisions, and should result in feedback about the effects of decisions. Third, different decisions require different data, so any data summary and reporting system must be flexible.

The specific administrative requirements for a data summary system are that data must be:

1. current at the time decisions are made,
2. succinctly presented,
3. accurate,
4. complete,
5. exclusive, i.e., not including extraneous information, and,
6. easily interpreted.

Team II has begun to develop a computer-based program that will readily meet the above requirements and provide essential and timely data upon which an administrator can make decisions ranging from the adequacy of a single pupil's progress to the selection of curriculum materials for a school.

Progress 1973-1974

Input formats. The number of input formats has been increased to allow teachers several alternatives for submitting pupil's daily data. This became necessary because the single input form used previously required much extra teacher time to use under some conditions. Currently five input forms are available to teachers:

1. multi-day pupil assessment event sheet,
2. daily pupil event sheet,
3. daily pupil schedule data sheet,
4. weekly one pupil, one project data sheet,
5. weekly multi-project, multi-pupil data sheet.

The above forms enable teachers to submit multiple assessment data for analysis, to submit data on a daily or weekly basis, and to submit data on a single project with one pupil, on numerous projects with one pupil, or on numerous projects with numerous pupils. Because of the variety of input formats teachers can collect and submit data with less expenditure of time than was previously possible.

Output information. A variety of output information is available to teachers and administrators in tabular and charted formats. Within-condition summaries can be reported while a phase is in progress, or after a phase is completed. Information may be requested for all data of a class, a teacher, a pupil, or a specific type of behavior. Between phase comparisons may be made including immediate changes, changes in the line of progress, and overall change. Group summaries of data may be obtained by class, teacher, pupil, or behavior.

Output formats. A variety of output formats can be requested as well. Results may be obtained either as tabular data or displayed on a chart which includes numerical descriptors. Graphic output of charted data will not only be useful as year-end summaries of sufficient quality to share with school districts and for publication, but will also provide an accurate model against which the accuracy of our classroom charts can be compared and checked.

Change codes and behavior codes. Procedures have been developed to enter and store a wider range of information about behaviors. A change code enables the teacher to indicate which contingency or instructional variable was altered. A method for precisely coding behavior has been developed. This code not only enables the computer to sort data for carefully defined behaviors, but also enables the teacher to input to the computer some information about the instructional materials or context in which the pupil is working.

Interface with Intake-Return-Follow-up. The computer programs have been adapted to the Intake-Return-Follow-up component of the project. Assessment data, once collected, are entered into the computer and results and charted data are returned within one day for analysis, decision making, and inclusion in a pupil's permanent record. In addition to the previously collected Intake-Return-Follow-up data, "progress reports" concerning growth in the same behaviors tested during intake are also collected every quarter. Upon request the computer can compare the results of each new set of data collected on a child with the data previously collected, and indicate overall progress on either the printed or graphic output format.

Data input. Data have been submitted from five classrooms for three quarters on all pupils in the classes. Currently the data which is of most benefit to teachers and administrators is within-phase information, such as starting frequencies, trends, ending frequencies, medians, etc. The fact that data have been continuously submitted over an academic year (6000 data days or 100 data days per 60 children) demonstrates the feasibility of such a system. In addition, within-phase descriptive data have been expanded so that teachers use the computer to calculate summary data. In the past these data have been calculated by hand at the end of each quarter.

Output request forms. The need for teacher output request forms has been eliminated. Regular outputs will be scheduled to meet the needs that are most common, and special requests will be handled through a data clerk until the nature of requests becomes fairly stable.

Curriculum committees. Curriculum committees in the areas of reading, computational arithmetic, and language arts continue to work on specifying and sequencing instructional objectives so that data may be collected on standard tasks. Literature reviews, task analyses, and lattice development are at various levels of completion for each of these areas.

Demographic information. Demographic information is now secured and stored in the computer for each pupil enrolled in the EEU program. As new pupils are enrolled the information is secured and entered. This information is currently useful for describing characteristics of the population being served, reducing filing work and enabling at least two types of analyses not previously possible. First, tables may be constructed to indicate the number of children falling into various categories --categories specified by any combination of the variables represented in the demographic data file. For example, for certain final reports we must indicate the number of children in each program by age and handicapping condition. Previously, this took several hours of personnel time, but now the computer does it in minutes at a low cost. Additional tables, useful to administrators, could be constructed to indicate such things as the amount of time on a waiting list by age and handicapping condition, the distribution of children in the EEU by geographic area (homes), length of time in the EEU by age at entrance, or source of referral by handicapping condition. It might also be noted that "handicapping condition" may be specified in terms of federal guidelines, state guidelines, AAMD guidelines, or any combination of those. The same file keeps name and address information for parents and guardians, and the same system is expandable to store information on other persons associated with or interested in the work of the EEU so that computerized mailing lists could be constructed. In addition the demographic file is capable of searching the performance data set(s) and forming groups of data on the basis of child characteristics. When this demographic data is interfaced with pupil performance, research could then be performed to compare, for example, the performances of children with varying types of handicapping conditions, varying lengths of stay in the EEU, or varying ages.

Exception reporting. Exception reporting is the only portion of the 1973-1974 scope of work in which no progress was made. Team II will be unable to complete a program for exception reporting until the computer input is regularized and methods are developed for the establishment of aims.

Area III: Intake-Return-Follow-up

Rationale

There is an increasing emphasis in education on the determination of specific academic and social needs of each pupil. The present goal of many school districts is the placement of a handicapped child in a remedial situation for all or part of the school day. In most cases, the objective of such a placement is the eventual return of the child to a regular classroom setting to continue his academic and social progress.

The process of referral, remediation, and reintegration requires consideration of several factors:

1. What are the student's academic and social performance deficits which need remediating? How are they measured?

2. How do these deficits compare to the performance level of the referred pupil's peers?

3. How are objectives established which are a basis for reintegration back into the regular classroom?

4. How long should the objectives be maintained before reintegration occurs?

5. How long should the reintegration placement be monitored to insure performance maintenance and continued progress?

6. What are the most efficient p cedures for use by personnel in public school districts?

The Intake-Return-Follow-up (IRF) procedures investigated by Team II will supply teachers and administrators with information which will help answer these questions. Team II's objective is to develop an efficient referral-remediation-reintegration process which evaluates pupil progress and success at several points; and can be used by public school teachers. This report includes a brief summary of 1972-1973 activities in the development of Intake-Return-Follow-up procedures and a detailed summary of progress made in 1973-1974 toward the project goals.

Progress 1973-1974

Review of first year: 1972-1973. During the first year for Intake-Return-Follow-up, the development included:

1. a description of academic and social movement cycles for 6 to 12 year old pupils;

2. an Academic Assessment Battery in the areas of reading, math, and writing skills;

3. a description of the Social Behavior Observation Scale for inappropriate classroom behaviors; and

4. a description of procedures for an efficient referral-remediation-reintegration process based upon the academic assessment battery and the social behavior observation.

In addition, the following procedures were completed for fifteen pupils:

1. referral from school districts;

2. teacher conferences;

3. collection of intake data;

4. objectives conferences; and

5. EEU placement.

Revision and development of intake procedures. During the second year of the project, the existing Intake-Return-Follow-up procedures were refined and others developed based on the data collected in 1972-1973. The procedures now include the following steps.

1. Name of referred pupil is obtained by admissions coordinator, based upon openings per class.

2. The Special Education director of the school district is contacted and a conference attended by Special Education director, school principal, teacher, counselor, and EEU coordinator is held. At this conference procedures are explained, schedules established, and peers selected for data collection.

3. Data are collected for the child's performance on the Academic and Social Assessment Battery for five days in his current placement. Data are also collected on the performance of two peers selected by the referred child's teacher. The data from these peers are used to help establish the return placement objectives. Specific information is obtained concerning the school setting of the referred pupil. This includes a description of current academic programs, successful and unsuccessful teaching strategies, and a description of the classroom design. With this type of information, in addition to the collected data, the prospective EEU teacher is better able to construct the necessary individualized program.

4. An objectives conference attended by Special Education director, school teacher, principal, counselor, EEU coordinator, and EEU teacher is arranged. The meeting includes an explanation of the results of the data collected and establishment of return placement objectives, both academic and social, based upon collected child and peer data.

5. Progress reports are sent to the appropriate school for each pupil placed at the EEU through IRF procedures. Data for progress reports are collected by administering the academic battery and collecting one-half hour social observation data for one complete week for each pupil once a quarter. This procedure allow the comparison of lines of progress and median scores showing the quarterly improvement of academic and social skills. A summary of the pupil's academic progress in relation to his academic level at the time of EEU placement and his return placement objective is also added. This method of reporting academic and social progress has been informative, precise, and also allows for continual assessment of the return placement objectives for each pupil.

Development of new procedures for the return process. The return procedures will include three conferences and the collection of return data to insure appropriate return placement. The three conferences allow for complete comparative analysis of all data describing the referred pupil's progress during his placement at the EEU. A transition program is also established for the pupil so that the return placement will be less of a change. In order to develop the transition program the EEU teacher and the return placement teacher compare their educational settings and then develop similar progreams. The results of the new return procedures will be documented when follow-up procedures are completely established during the Fall Quarter, 1973.

Revision of Academic Assessment Battery probes and social behavior observation procedures. Each probe of the Academic Assessment Battery was revised so that all responses have been precisely defined and all probes can now be used for a complete analysis of type and incidence of pupil errors.

The revised social observation procedures for inappropriate behaviors were developed with consideration of two objectives: 1) the need for precise, efficient procedures that can be used in a public school classroom; and 2) pinpointing major disruptive behavior for frequency tallies. The teacher pinpoints a few (1-7) major disruptive behaviors and notes the frequency of occurrence for each behavior. The frequency can either be tallied for one hour a day on five consecutive days, or for the entire school day on five consecutive days, depending upon the teacher's preference.

During the revision of the observation procedures, it was noted that most referred pupils have appropriate behaviors but they may have a low frequency of these behaviors or they may display the behaviors at inappropriate times. Therefore, in order to develop a complete analysis of social behaviors and social skills, appropriate social behavior movement cycles will be observed. These data will also be of value in pinpointing social return placement objectives for the pupil.

All definitions of appropriate and inappropriate behavior have been revised and the social behavior observation procedures have been simplified so that frequency data can be taken by public school classroom teachers.

New materials developed for the Academic and Social Assessment Battery. On the basis of data collected in 1972-1973, Team II developed some new materials to be used in the Intake-Return-Follow-up procedures.

1. The Screening Probe for the Academic Assessment Battery (SPAAB). The procedures developed in 1972-1973 mandated that all skills be probed for five consecutive days even if the pupil was considered to be at criterion level or above for a specific skill. This seemed to be an inappropriate use of time in assessing the pupil. In order to develop the most efficient, precise procedures for administering the academic assessment battery, there was a need to pinpoint individual skill deficits (for each referral) and then take data for five days using only probes for those specific skills. A screening probe for the academic assessment battery was developed in order to initially pinpoint the pupil's skill deficiencies.

2. The preacademic probes for the areas of reading, math, and writing to be included with the original academic assessment battery.

Another area of concern upon evaluation of the collected data was the need for probing pre-academic skills. Although several referred pupils were in first or second grade classrooms, their skill levels were far below the skills identified in the Academic Assessment Battery. Therefore, twenty-one additional probes were developed to probe the pre-academic skills (matching, color discrimination, number concepts). There are now forty probes in the academic battery, and only the probes designated by pupil's score on the screening probe will be administered for five days of data.

Area IV: Establishing Criteria Performance Levels

Rationale

Robert Mager (1972) advocated specifying criteria performance levels within the context of each behavioral objective. However, these criteria most often included only a specified level of accuracy of performance (e.g., five correct). However, the fluency with which a task is performed is often more indicative of the level at which the behavior has been mastered. For example, a student who scores five correct in one minute has significantly more fluency than one who takes one hour to score five correct. Often, in fact, fluency, not accuracy, is the very reason the child is in the remedial program: "he's hyperactive," "he's slow." Both fluency and accuracy together serve as indicators of performance. A measure of each is necessary to determine performance on most of the basic skills. Teachers set performance aims. These aims, or criteria, may be established for several reasons:

a. to insure progress on future tasks (as suggested by Bloom, 1971);

b. to insure maintenance of that skill;

c. to insure generalization to other areas;

d. to meet peer performance levels.

Proficiency, on the other hand, insures mastery of the task as defined by the parameters and objectives of the task. For certain skills, such as spelling, mastery may mean maintenance. For others, such as reading consonant sounds, mastery may mean success in the tool skill (reading). However defined, proficiency levels must be set empirically, with large data sets to assure reliability. Criteria levels may be proficiency levels, or they may be relevant to a particular student only (higher or lower than proficiency levels), but they are usually set individually. Since the common data type which can measure both accuracy (correct and error) and fluency (total performance) is rate, the daily measurement system described throughout this paper has been the basis for research into both criteria and proficiency levels.

Team II is currently investigating commonly used criteria and aims as well as methods for efficiently determining proficiency levels.

Progress 1973-1974

Collection of aims. As an initial step toward investigating proficiency levels, Team II collected criterion levels which have been set for thirteen separate academic tasks. The aims were set in many ways: by estimate, proportionally, from normative data, and functionally. These aims were compiled along with information about the type and age of student, the type of material, and how the aims were set. In addition, rules for setting aims were compiled including rationales, procedures, examples, and cautions. The methods explored included previous performance, adult to child proportional data, peer comparison, functional analysis, normative data, intersection of a known desired data and desired line of progress, and performance ceiling.

Fluency as a component of criterion performance. One research project was conducted which attended to the issue of fluency as a component of performance by comparing acquisition and retention under a standard requiring only accuracy to one also requiring a desired fluency (desired rate of response).

Accuracy Versus Fluency Plus Accuracy
Used as Criteria
in a Mathematics Program

Lestra M. Hazel

Two students of similar mathematical ability were given identical math sheets in addition and subtraction in an attempt to determine whether accuracy or accuracy plus fluency was more effective when used as criteria in an acquisition-retention situation. One student was required to reach only accuracy criteria before moving on to the next level; the other student was required to reach fluency as well as accuracy criteria. Post-test results indicated that the student working to fluency plus accuracy retained more information than the student working to accuracy alone.

Number of days at criteria. Four separate projects attempted to ascertain whether retention was facilitated by requiring performance on different academic tasks at a desired rate for several days rather than only one day before moving to a subsequent task. Data from these projects are inconclusive at present, but the initial data seem to indicate that the number of days a child is required to perform at a desired rate does influence the maintenance of that skill.

Investigation of the Difference in Maintenance Rates
on Reading Lists of Pupils Held to Criteria
for One, Two, and Three Days

Lynette Taylor and Marie Eaton

The effect on maintenance of holding a pupil to criteria on a reading list for one, two, or three days was investigated in this study with two boys, aged eight and eleven years. The material consisted of teacher-made lotto games and six five-word random order reading lists per pupil drawn from the Dolch word lists, preprimer through second reader. On lists IA and IIA the pupils were held to the criteria of fifty correct responses and zero errors per minute for one day, on lists IB and IID for two consecutive days, and on lists IC and IIC for three consecutive days.

Lotto game drill always preceded the timed reading list. The pupils were tested on three lists daily, one each from groups A, B and C. When the pupil met criteria on any one list, that list was shifted to a maintenance phase. Maintenance testing occurred once weekly.

The results from subject one's data indicate that in terms of accuracy, maintenance rates were best when the pupil was held to criteria for two or three days before entering the maintenance phase, although longer acquisition phases were required for the three day criteria. Subject two's data indicated that the maintenance phase scores were similar whether the pupil was held to one, two, or three days at criteria; although three days required longer acquisition phases.

A Project to Investigate Acquisition and Maintenance of Spelling Words by Pupils Held to Criteria for One, Two and Three Days

Mary Jo Hedges

The main purpose of this study was to ascertain the optimal number of days a child should perform at criteria on spelling words in order to achieve maintenance. Two subjects, aged nine and ten, were held to a criteria of 100 percent accuracy over one, two, and three days for separate lists of words. After the subjects had met criteria, a second goal of the research was to examine the amount of generalization in letter patterns to lists of similar words. The results tend to indicate that three days performance at criteria may be desirable for maintenance. With regard to generalization, it appears that in some instances the subjects did generalize spelling patterns to lists of similar words. However, due to the brevity of the maintenance phases and the variability of data on the generalization lists, further research is needed for conclusive evidence.

An Investigation of the Differences in Maintenance Rates on Spelling Probes When Held to Criteria for One, Two, or Three Consecutive Days

Terry Ryan, Sandra Smelser, and Marie Eaton

The objective of this study was to determine the effect of the number of days at desired rate on the maintenance of skills. Three learning disabled boys, aged nine, were given three one-minute spelling problems of six words each day. The only difference in procedure between the probes was the number of days required at criteria on the words. On one list, one day at desired rate was acceptable. Once a pupil had met all the criteria for passing a probe, he was given a maintenance test on those words the following week and each week thereafter throughout the project's duration. The data indicate that best results were obtained when the boys were held to criteria for two days, in terms of maintenance of correct and error rates and covering material in a reasonable length of time.

The Effects on Oral Reading Rate and Accuracy of Requiring One, Two, or Three Days Criteria Performance on a Word List

Kathleen Terry, Chuck Veilleux, and Marie Eaton

In this study two variables were investigated: first, the effects on oral reading rate in context of reading lists of the words contained in the story; and second, the effect of the number of days at desired rate required on subsequent reading rates and maintenance. The subject was a twelve year old moderately retarded child who was reading at a preprimer level. Three sets of word lists with corresponding stories were devised. A desired rate of thirty words per minute (wpm) with zero errors was required on each word list before the child began reading the story which contained the words. A desired rate of sixty wpm correct with one error or less was required in the story before the next word list in that set was introduced. On the first set, one day at criteria was considered sufficient for both the list and the story. On a second set, two days were required and on the third set, three days at criteria were necessary before moving to a new list or story.

The data indicate that two days at criteria produced better performance in terms of consistency of response, number of days required to meet criteria, and maintenance.

Accelerating versus stable aims. The educational progress of their students is of immediate concern to most teachers. They are always searching for methods which will maximize the work capacity of each child within the classroom so that educational progress for each child becomes reality.

Reinforcement procedures have been successful in motivating many children to increase their work output and quality (Cotter & Spradlin, 1971; McKenzie, Clark, Wolf, Kothera, & Benson, 1972). Others have examined different schedules of reinforcement and their effect on pupil performance (Lovitt & Esveldt, 1970; Kirkwood, 1971; Hansen, 1972).

A number of these investigators, however, have noted that in some cases the child's performance level tends to approximate the contract rate or level at which he receives reinforcement (Lynch, 1972). Therefore, this study was initiated in order to explore pupil performance under stable versus accelerating contract aims.

The Effects of Stable Versus Accelerating Contract Rates on Math Performance

Valerie Lynch

In this study, the two subjects, aged thirteen and fifteen years, were reinforced for rates equalling or bettering a previously established desired line of progress in math. Therefore the pupil's contract rate increased slightly each day. This procedure was contrasted with the more typical stable contract rate phase.

The results of this study are confusing and contradictory. A great deal of variability was exhibited by both subjects during each phase of the experiments. Subject A's highest median rate occurred during a stable contract rate phase, while this did not hold true for Subject B. Subject A exhibited a higher mean number of errors during accelerating contract rate phases while Subject B did not. The shortest amount of time to reach criterion occurred during an accelerating contract rate phase for Subject B, but during a stable contract rate phase for Subject A. Taken together, the data do not support the superiority of one type of contract system over another. A number of problems are evident within the study which deserve discussion.

The contingency schedule history of both subjects was similar. Both Subjects A and B had worked under a stable contract system before this study was initiated. Neither had previous experience with the accelerating contract rate system. The fact that both had pre-exposure to one type of contract system but not the other may have contaminated the results.

The great variability in data during stable contract rate phases points to the possibility that the arbitrary decision to choose 20.0 responses per minute as the stable contract rate may have been in error. It is probable that this rate was far below the subjects' capabilities and therefore not challenging.

Finally, the addition of a third condition dissimilar to the accelerating and stable contract rate systems may have clarified the results. Both the stable and accelerating contract rate systems consist of a single line which defines performance as "good" or "bad." In other words, under both systems a specified rate is set and performance falling below that rate is not reinforced. The only difference between the systems is the angle of the line of progress which determines which performance is reinforced and which is not.

Because of problems inherent in this study no conclusions can be drawn as to the comparative efficacy of the contract rate systems under consideration. However, in a time when educational accountability is becoming a reality, it is important to provide teachers with tools and knowledge which will aid in promoting maximum performance of all children within the classroom. The research which exists on reinforcement schedules in the classroom suggests that with good research design, control, and larger samples, this area of study could provide valuable information to the classroom teacher concerned with the progress of his pupils.

<u>A discriminate analysis procedure for the empirical determination of proficiency levels.</u> The collection and evaluation of daily measurement data on the performance of pupils allows us the opportunity to individualize instructional programs and procedures to meet the needs of each. Setting performance criteria is now a best guess proposition; errors prove costly in terms of individual student performance time. Proficiency levels would provide empirical bases from which to begin productive individualization.

In order to set empirical performance criteria we need to collect data on a large sample. During Autumn Quarter, 1973, Team II collected daily data on large numbers of pupils. The project is now completed, and although the analysis of the data has been both time consuming and difficult, we have found that a modified discriminate analysis procedure can provide proficiency levels.

A Discriminate Analysis Procedure for the Determination of Performance Proficiency

Kathleen Liberty, Owen White, and Corky McGuigan

Data were collected on the performance of forty-one subjects for thirty-six days. Subjects sorted cardboard shapes into boxes for a one-minute period daily. During the first phase, the subjects sorted two shapes; the number of shapes was increased by one during each of the succeeding three phases. This skills sequence was constructed to resemble a skill hierarchy used for common educational programs. The data were used to test analysis procedures useful in the determination of proficiency performance levels. Eleven trials were required to define rules for predicting performance and proficiency levels. The number of trials of analysis were large, however, and could be reduced through a more precise definition of the variable important to the skill. However, the utilization of a modified discriminate analysis procedure for the determination of proficiency levels seems to be a promising method. Further studies using a larger computer will determine the efficiency of the data. Future studies in which proficiency levels are evaluated within instructional programs will be necessary to check the accuracy and application of proficiency levels determined through this method.

Area V: Instructional Procedures

Rationale

When the body of literature on traditional instructional procedures is reviewed, it becomes clear that many educators use drill, fading, cues, prompting, practice, or other procedures on the basis of the recommendations of experts only. The literature has little empirical evidence which supports the use of these procedures or delineates how or when they should be used. Therefore, Team II has investigated some of these procedures using applied behavioral analysis methodology.

Progress 1973-1974

In 1973-1974 research was done in several areas: drill practice, prompting, feedback, whole-part learning, and cues. The following section summarizes the research in each area.

Drill. Drill has long been used, especially by teachers dealing with learning disabled children, as a method for improving children's performance on various learning tasks. Reading specialists such as Gates (1947) or Gray (1956) often recommended drill procedures as a method to improve reading performance.

Early researchers such as Hebb and Foord (1945) and Thorndike (1932) working in the fields of acquisition, retention, generalization, modeling, and active responding all dealt with component parts of the drill process, yet there is little research in classroom settings which reports the functional effects of drill on academic performance.

A number of different modes of drill were investigated this year. In one study, routine drill was investigated as an instructional procedure to teach sight words to two severely handicapped pupils.

The Effect of Flashcard Drill on Oral Identification of Social Sight Vocabulary

Kathleen Liberty

Two severely handicapped boys enrolled in the secondary classroom at the Experimental Education Unit were subjects in this study, which was designed to investigate the effect of flashcard drill on the mastery and maintenance of social sight vocabulary words. These words were those associated with a "necessary" social sight vocabulary, and included such words as "danger," "poison," and "keep out." During the baseline phase, the subjects were given a list of the twenty-six different words. They were timed for a one-minute period as they read the words. During the intervention phase, the teacher presented the flashcards individually to each subject. The teacher and the subject read through the flashcards three times. (One word or phrase was printed on each card.) Following this short drill, the subject was given the sheet and asked to read as data were collected for one minute. This phase was terminated when the subject read words at or above about fifty correct per minute with two or less errors for two consecutive days. The third phase (maintenance) began approximately one week after the end of the flashcard phase. During this phase, data were collected once a week for one minute as the subject read from the sheet of words. Both subjects were performing at about five correct per minute during the baseline phase, with S_1 having a median error rate of thirteen and S_2 of six. Under the flashcard drill conditions, both subjects made rapid gains. S_1 reached criterion in eleven days, while S_2 met it in nine. S_1's median performance during the maintenance phase was forty-nine correct with two errors while S_2's was fifty-seven correct with three errors per minute. For both subjects, routine drill with the flashcards accelerated correct performance, decelerated error performance, and resulted in adequate retention of the words. Future studies will examine conprehension of these words, and transfer to "real" situations.

Four studies compared routine versus novel drill as an instructional procedure:

Four Studies Investigating the Effects of Routine and Novel Drill on the Acquisition and Performance Levels of Learning Disabled Pupils

Corrine McGuigan

STUDY I: The effects of routine and novel drill on the acquisition rates of twelve pupils learning the manual communication alphabet.

Study I was designed and implemented to study the effects of routine and novel drill on the acquisition rates of twelve pupils learning the Manual Communication Alphabet. Four groups were formed with three pupils in each. Two of the groups were drilled routinely (i.e., with the same materials and in a consistent manner) and the two others received novel drill (i.e., varying instructions and varying techniques). In addition, one routine group and one novel group received informational feedback (i.e., they were told after each session the number of correct and incorrect formations they had made).

The results of Study I indicated that the effects of routine drill with feedback were superior to the effects of routine drill without feedback and novel drill with and without feedback for students learning the manual communication alphabet. The line of progress for correct responses for two of three pupils in the routine with feedback group (Group I) proved to be considerably greater than those of pupils in any of the other three groups.

The error rates showed no greater or lesser 'celeration patterns using routine drill techniques and feedback than any of the other groups.

Maintenance checks also revealed that while Group I (routine with feedback) dropped the farthest from end rate, they did not fall below what others had achieved.

When Groups 2 and 3 are compared, it should be noted that, again, routine drill without feedback shows slightly greater acceleration for correct responses and greater deceleration for error responses as compared to novel drill without feedback.

STUDY II: The effects of routine and novel drill on the acquisition and performance level of a student learning the manual communication alphabet.

One pupil was chosen from the routine drill-no feedback group of Study I. An A-B-A design was implemented to ascertain if different drill types produced different performances once the pupil had progressed through the acquisition stage of learning toward criterion levels. The pupil showed a slightly lower trend in Phase 2 (novel drill) and again in Phase 3 (return to routine drill) than he had in Phase I (routine drill). It should be noted that the median scores were progressively greater in each phase, showing continued progress by the student.

As for error responses, there seemed to be a detrimental effect when novel drill was introduced in the second phase. A decelerating error trend occurred when routine drill was reinstated in Phase 3. This increase in error responses during the novel drill phase supports the hypothesis that novel drill may increase error responses when the task is not at a criterion level. This hypothesis is also supported by the findings of the third and fourth studies in this project.

STUDY III: The effects of novel and routine drill on the acquisition rates of a pupil learning to form manual communication symbols.

The results of this multi-baseline study indicated that the pupil who had attained a high line of progress under routine drill conditions when learning the Manual Communication Alphabet progressed well under novel drill when learning the symbols for manual communication (a similar but more meaningful task than the Manual Communication Alphabet). However, data point out that errors were at a higher rate in the novel drill conditions than in routine drill (supporting studies II and IV). The probable reasons for the change in effectiveness of the drill types in this study are 1) the level of meaningfulness of the material, and 2) the close relationship between this task and the one taught directly preceding it.

STUDY IV: The effects of novel and routine drill on the acquisition and performance level of a student writing numerals one through one hundred.

Again, a multi-baseline type design was used for cross comparison of data. The results show that routine and novel drill were effective in increasing correct rates on writing numerals 1-50, with novel drill showing slightly greater accelerating lines of progress. Both novel and routine drill were also effective in reducing the amount of error responses, novel again having a slightly greater effect.

Routine drill did result in improvement in performance when the pupil was asked to write numerals 51-100. During Phase I (novel) a previously decelerating pattern changed and errors increased considerably. Phase 2 showed decelerating patterns of errors in both novel and routine drill sessions, routine having the greater trend deceleration.

It should be pointed out that for this pupil, daily drill on numbers 1-50 during his regular in-class math session may have influenced the results.

The effects of new versus error word drill were compared in two studies.

A Comparison of New versus Error Word Drill on Reading Performance

Marie Eaton and Luella Haisch

Applied behavior analysis techniques were used to assess the influence of two types of word drill on the reading performance of six primary age learning disabled children: drill on new words and drill on error words.

The data indicate that drill is an effective procedure to improve oral reading performance and that for most children drill on error words is superior to drill on new words in terms of acceleration of correct rate and deceleration of errors.

Furthermore, the data illustrate how teachers can use applied behavior analysis methodology to select the most appropriate teaching procedure for the children in her class.

The Effects of New versus Error Word Drill on the Reading of Recipe Cards

Marla White

Drill on new versus error words were compared as techniques to teach sight words necessary to read simple recipes. For this thirteen year old subject both procedures proved equally effective in reducing errors. The author hypothesized that these results were evident because the pupil's errors were largely in the prefix or suffix portion of words and would vary from day to day. Therefore it was not the drill on specific words which proved efficient but the drill procedure. Further data are being collected with this subject to determine if drill on and attention to prefixes and suffixes will increase accuracy.

Another area of drill explored this year was the effectiveness of massed versus distributed drill. For a wide variety of tasks the question has been asked: Are long term drill sessions or numerous shorter drill sessions more beneficial to learning performance? To explore this question experimenters have conducted studies dealing directly with massed and distributed training (Ausubel, 1969).

Massed training is defined as a situation in which trials are given in rapid succession with a minimum time interval between each trial. On the other hand, distributed training is a situation in which some longer time interval is allowed between each trial.

An Investigation of Pupil Performance to Determine the Effectiveness of Massed versus Distributed Drill in the Acquisition of Beginning Math Facts

Chuck Veilleux

This project was concerned with the acquisition of basic math facts and whether massed or distributed drill would produce the best acquisition of these skills for an eleven year old retarded boy.

A multiple baseline design was used to investigate these drill methods. Procedures were identical for both conditions except that the math facts to be learned for the massed condition were presented in one five minute drill session, whereas the facts for the distributed drill were presented in five one minute drill sessions spaced throughout the day.

Analysis of the data provided in[illegible]ve results. The pupil was exposed to more material with ma[illegible]; however, performance was more consistent across phases fo[illegible]cs learned through distributed drill. It is impossible to generalize from these results. The literature on massed versus distributed drill supported the distributed approach because learning generally occurred at a faster rate. In this study, less material was learned, but performance was more consistent across the phases with a distributed approach.

An area of concern closely related to the massed-distributed drill issue is the whole-part learning issue.

The objective of nearly all persons committed to the profession of teaching is to provide the best curriculum and instructional procedures possible for their pupils. To meet this objective, research is often designed and implemented to investigate which instructional or curricular variable is most effective in aiding the learner. For many pupils, this means presenting the materials with contingent positive reinforcers or presenting the material in various revised forms, in different time intervals, or in varying amounts.

This latter teaching intervention, presenting material in varying amounts, is a technique often referred to as "part learning" which is in direct contrast to "whole learning." Whole learning means that the material is repeated as a whole from beginning to end at each trial until the criterion is reached (twenty spelling words are presented at once). Part learning, however, refers to the technique of dividing the material to be learned or activity to be performed into parts (four units with five words in each unit) which may be practiced separately and then combined in a number of ways to reform the whole (McGeoch, 1931).

The question of whether pupils function better when instructed by the whole method or by some form of the part method has stimulated a large amount of research. The studies are, however, usually lacking in empirical data and often raise more questions than they answer. The following pilot studies were designed to empirically ascertain if certain children might perform better when the material they are required to learn is presented in parts rather than in the traditional whole.

Whole-Part Learning

Corrine McGuigan

Two pupils, a boy aged fifteen and a girl aged ten, served as the subjects for a study to assess whole versus part learning. Both had been referred to the Experimental Education Unit because of academic deficits and inappropriate social behavior.

Spelling was the subject area chosen to investigate the whole-part issue. During one condition the pupils were presented with a list of words to be learned. Daily quizzes were given on the words and the pupils were allowed to move to a new list when 100 percent accuracy was achieved. During the second condition a similar list of words was presented to the student, but instead of the whole list, only portions of the list were presented at a time. When each portion was learned to 100 percent accuracy the next portion was introduced until the entire list was learned.

The data supported the hypothesis that during part learning periods both students were able to perform better than when the material to be learned was presented as a whole.

Putting aside empirical data for a moment, the author wishes to point out a few observations which were not recorded or charted. For both pupils, who often refused to work, part learning was a great help in curbing the obviously unpleasant attitude toward spelling. They often commented that only two or five words per day was really not so bad. It seems possible that such a change in attitude might also account, in part, for the higher scores during the part learning condition as well as for the relatively low scores during the whole learning condition. Certainly, this attitude -- whether it is feelings of success which spur success or not -- is an important variable for consideration by all teachers.

What seems implicit in this study is the fact that students have optimal levels of performance. For some students, not as severely handicapped, five words, ten words, or twenty words per session are tolerable amounts and will result in desired performance. It is necessary for each teacher to discover the performance levels of each pupil. Does the pupil function better when the total list is presented or when it is presented in parts? What is the optimum length of each part and of the whole?

Currently, research is being conducted in this area which not only deals with optimum levels of performance and the question of whole versus part learning, but also with the most efficient types of part learning (Progressive Part method, Repetitive Part method, and Pure Part method), and the immediate and long term effect of each on retention.

Another type of whole-part learning might be to have a child learn each separate skill involved in a task before learning the whole task. Often when a child demonstrates an inability to perform a whole task, the teacher will select components of the task to be learned before the whole task is reintroduced. The following study explored the effects of requiring performance at criteria on a component part of a reading task on the child's subsequent performance of the whole task.

An Investigation of the Influence of Reading Word Lists to Criteria on the Number of Days Necessary to Meet Criteria in the Text

Ingrid von Christierson and Marie Eaton

Many teachers request pupils to meet criteria on a word list before reading these words in context. There is little data, however, which empirically supports the use of this procedure. This study investigated whether reading a word list to criteria would increase oral reading accuracy and fluency or affect the number of days required to meet criteria in the text. During each day of the initial phase the pupil, a twelve year old learning disabled boy, was requested to practice the words selected from a story in his reader until he was able to read them at a criterion level of thirty wpm with one or less errors. Only then did he read the words in context. In the B phase the word list and the corresponding story were both presented each day until criteria were met on both. The second procedure was superior both in terms of fewer number of days required to meet criteria and in terms of correct and error rate on the stories.

<u>Summary of drill research</u>. In the past two years several studies were conducted investigating the effects of drill on academic behaviors for mildly and moderately retarded children and children labeled as learning disabled and emotionally disturbed. Some general conclusions may be drawn from these drill projects taken together.

1. Performance under drill conditions was superior to no drill.

2. Requiring a child to complete each day the drill exercises on a word list to desired rate did not always result in superior performance in reading when compared with drill with no desired rate criteria.

3. Drill on error words was generally better than drill on new or all words in improving oral reading performance.

4. Drill on new words was generally more effective in improving correct and error rate on reading words in context than drill on all words.

5. Drill on randomly selected words did not produce the same gains in oral reading performance as the other types of drill.

6. Routine drill produced better gains on several learning tasks during acquisition phases than did novel drill.

7. Once accuracy was achieved, novel and routine drill produced equal gains in rate on spelling, sorting, and manual communication tasks.

8. Self-directed drill produced gains in accuracy, but not in fluency on mathematical skill sheets.

9. Teacher-directed drill produced better gains than self-directed drill in terms of fluency.

10. When feedback of results was given with drill procedures, performance generally improved more than if drill was given without feedback.

11. Both massed and distributed drill procedures resulted in improved performance, but the data did not strongly support either.

12. Part learning was superior to whole learning for children with previous histories of instructional failure.

Practice as a means of insuring retention. The literature on the nature of learning has concerned itself not only with definition of what learning is, but also on the best methods of insuring that learning actually occurs. Once a skill has been learned, the next concern of educators is the retention of that skill.

Both drill and practice have been advocated to facilitate skill acquisition and skill maintenance. However, most authors fail to procedurally distinguish practice from drill, although a functional definition derived from the research can be made. Drill is the directed repetition of the specific response to be learned. Smith (1973) for example, directed the subjects in daily drill over identical material until the response was acquired to criterion. If the response to 2+1, 3+1, 1+1, etc., was to be learned, that response was drilled. During practice, however, the learned response is utilized in solving problems requiring that response as well as others of a similar or dissimilar nature. If the response to +1 problems has been acquired, the subject might practice that response by solving mixed add fact problems, 3+1, 6+2, 5+0, etc., or by solving problems requiring different processes, 1+1, 7-3, 8x6, etc. This distinction of practice from drill is supported by Travers (1967).

Such distinctions, as well as the results of investigations into retention, are important to the classroom teacher who must daily deal with the problems of forgetting. A common skill area in which retention is crucial is spelling, since the spelling of each word must be individually maintained. The spelling response is not primarily a building block, to be utilized in other responses (as 1+1 is utilized in 123+123). The study examined the effects of practice on the retention of spelling words learned to criterion.

The Non-Effect of Practice on the Retention of Spelling Words Learned to Criterion

Kathleen Liberty

The four subjects for this study were enrolled in a secondary level classroom at the Experimental Education Unit. Subjects 1 and 2 were fourteen years of age, and working on spelling material at about the third grade level. Subjects 3 and 4 were thirteen years of age, and beginning spellers. Subject 1 was the only girl.

Each subject was given a list of words to learn. Once the words were learned to a previously set criterion level the maintenance phase began. During maintenance, daily practice was provided to subjects 1 and 3 which involved a series of worksheets including some of the "experimental words" and similar words as well. Maintenance tests were given to all subjects weekly for the remainder of the study. All subjects maintained at or near their criterion rates. The data indicate that practice has little, if any, effect on retention of spelling when those words are learned to a criterion level.

<u>Prompting and Feedback</u>. Most of the programmed materials which have flooded the market since the early 1960's have been based on the premise that children learn faster and more effectively if they are given immediate feedback in their responses (Bilodeau and Bilodeau, 1961; Ammons, 1956). In addition, some of these researchers and publishers have developed these materials so that children can progress through them without making any errors. Unlike the old maxim "you learn from your mistakes," these persons hold that errorless learning produces a more stable response more efficiently, and they rely heavily on prompts and cues to allow the child to progress without error.

Previewing as an instructional tactic may also be a kind of prompting device. Travers (1967) stated that a "warm-up" period may help students function at maximum efficiency when the task is repeated. This "warm-up" period or previewing may serve as a prompt for the desired response.

Data were gathered in several studies to determine some effects of feedback on the performance of children.

Adverse Effects of Self-Correction in a Subject's Mathematics Performance

Kathleen Liberty

This study investigated pupil correction of mathematics material to determine if this procedure facilitated progress in comparison with the usual routine of teacher correction of material.

The subject was a thirteen year old boy enrolled in a secondary classroom. The materials used included Books 16 and 17 of the mathematics program from Sullivan Associates at the Behavioral Research Laboratories (1970). The problems were generally three and four term double digit addition problems with carrying.

During Phases 1 and 3 the teacher corrected the pupil's work at the end of a five minute work period. During Phases 2 and 4, the pupil corrected his own work.

For this subject, the data indicated that lines of progress were superior in the "teacher correction" phases. Self correction did not provide the benefits for this child asserted by learning theorists.

The Effects of Informational Versus Correctional Feedback on a Subjects' Phonics Performance

Pat Leuthy

In this study the effects of two kinds of feedback were compared. Informational feedback involved praising the child for correct responses and telling the child when an error was made. Correctional feedback involved giving the child the correct answer whenever he made an error as well as praising each correct response. Both medians and performance trends indicate that correctional feedback was superior to informational feedback.

Some benefits of informational feedback were discussed in another paper by a Team II member.

Easier Transitions to New Material: A Possible Effect of Non-Correctional Feedback

Kathleen Liberty

This study used forty-one subjects aged seven through eighteen years. The subjects were asked to participate in a sorting task which involved the sorting of progressively more shapes. During the first sorting task the subjects were not given feedback about their performance. On all subsequent tasks, informational feedback (knowledge of results) was given each subject.

The group data provide some information about the effects of this particular type of informational feedback:

1) Telling the subject the performance results may ease the transition to more difficult material.

2) The effects of such informational feedback will probably be immediate, but not sustained.

3) The effect will be demonstrated in rate of performance, rather than in change in performance over time.

4) The effect on a group may be seen in a much more variable performance range.

Previewing. Last year, studies on the use of previewing as an instructional technique proved effective in reducing the amount of errors in oral reading performance. Further investigation into previewing was conducted this year.

The Effects of Two Previewing Techniques on Oral Reading Rates

Ingrid von Christierson

In this study the effectiveness of two previewing tactics were evaluated: 1) oral previewing with feedback, and 2) previewing by listening to a tape selection. The subjects were two boys, aged twelve and thirteen years, enrolled in a secondary class. Using an ABAC design, the author demonstrated that oral previewing with feedback was the more effective previewing tactic in terms of both increase in correct rate and decrease in error rate.

Cues/Demonstration. An investigation into those instructional procedures which facilitate skill acquisition is definitely necessary. In the past, research has tended to focus on instructional materials rather than instructional procedures. However, without systematic instructional procedures, even the most highly developed materials will prove useless. In addition we must concern ourselves with generalization, with some guarantee that the particular behavior learned will be used in response to other appropriate stimuli. If a particular instructional procedure will not only facilitate acquisition, but foster generalization, such a procedure must certainly be promoted. Cues and demonstration have been suggested as possible techniques, and the following research was intended to explore this issue.

The Use of Demonstration to Facilitate Skill Acquisition and Generalization in Arithmetic

Kathleen Liberty

This study investigated whether working a problem (demonstration) for a subject and then leaving the completed problem on the subject's desk (permanent model) facilitated skill acquisition. Skill generalization to slightly changed stimuli was also explored. This demonstration procedure was used to teach two classes of math problems to a thirteen year old boy who was performing at about first grade level in arithmetic.

The use of demonstration and a permanent model were very effective in changing the performance of this subject. In addition, further demonstration and modeling were not necessary when the subject was presented with different problems of the same type.

Fading Cues Maintains Performance of Oral Counting by Fives

Kathleen Liberty

A seventeen year old severely handicapped boy enrolled at the Experimental Education Unit served as the subject in this study. The pupil had just completed an instructional sequence in counting by ones to one hundred. The subject's educational program established that the next skill to be learned was counting by fives as a prerequisite skill for a time-telling program. A narrow strip of paper with the numerals 5, 10, 15, ...55, printed about one inch apart, was placed on the subject's desk. The subject and the teacher counted orally together for three complete, correct sequences through the numerals each day. Following this drill period, the subject was asked to count alone for thirty seconds while the teacher recorded the number of numerals correctly or incorrectly counted. When the subject reached a criterion of thirty-three correct in the thirty second period, with no errors, the next phase was initiated. During the second phase, the practice period was identical to that of the first. However, the numeral 5 was covered during the timing. When criterion was reached, the third phase began, with the numerals 5 and 10 covered during the timing. During each subsequent phase, one more numeral was covered during the evaluation period while the drill period remained the same. During each phase, the subject's response remained at about thirty-three correct per thirty second period, while errors ranged from two to zero. However, when the numerals 5-40 were covered, the subject was placed in a group home. Phases after this period show a variable error performance. Due to the termination of the school year, only one performance day of no cues is recorded. On the final day, without cues, the subject performed thirty-three correct with one error. Although the cues were faded relatively slowly, the subject was able to maintain performance throughout the study. Future follow-up data will show the maintenance of this skill. This is extremely important for subjects who have a history of variable performance (as does this subject) or who need to have relatively small steps in order to progress at acceptable levels.

The Effect of Cues on Identifying Cursive Letters

Kathleen Liberty

The subject was a thirteen year old boy who previously demonstrated proficiency in saying the alphabet from memory and from printed cues. At the time of this study, the subject was beginning work on cursive handwriting. Although the sheet given the subject was in alphabetical order, the pupil could not correctly name the single lower case cursive letters. A one minute performance sample showed that during the seven day baseline period, the median correct performance was twenty-six per minute, with errors at about twelve per minute. However, both correct and error performance were increasing. At this point, lower case manuscript letters were placed above the corresponding cursive letter on the subject's "probe" sheet. During the five days of this condition, the subject's median correct performance rose to seventy-four per minute, while errors fell to zero. The printed cues were removed during the final phase. The subject's correct performance was about equal to the obtained cued median. However, without the intervention, the subject's performance would have been about that level anyway. Errors, however, rose to a median of ten per minute. Because the final phase was terminated early, it is impossible to tell if errors were increasing or decreasing. It is tentatively suggested that the subject did not read the cursive letters during the period when printed cues were available, so that the cues did not affect the performance of this skill. Since the subject knew the alphabet, the results are curious. Perhaps the cues should have been written over rather than above the cursive letters. Perhaps future studies can look at the placement of cues for effective behavior change.

The Use of Cues to Teach Name and Address to a Secondary Aged Pupil

Ingrid von Christierson

The use of a teacher-made cue sheet to teach name and address to a pupil was investigated using an ABAC design. During the A phase the pupil was merely asked to write his name and address. During the B phase, the pupil was presented with a sheet of paper on which the pupil's name and address were printed before he was asked to write his name. During the C phase, maintenance of the skill was tested by having the pupil write his name and address for the receptionist.

The teacher-made cue sheet was an effective intervention. The effects were noted on correct and error rate, but most dramatically on percent correct data. Correct rate was only slightly influenced while error rate and percent correct were significantly influenced. At the onset of the project the pupil was able only to write his first name; by the end of the project he had retained the information taught him with the aid of a cue with 100 percent accuracy.

The effect of cues on mathematics performance has also been assessed. Drill with a model present is a teaching tactic that has received increasing consideration by applied behavior analysts (Haring, 1974; Eaton & Swenson, 1973; Smith, 1973). An example of the use of a model is placing problems with the correct answers at the top of an arithmetic computation page. In these papers such pages are called cued math pages. Pages without answers present are referred to as non-cued pages. A rationale for the use of cued pages (model) is that children can perform arithmetic problems easily with answers present, and learning can occur with few errors.

Cues are incorporated as teaching techniques in other subjects. For example, when children learn to write, sample models of letters are displayed on worksheets to show the child what the finished product should look like. Some educators claim that cues can be a more successful instructional technique than teaching a child to rely on counting on fingers or drawing lines to help compute answers. Counting fingers or lines can be a relatively slow process and will hinder the fluency of computation as the child progresses to more involved mathematics. During the last two years, thirteen separate studies were conducted which explored different uses of cues for teaching math facts. One study investigated performance levels in mathematics probe sheets after cues were withdrawn. Five explored cues as a teaching mode by comparing performance of cued fact sheets with non-cued fact sheets and seven compared cues and flashcards as teaching strategies.

Arithmetic Computation Drill With and Without a Model Present

Dale Gentry and Georgia Adams

Models, or cues, have often been used as an instructional procedure. An important issue, if one uses this tactic, is what happens to a child's performance when cues are removed and the child must perform the same problems without the use of a supporting device. Only if a child maintains or readily regains his previous performance level in the absence of cues can we assume that he has "learned" the problems and is not simply engaged in rote copying. The present study considers pupil's performance characteristics over several days on cued math sheets, then over several days on the same problems, but without the cues.

In general, the data indicate that the use of cued arithmetic pages can be effective in teaching arithmetic computation. Children performed with few errors during cued phases, while increasing their correct rates. In addition, when the transition was made to comparable non-cued sheets, error rates remained low; pupils' accuracy remained high when cues were omitted. Additionally, correct rates decreased only moderately when moved from cued to non-cued pages. In most cases, the rates accelerated to the same level reached in the previous cued phases.

Cued sheets resulted in acquisition of math facts with few errors. Removal of cued sheets resulted in no loss of accuracy and only a minimal loss in correct rates, which was readily regained.

Cues as a Method for Teaching Mathematics

Marie Eaton, Marsha Bayly-Schoene, Mary Jo Hedges, Valerie Lynch, and Stephanie Taga

Five studies were conducted which invesigated cues as a tactic to teach simple math facts. The subjects ranged in age from eight to fifteen years. Their primary referral reasons also varied and they bore such disparate labels as autistic, severely mentally retarded, emotionally disturbed, schizophrenic, and learning disabled. All the studies followed a similar design. Math facts were divided into separate groups. After baseline data were taken on all groups, cues in the form of sample problems with the answers supplied, were placed at the top of the child's worksheet for one group only, while data continued to be collected on all three.

The following statements summarize the results of these studies.

1) When the problems on the worksheet were presented to the pupils who were in an acquisition phase (correct rate low, error rate high), cues were an effective procedure.

2) When the problems were presented to pupils who were in a fluency stage (correct rate low, error rate low), cues did not seem to make an appreciable difference in rate of improvement.

3) Children who were more severely handicapped often had trouble learning to use the cues.

4) Some pupils were able to generalize from cued to non-cued sheets, while others showed improvement only on the cued sheets until cues were introduced to non-cued sheets.

Cues versus Flashcard Drill to Teach Simple Math Facts

Marie Eaton, Ingrid von Christierson, Lynne Anderson, Jacque Doane, Connie Deyaney, and Kathi Terry

Data were collected in seven different projects in order to compare the relative effectiveness of cues and flashcard drill on acquisition and maintenance of math facts. The eight subjects varied in age from eight to sixteen years. All were performing far below grade level in mathematics. Identical multiple baseline designs were used for all the studies. The math facts were divided into two sets for each process: easy facts (one digit answer) and harder facts (two digit answer). Each problem in each set was then randomly assigned to a worksheet (four in each set). No problem appeared on more than one worksheet and five variations of each worksheet were constructed. Baseline data were then taken on all eight worksheets in whatever process (addition, subtraction, multiplication or division) the teacher selected. After the baseline phase, cues were introduced on one worksheet in the easy set and flashcards were introduced on one worksheet in the harder set. Data continued to be collected on all worksheets. When the pupil attained desired rate on the cued or flashcard worksheet, the interventions were alternated so that flashcards now were introduced on the second easy worksheet and cues on the second harder fact worksheet. The interventions continued to alternate until performance on all sheets was at desired rate.

The results of these studies can be summarized in the following statements:

1) In all studies, learning was evident with both cues and flashcards, but cues were superior in terms of:

   a. lines of progress, and
   b. the number of days required to meet the desired rate.

2) The introduction of cues resulted in an immediate improvement of correct and error rates with error rates reaching zero within the first few days.

3) Generalization findings were mixed. Most studies reported no generalization with either intervention. One study, however, did report some generalization of improvement to other worksheets when cues were introduced.

4) Maintenance after the intervention was discontinued was better for the cued pages.

These results seem to indicate that when cues and flashcard drill are compared as teaching tactics, cues resulted in superior performance. Since cues are far less expensive then flashcard drill in terms of teacher time, these results have special significance for teachers of children who present learning problems.

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TEAM III:

RESEARCH AND APPLICATION OF INSTRUCTIONAL PROGRAMS

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TEAM III:

RESEARCH AND APPLICATION OF A PROTOTYPIC MODEL FOR INSTRUCTIONAL MATERIAL DEVELOPMENT

Frequently, exceptional children have difficulty acquiring new skills. Thus, the learning process often proves to be frustrating for many of these children, as well as for their teachers. Regardless of the difficulty, however, it is important that children master a variety of specific skills so that as adults they might lead independent lives. It is apparent to educators that there is a relationship between the number of basic life skills which an individual possesses and his ability to function in society. If, for example, one is to successfully hold a job, there are many different skills he must possess. These include the ability to arrive at the job site on time, perform the job required, prepare or purchase lunch, cooperate with peers, and return home. There are many skills necessary to complete this chain. Often, success in a job situation depends on the ability to drive a car or read bus schedules, tell time, handle money (deposit pay checks, budget expenditures and purchase items), and recognize survival words such as men, women and danger.

Typically, teachers of normal or gifted youngsters do not have to teach their students how to put on their coats or tie their shoes. These children come to school already possessing such basic abilities. Similarly, normal children often learn to tell time and make change without direct instruction. Those youngsters who do not learn by observing the actions of others, however, need to be systematically taught many of these skills. Since there are numerous life skills which a student must master, it is vital that instruction time be effective. The need for an efficient system of presenting that instruction is apparent. Research has been conducted which investigated a number of antecedent and subsequent events (Smith, 1973). The effects of instructions (Lovitt & Curtiss, 1968; Lovitt & Smith, 1972), feedback (Hillman, 1970; Kirby & Shields, 1972), and reinforcement contingencies (Chadwick & Day, 1971; Smith, Lovitt & Kidder, 1972) have been the topic of much research and have influenced various types of behaviors. If, however, the actual material presented to the learner is inconsistent or poorly sequenced, learning will be impeded. Unfortunately, at the present time effective curriculum materials for most of the basic educational and life skills needed by special education students are not commercially available. Classroom teachers are therefore left with the responsibility of selecting, sequencing and planning lessons to teach self-help and life skills.

The primary focus of Team III's research is the creation, refinement and verification of a model for curriculum development. This prototypic model for the development of instructional programs and materials provides the educator with structure to guide him through the requisite steps followed in program development. The materials resulting from this process are highly structured and pertain to specific skills. The prototypic model is intended to serve as a guide for the development of instructional sequences which are nearly error free and which teach new skills in a minimum amount of time.

The Prototypic Model

This prototypic model for instructional materials development was initially conceived under the auspices of the Program Project Grant. During the first two granting years, it was partially tested and refined. Continued research efforts will be conducted during the final year of the grant to test the efficacy of the final steps of this model.

Considerable refinement of the model has occurred over the past two years. Details are now available in both a graphic (lattice) and descriptive format.

To clarify the process used in this model, one instructional program developed during the first two years of the project was selected as an example. The program selected was Let's Tell Time; when examples are used in the description of the model, this program is used. (See Figure 1)

Prerequisite knowledge

New skills are developed by building on those already mastered; knowledge is expanded and refined. To successfully master a new skill, the prerequisite skill should be mastered. The educational programmer must come to his task with some entry skills. First, he must be thoroughly familiar with the skill to be programmed. If he wishes to create an instructional program to teach youngsters how to tell time, the instructional programmer must be proficient in the skill of time telling.

Besides knowing how to perform the skill, the programmer should be competent in basic programming techniques, such as cueing, fading, and chaining (see Skinner, 1968). He must be able to create instructional frames which will break the task into steps small enough to be mastered, and still retain the interest of the learner.

In addition to these two general skills, the instructional programmer must be aware of general human learning characteristics. For example, he must be able to build into his sequences enough repetition to allow for overlearning. He should know how to include demonstration sessions to provide modeling, and review sessions to insure that mastered skills are maintained at a proficient level of performance.

needed refinement of this component of the prototypic model.

Primary decisions

If the educational programmer feels certain that he possesses the necessary entry behaviors to approach the task of creating educational sequences, he is ready to begin the process of developing a skill-specific instructional sequence. There are important decisions which must be made initially. First, the specific skill to be programmed must be clearly and precisely identified. In our example, time telling is that specific skill and the terminal objective of the proposed sequence.

PROTOTYPIC MODEL FOR INSTRUCTIONAL MATERI

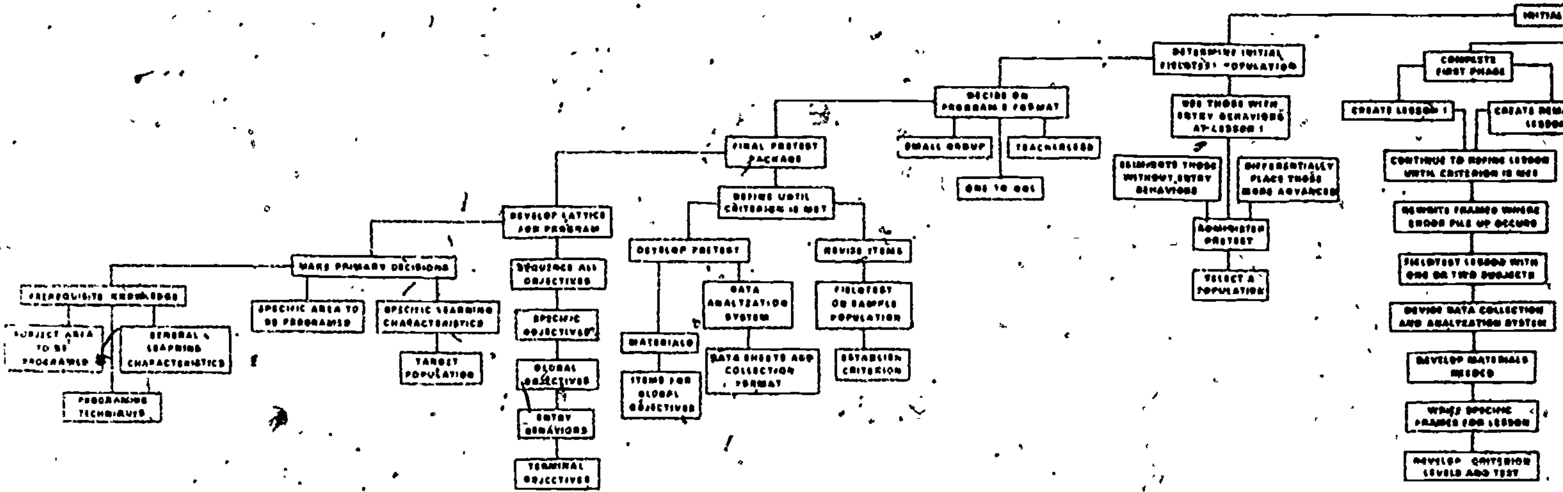

Figure 1

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PROTOTYPIC MODEL FOR INSTRUCTIONAL MATERIAL DEVELOPMENT

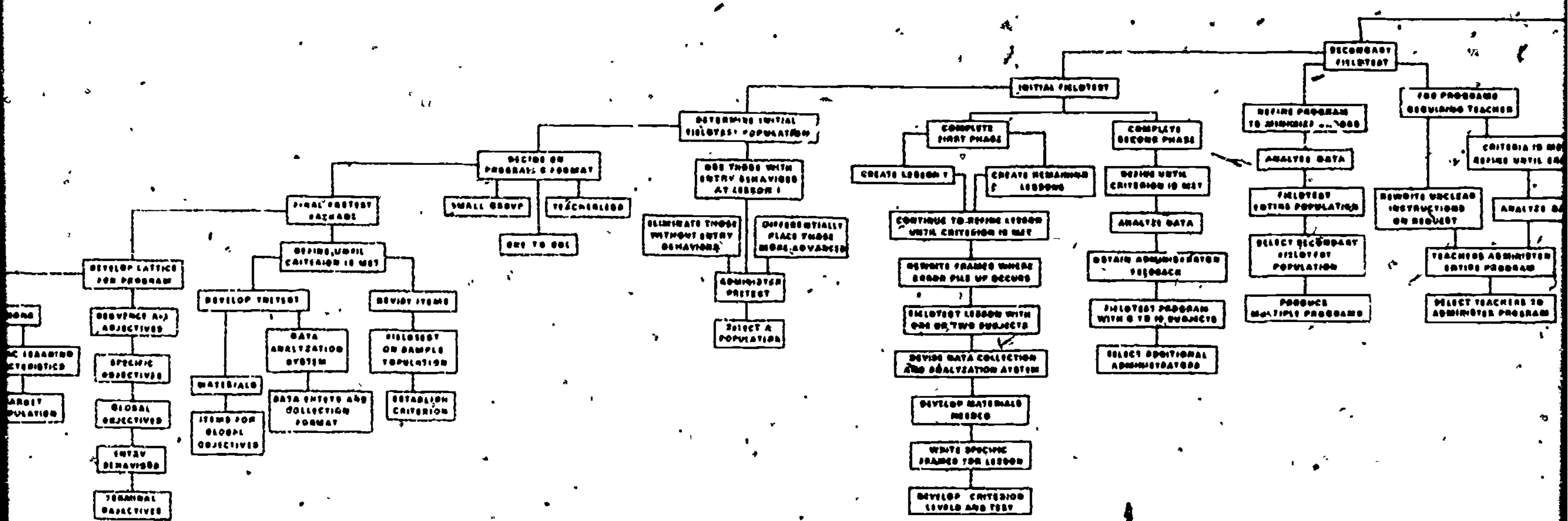
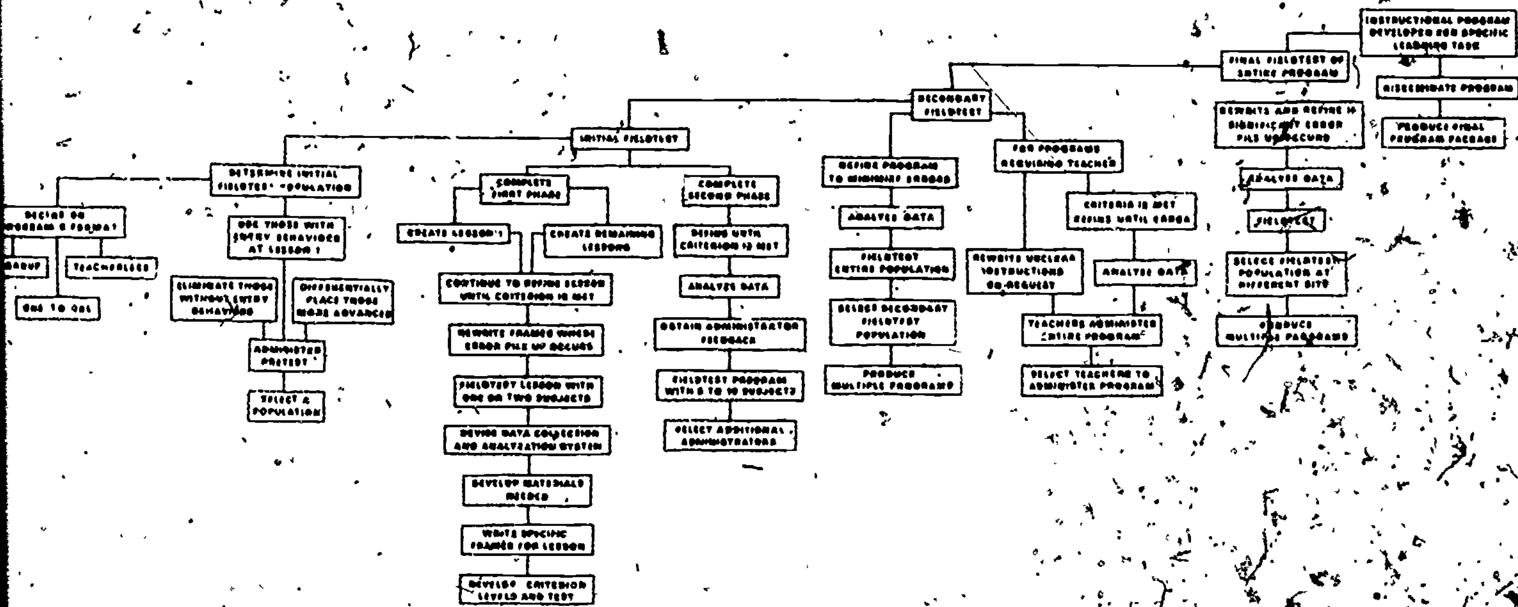


Figure 1

PROTOTYPIC MODEL FOR INSTRUCTIONAL MATERIAL DEVELOPMENT



In this sequence only time telling is taught; the sequence does not include instruction on number recognition, the use of a punch clock, or how to set an alarm clock. In this example, only the skill of telling time or reading a clock is programmed.

The second decision which must be made at this point regards the intended audience or target population for whom the program is to be written. The instructional programmer will have to recognize specific deficits which occur in his target population. If, for example, the sequence will be used primarily by visually handicapped students, print size on worksheets will have to be altered or worksheets will have to be omitted from the program. Braille watches might be used as lesson aids.

Lattice developed

Once the target skill and population have been precisely defined, a task analysis process is initiated. Team III has modified the lattice system developed by Woolman (1962) to implement this step of the prototypic model. As this component of the model seems particularly applicable to the daily needs of the classroom teacher, it will be discussed in greater detail here.

The lattice calls for a graphic display of the analysis of specific tasks. Goals and objectives are put into a hierarchy so educational activities can be planned to help students master various skills in a systematic fashion.

It is important for teachers of handicapped youngsters to carefully specify what academic and social behaviors their students need to acquire. For successful learning, goals must be precisely stated. The identification of a task to be mastered is only the first step towards the development of an educational sequence. Often, the subgoals of tasks need to be specified. These subgoals can also be broken down into smaller objectives. Careful sequencing of these objectives, subgoals and major goals leads to the achievement of educational activities to lead the learner to mastery of each objective along the way to mastery of the task.

The lattice system is one way to organize educational activities and to sequence skills. Once a lattice is constructed, the sequence of events which eventually lead to the completion of a task is clearly delineated. The lattice forces the teacher to specify goals and objectives. Integral parts of a task are specified and put into a hierarchy; thereby, the sequence of a task becomes identified.

The lattice is not an instructional sequence, nor does it outline the exact activities included in the educational sequence. It is a display of the component parts of skills. The sequence of behaviors which lead to the completion of specific tasks is arranged and displayed in lattice format. When Myron Woolman originated the lattice system, he did so to give structure to the ordering of educational activities. He felt that by latticing a task before instruction begins, the teacher could see the relationship and integration of concepts to be taught. Woolman (1962) expressed the intent of his lattice system:

> any body of material to be learned can be organized into a sequence which permits the systematic growth of a pool of relevant responses to the stimulus being learned. ... as learning progresses, the learner is alternately required to add new information and integrate it into the ever growing pool. This continues until the learning objective is achieved (p. 181).

Others, since Woolman initially proposed the lattice system, have also adopted his procedures. Budde and Menolascino (1971) showed how the lattice system can be applied to vocational habilitation. Bricker (1972) used a lattice format to display his sequence for language acquisition. Smith and Smith (1973) employed the lattice system before they developed structured instructional programs for self-help and life skills.

Lattices can be very sophisticated or very simplistic. They can be constructed in such a way as to show the relationship of one skill to another. They can become three-dimensional to show the difficulty as well as the sequence of component tasks. Such complex systems, however, are often confusing. For the purposes of organizing educational activities or analyzing instructional skills, complexity is usually not necessary.

For most teachers' purposes, lattices should simply state the analysis of a task. Simplified lattices allow for ease in communication among teachers who use this system for task analysis. One other advantage of using a simplified lattice system is for speed of construction. To meet the many educational needs of their students, teachers need to be able to analyze specific skills as quickly as possible. The following section describes the procedure which teachers can use to construct lattices to display their analysis of specific skills.

<u>Lattice construction</u>. Since a lattice is a graphic display of an analyzed skill, there are specific procedures which must be followed in its construction. Since there is a sequence of events which must be followed to construct a lattice, we use a lattice to display this sequence. (This Procedural Lattice for Lattice Development is presented in Figure 2.) In addition to the graphic display, narration is included to explain what the boxes mean and why they are placed on the lattice in their respective positions.

<u>Prerequisite knowledge</u>. Just as children need to possess specific skills before they can perform complex tasks correctly, so too must adults possess certain skills before they can break down a task and display that analysis in lattice format. Before a teacher breaks a skill into component parts and attempts to construct a lattice, he should know what a modified lattice is and how it is used. The sections included in this part of the lattice summarize the knowledge a teacher should posses before attempting to "lattice" a skill.

PROCEDURAL LATTICE FOR LATTICE DEVELOPMENT

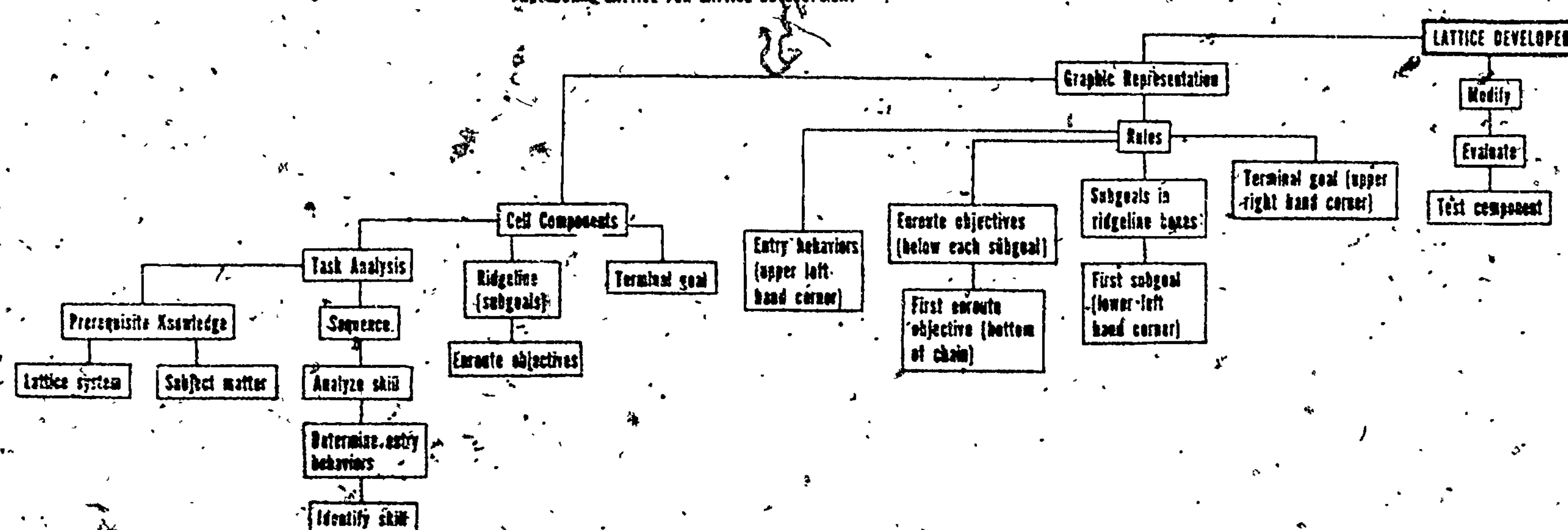


Figure 2

1a. Lattice System. Some rules and conventions are followed when constructing a lattice. First, the purpose of constructing a lattice is to obtain a sequenced list of the major component parts (enroute objectives and subgoals) of a skill to be taught. After the teacher analyzes the skill and puts the analysis in lattice format, he will refer to it as he designs the instructional sequences to help his students attain mastery of the desired behavior. The format used should be consistent so interpretation of the analysis is identical to the sequence originally intended.

The second reason for following a prescribed format for lattice construction is communication. If other teachers analyze skills in the same manner, lattices can be shared with colleagues. Skill analysis and sequencing need not be done over and over again by teachers in contact with one another. Specific details about latticing rules are found under heading number 4: Graphic Representation.

1b. Subject Matter. Prerequisite knowledge of subject matter is more important than knowing the rules and conventions for lattice construction. The teacher should have a thorough knowledge of the subject matter to be analyzed. It is impossible to break down an academic task or skill if one cannot successfully complete the task himself. For example, a teacher who needs to teach his students how to tell time cannot divide that skill into component parts without knowing how to tell time accurately.

2. Task analysis. After the teacher feels that he is familiar with the procedures used to construct a lattice and is competent at performing the task to be analyzed, it is time for the analysis of the skill to begin.

2a. Identify the skill. The first decision for the teacher to make regards the task to be analyzed. He must determine precisely what task he wants to submit to analysis. Skill identification must be specific. If a child needs to learn how to tie his shoes, then shoe tying is the task to analyzed. The learner might also be deficient in putting shoes on his feet, but that is a different task and should not be included in the shoe tying lattice. In the present example, time telling is the task which was submitted to the task analysis, rather than a time concept such as promptness or tardiness.

2b. Determine Entry Behaviors. After the task to be analyzed is identified, the teacher should decide what skills he will expect of students beginning the sequence. For example, in constructing the lattice for Team III's time telling program, it was realized that number recognition constituted an essential prerequisite skill. The authors decided, however, not to teach number recognition when they teach time telling; therefore, students are expected to demonstrate a proficiency in that skill before entry to the program. In instructional programs which use a considerable amount of color cueing, color recognition should be an entry behavior.

Our experience indicates that more efficient instruction occurs if prerequisite skills are mastered before the student enters a specific sequence such as time telling. In many cases, entry behaviors are determined in an arbitrary fashion. Different teachers expect different entry levels from their students. Nevertheless, some entry levels should be specified.

2c. Analyze Skill. Although not a sophisticated or scientific method, one way to analyze a skill is to use a repetitive process. As the teacher performs the task and observes others execute the skill over and over, the sequence of behaviors becomes apparent. The major component parts of the skill can be identified, and the often inherent sequence of events becomes obvious. As the teacher repeats the task, he should carefully scrutinize his actions. Each step should be identified.

As the skill is analyzed, each part of the skill is written on an index card. In this way, the sequence of these component parts can be easily ordered and reordered.

2d. Sequence. Once all the component parts of the skill have been identified, each part is sequenced. Frequently, the sequence develops directly from the skill. In shoe tying, for example, the sequence of events followed to tie shoes is constant. The natural order followed to complete the task is the sequence.

When the sequence of behaviors is identified, a hierarchy of skills is concurrently determined. Some parts of the skill are major component parts; others are subordinate steps which lead to the completion of the major steps in the process. In shoe tying (the lattice for Team III's Shoe Tie Program is displayed in Figure 13), completion of the half-knot and tying the bow are two major component parts. These, then, are the subgoals of the final or terminal goal of the student mastering the skill of shoe tying.

For the time telling lattice, six such major subgoals were identified ranging from "hand discrimination" to "time after hour discrimination." The enroute objectives which lead to the completion of each of these subgoals are placed under the subgoals to represent the hierarchy of the steps in the task.

All of these steps (identification of the skill, the determination of the entry behaviors, the analysis of the skill and the eventual sequencing of the steps used to complete the task) comprise the major elements of the task analysis process.

3. Cell components. Lattices are comprised of a series of interlocking boxes or cells. Each of these cells must be placed in positions that represent the sequence and the analysis which was determined in the preceding step of this process. The terminal behavior or goal, the subgoals and the enroute objectives now are stated concisely and marked for the graphic representation. The next step in lattice development can be completed.

3a (1). Enroute Objectives. Enroute objectives are those behaviors which lead to the completion of the subgoals. For the "Minute after visual and auditory stimulus discrimination" subgoal of the time telling sequence, steps such as "Counting clockwise 5's" are the enroute objectives. These are placed underneath the subgoals.

3a (2). Ridgeline. The lattice ridgeline is comprised of the subgoals and terminal goal of a task (Figure 3). When the lattice is formed, these are connected in a step ladder format which leads up towards the terminal behavior.

3b. Terminal Goal. There is one terminal behavior or goal for each lattice. Depending on the complexity of the lattice, the terminal goal could be as concrete as "shoes tied" or as abstract as "time concepts." Regardless of the nature of the skill which is analyzed, there is only one, concisely stated, terminal goal for each lattice. In this example, the terminal goal is "Telling Time." All the previously identified steps lead directly to the completion of the terminal behavior.

4. Graphic representation. For lattices to be consistently interpreted by many people and to be meaningful to the person who constructed the lattice, certain rules or conventions should be followed. Since the lattice is a blueprint or master plan which depicts the steps and the sequence which lead the learner to mastery of a specific task, it is important for the graphic display of the analysis to be easy to interpret.

4. A. Rules. For a lattice to be interpreted consistently, there are some rules about placement of the cells and lines which connect the cells. Rules about lines connecting cells and descriptions of cell placement follow.

A step ladder format is used for the arrangement of the subgoal sequence. These boxes display this sequence from left to right. The ridgeline is connected by lines which form right angles (see Figure 3).

Whenever possible, enroute objectives are connected to each subgoal cell with straight lines. If necessary to show three or more enroute objectives not primarily related to each other, these may be placed under the subgoal cell with both straight and bent lines (Figure 4).

If one enroute objective must be completed before another task is initiated, the cells are put together in a chain. When one task is definitely prerequisite to the next, the first objective in the chain is put in the bottom cell. All of the ensuing enroute objectives lead up to the subgoal (Figure 5).

Major subgoals may be considered terminal goals of "mini-programs" within one complete lattice. In some cases, it is desirable to have an overall lattice showing how skills relate to each other for curriculum planning. This can be accomplished by using the lattice system also. In the example shown below (Figure 6), two small lattices are put together under one terminal behavior. This format can easily be adapted for the purpose of displaying the progression of skills taught in one academic year for particular skill areas such as computational arithmetic or self-help.

4a. Entry Behaviors. These are behaviors or skills which the learner must possess before he begins the instructional sequence developed from the lattice. These do not appear as cell components, but are listed on the lattice page. A convenient place to list the entry behaviors is in the upper left hand corner. They are labeled as entry behaviors and stated in concise terms and usually appear as a list.

4b. First Enroute Objective. This objective leads to the completion of the subgoals which, in turn, leads to the completion of the terminal

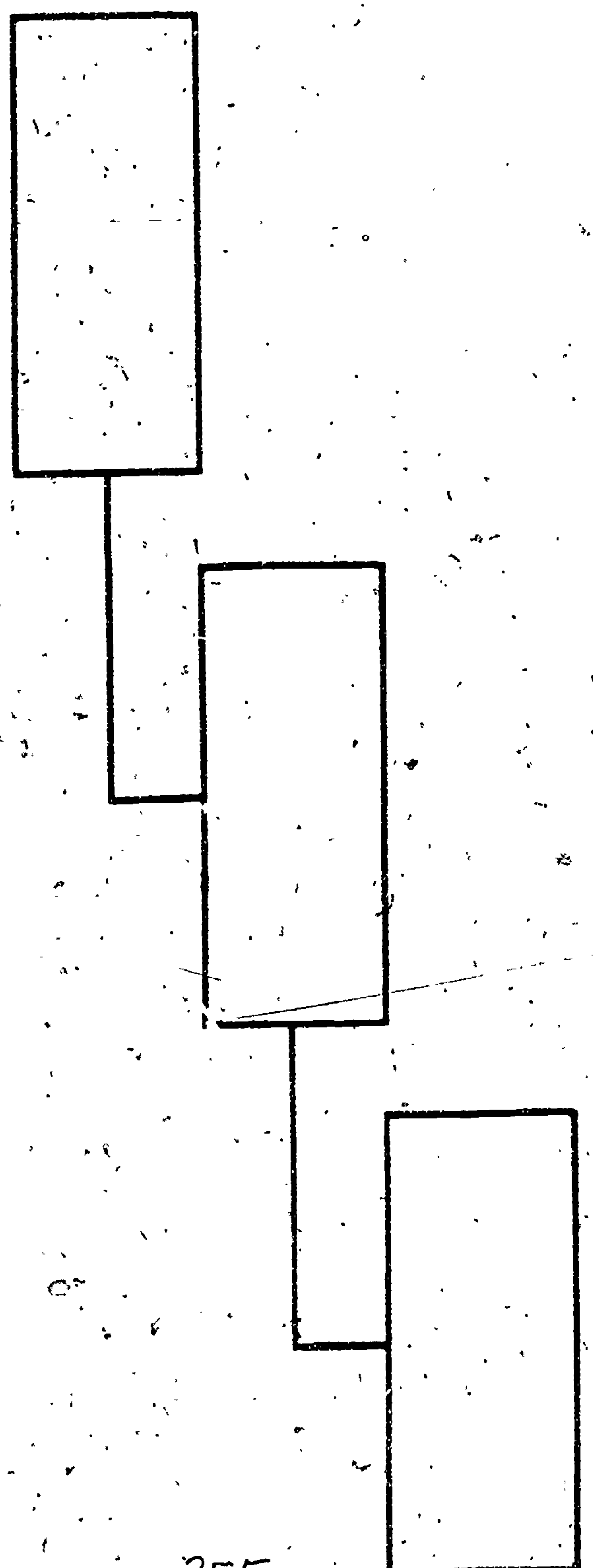


Figure 3

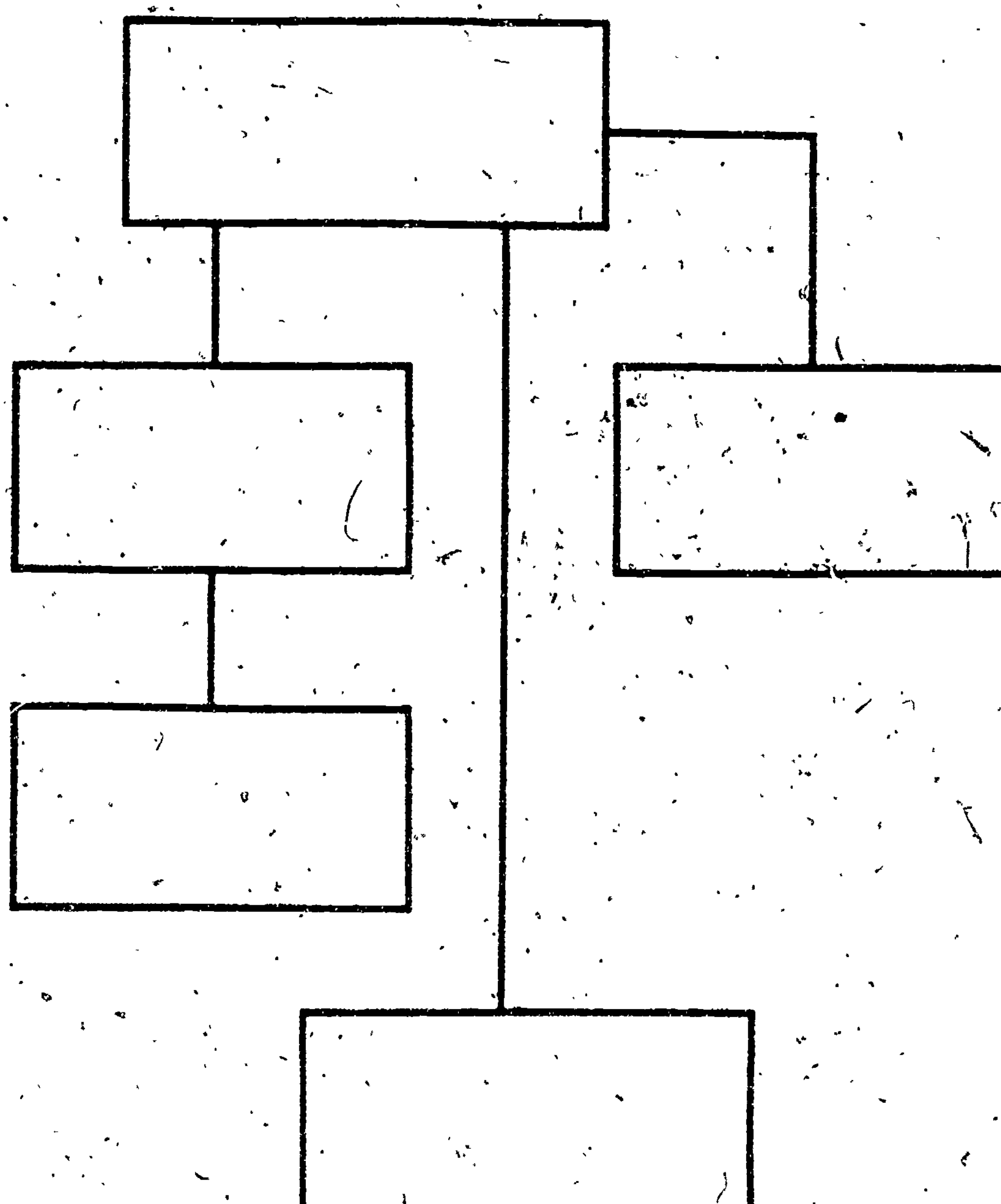


Figure 4

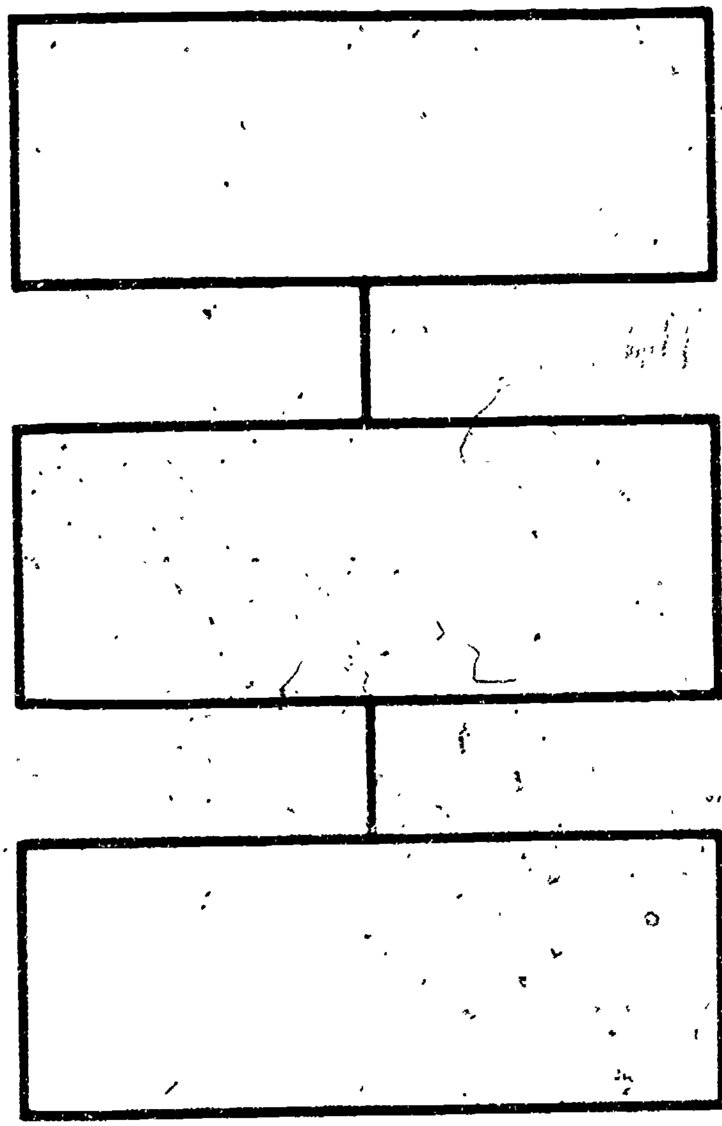


Figure 5

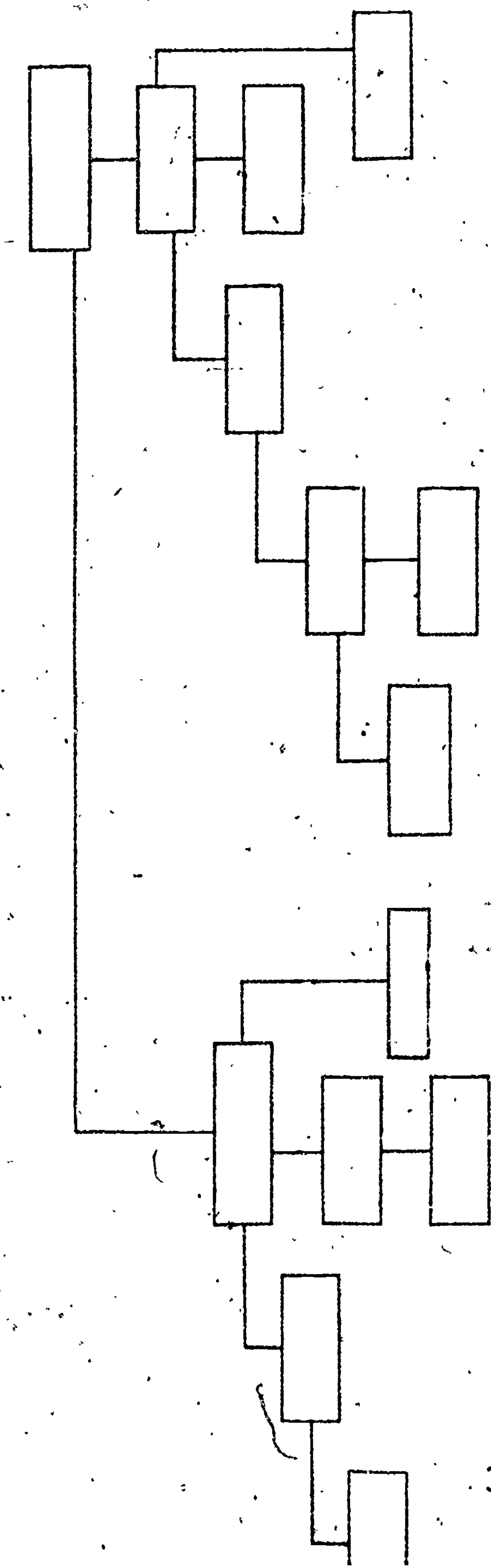


Figure 6

goal. If the sequence of these objectives is a simple progression, the first enroute objective is placed at the bottom of the chain. If several objectives or a set of objectives are included under one subgoal, the goal which is mastered first is placed to the left of the other enroute objectives.

4c (1). First Subgoal. The first subgoal in the sequence, the first ridgeline cell, is placed towards the bottom left hand corner of the page. The enroute objectives which pertain to the completion of that subgoal are positioned underneath this first ridgeline box.

4c (2). Subgoals. The remaining subgoals are positioned in step ladder format (from left to right) leading to the terminal behavior. These comprise the ridgeline.

4d. Terminal Goal. The terminal goal always appears in the upper right hand corner. It is stated concisely and is positioned to clearly indicate that it is the end-goal of the sequence.

5. Lattice Developed. This is the terminal goal of the task analysis process described in this section. Before a lattice is truly completed, however, some final testing and evaluation must be conducted.

5a. Test Component. The teacher should perform the latticed task once again. As he does so, he should follow the lattice as it is now constructed. Each component of the task should be scrutinized to be certain that the words which appear in each cell adequately describe the behavior. In addition, the sequence should be rechecked to guarantee accuracy of the order of the behaviors.

5b. Evaluate. The entire process needs to be evaluated. If the teacher finds that the lattice does not display the sequence or the analysis properly, this should be noted. If terms are misleading, those terms must be identified.

5c. Modify. If errors in the lattice have been identified, they must be corrected. If entry behaviors were omitted, they must be included. If the order of the subgoals was incorrect, it should be adjusted. Once all of these final checks have been completed, the task has been analyzed and displayed so that instructional activities can be organized. These activities should aim at bringing the learner to mastery of each enroute objective and its subgoals. Mastery of these component parts of the lattice should eventually lead the learner to mastery of the terminal behavior. The lattice for time telling was constructed in this manner and is included as a sample lattice (Figure 7).

The lattice approach could be helpful to teachers as they plan their curriculum activities for a year, month, or week. The system allows teachers to specify which skills they want their students to master. In addition, it allows them to display the analysis of these skills in a simple format so that enroute objectives can be easily identified.

The lattice system is an adaptation of the original Woolman system; it was modified by Team III members to suit the academic instructional situation.

TIME TELLING LATTICE

Entry Behaviors

Number recognition 1-59
Rote count 1-59
Write numbers sequentially 1-59
Count by 5's to 55
Count by 10's to 50
Discriminate between red and black

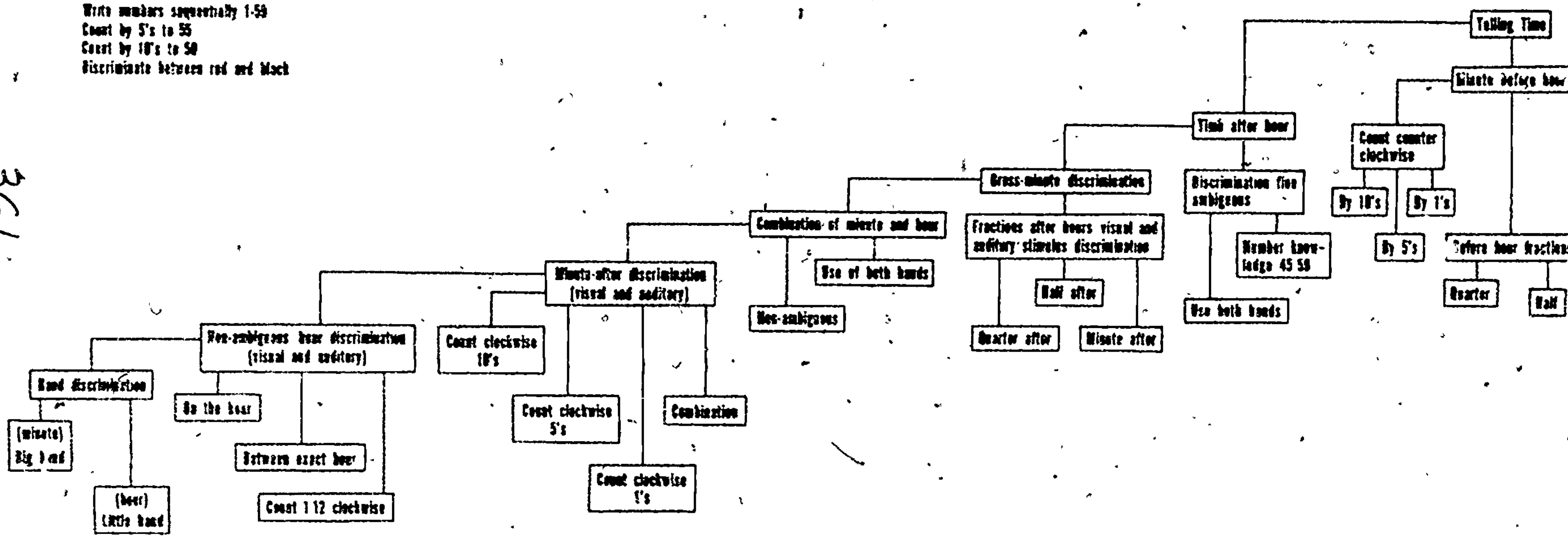


Figure 7

The adaptation attempts, in simple terms and format, to provide a model of a complex task or concept. It does not include every detail of the analyzed task, nor does it display the tactics which are employed to teach the task. However, the lattice system does provide the teacher with an outline from which he can plan activities that will help his students acquire needed skills for which effective programs are not currently available. Similarly, for the programmer who implements the prototypic model in its entirety, the lattice serves as a blueprint from which the instructional program is later built.

Pretest Package

Once the lattice has been constructed, it plays an integral part in the next stage of the program's development -- the development of a pretest. Test items are constructed to sample each behavior identified in the lattice. The purpose of the pretest is threefold. First, the test indicates whether the learner has already mastered the task and does not need to enter the instructional sequence. Secondly, the pretest samples the entry behaviors to determine whether the learner is ready to enter the sequence at Lesson 1. The third purpose relates to differential placement in the program. If, for example, the learner has not mastered the task, but can successfully complete some of the component parts of the skill, the learner's exact beginning level should be specified. In this way, once the program is fully developed, not all children will begin with the same lesson. Students who initially possess some of the behaviors required to perform a task successfully, but who cannot accurately complete the terminal behavior, can be placed in the sequence according to their initial skill level.

Test items are constructed for each component part of the skill; items are included from each ridgeline and many enroute boxes. Materials needed for the pretest are developed and a data collection system is prepared. For an accurate indication of each learner's skill levels, pretests are individually administered. Because the pretest is a critical part of the entire program package, fieldtesting is required to determine whether the pretest accurately identifies varying skill levels.

Program Format

The next decision relates to the program's format. One option might be a series of worksheets which do not require teacher assistance. In this case, a teacherless program would emerge. Another option might consist of structured lessons for teachers or paraprofessionals. This procedure produces either small group or one-to-one programs. The time telling sequence was developed for use on a one-to-one basis. Since this is an expensive educational procedure, the instructional sequence was designed for administration by untrained as well as trained personnel.

Initial Fieldtest Population

In this stage, the first group of learners to receive the instructional sequence is selected. The pretest instrument, already developed, is used for this purpose. Those having all of the entry behaviors, but not possessing skills beyond those taught in the first lesson are selected. Learners possessing advanced skills could enter the sequence, but to verify each lesson, those having only the entry behaviors are used for this first fieldtest group.

Initial Fieldtest

Phase 1. The initial fieldtest stage consists of two phases. In the first phase, actual lesson writing is done concurrently with fieldtesting by the program writer. General criteria levels are established for all of the lessons. In the time telling program, the authors decided that no more than 10% error would be accepted for each lesson. Therefore, any lesson not meeting the criterion of 90% correct responding was rewritten. A general data collection system was also devised. Data were collected for each frame for each lesson. This allowed the programmers to determine when a specific frame produced most of the error. When this happened, that frame was corrected and retested. Rewriting continued until most error was eliminated.

A format was also developed to facilitate the actual task of lesson writing. Since these instructional programs are highly structured and are intended for use with a wide variety of personnel (e.g. parents, volunteers, and classroom aides), a 3 column format was developed for ease in administering the lessons. In our system, all of the teacher's directions are found in one column. Those actions used to model the desired behaviors are carefully described to the teacher. Words said to the student are printed in capital letters. All of the student responses are found in the second column. Whenever the student is required to answer a question, imitate a behavior, or manipulate supplemental materials, the student's expected response is indicated in this column. The third column contains suggested remediation activities. In some cases, all error cannot be eliminated by rewriting the program. Whenever a problematic instructional frame occurs, an elaboration of the teacher's directions appears in this column. A sample lesson format is included (Figure 8).

The first lesson of the program is written once a convenient lesson format has been designed. If teaching aids are used, inexpensive ones are developed. The tasks taught in this lesson aim at bringing the student to mastery of the first enroute objective of the first component part specified in the lattice. Each lesson should bring the learner one step closer to mastery of the terminal behavior. Even though more than one lesson is required to teach one enroute behavior, the aim is to move the learner progressively closer to the target behavior. After the first lesson is written, it is tested on one or two subjects. If excessive error occurs, the lesson is rewritten and retested. The second lesson is then written and fieldtested. If more error occurred than was allowed for in the original criteria, the lesson is rewritten and retested. These procedures are repeated until all of the lessons have been written and fieldtested on a small population of students.

Phase 2. The second phase of initial fieldtesting is now begun. At this time the entire sequence has been developed, but the program has not been tested in its entirety because of the considerable rewriting inherent in the first phase of initial fieldtesting. Therefore the program is now submitted to a second phase of initial fieldtesting. In this phase, the program is administered by one or two of the program writer's colleagues.

Hour Hand: Lesson 1

Materials: Large manipulative clock, Aids H-4 and H-1.
Criteria: Student reads and sets the appropriate hours on Aid H-1.

Instructor	Student	Remediation
Place the large manipulative clock in front of the student: Say: TODAY YOU ARE GOING TO BEGIN TO LEARN HOW TO USE THE HOUR HAND. POINT TO THE HOUR HAND. (R-1)	R-1. Points to the hour hand.	If the student fails on the first try, return to Lesson 3 of the Hand Discrimination Section.
POINT TO THE MINUTE HAND. (R-2)	R-2. Points to the minute hand.	

Sample of Program Lesson Format Developed by Team III

Figure 8

Feedback from these administrators enables the programmer to clarify any teacher directions which prove to be ambiguous or incomplete. Approximately 10 children are selected for this fieldtesting. These children possess only the entry behaviors specified in the pretest and lattice, and are not differentially placed in the program at advanced levels. The entire sequence is then tested with these children to insure that the majority of error was eliminated in the previous stage. If these fieldtest data indicate that the sequence does in fact bring children to mastery of the terminal behavior with a minimum amount of error, the program is ready for secondary fieldtesting. If, however, substantial error occurs during this fieldtesting, the program needs to be rewritten and retested.

Secondary Fieldtesting

Once the instructional program is written, fieldtested with a limited number of subjects, and rewritten, the sequence is ready for more extensive fieldtesting. Multiple packages of the instructional program are produced. The teachers' manuals are edited, typed, duplicated (at least 50 copies), and bound. If supplemental materials such as teaching aids and student workbooks are used in the program, they must also be produced in sufficient quantity for the secondary fieldtest population. Teaching aids should be durable and reusable, with the exception of student workbooks.

Additional fieldtesting is required for several reasons. First, it is important for more children to be included in the fieldtest population. This number need not exceed 50 youngsters, but should be more than the 12 to 15 students who participated in the initial fieldtesting stage. Additional students are needed to validate the instructional sequence and determine whether error pile-up occurred because of unclear instructional frames.

Another reason for the secondary fieldtesting relates to teacher-induced error. In the initial stage of fieldtesting, the instructional programmer and those familiar with his procedures tested the program. Because of the "in-house" nature of the initial fieldtesting, elements of the directions may have been omitted or written unclearly. Instructional programmers frequently use jargon familiar only to themselves and their colleagues. This jargon could mislead or confuse the classroom teacher and could result in new student error.

Before an instructional program is ready for dissemination, those parts of the lesson sequence which caused teacher-error should be isolated. This is accomplished by analyzing feedback from teachers using the program. First, data gathered in the secondary fieldtest stage should be analyzed. If numerous errors occurred in sections which were error free in the initial fieldtesting, it is probable that teachers did not understand the directions as intended. In some cases error pile-up occurs for one teacher and not for another. This kind of inconsistency will appear in children's data, indicating ambiguity in teacher directions.

Often, however, student data fail to indicate ambiguity which exists in teacher directions. A teacher may not understand the directions in one section, but if he teaches it appropriately, the student data will not indicate a need for rewriting. The second kind of feedback, di ct communication with those using the program, will make this type of problem apparent to the instructional programmer. Whenever ambiguity or error occurs, the instructional programmer has an obligation to rewrite those sections.

Final Fieldtesting

During the last phase of instructional material development, enough program packages are produced to conduct final fieldtesting with another 40 to 50 students. The procedures used in secondary fieldtesting are repeated in order to validate the entire program including all of the revisions. Each fieldtesting stage has had a slightly more sophisticated purpose. The initial stage tested the first draft of the program with emphasis on student error. The secondary fieldtest stage specifically monitored both student and teacher error. After these steps have been completed, the instructional program is ready for dissemination. Final fieldtesting insures that revisions made after the secondary fieldtest stage actually reduced student and teacher error.

Instructional Program Developed

The specific skill taught by the instructional sequence has been carefully selected and analyzed in such a way that each step in acquiring the skill was precisely identified and sequenced. The lessons have been written so mastery was obtained on each of these steps, and the emerging program has been fieldtested at least three times. There are various ways to accomplish dissemination, including federally sponsored clearinghouses and commercial publishers. The instructional programmer needs to determine the most appropriate vehicle to disseminate the now fully developed instructional program.

Status in September 1973

During the first year of this project (1972-1973) the lattice system was refined and several instructional programs were written and developed through the first stages of initial fieldtesting at the Experimental Education Unit (EEU). By September of this past year (1973), four programs had entered the final stages of initial fieldtesting: (1) Shoe Tying, (2) Measuring (Ruler), (3) Time Telling, (4) Make Change: (a) Coin Discrimination, (b) Bill Discrimination, and (c) Money Values. In addition, one program (Alphabetizing) had been written and was ready for initial fieldtesting.

Considerations of limited time and resources necessitated a reprioritization and and revision of the original 1973-1974 Scope of Work projected for Team III. The final objectives selected for the academic year 1973-1974 were as follows:

1. Continue research on the methodology of creating instructional programs (i.e., development of the prototypic model).

A. The latticing technique
B. Dissemination of research on refinement of the prototypic model

II. Continue refinement of prototypic model procedures through actual program development:
A. Reach the Secondary Fieldtest Stage:
1. Shoe Tying
2. Measuring (Ruler)
3. Make Change:
a) Coin Discrimination
b) Bill Discrimination
c) Money Values
B. Complete Initial Fieldtesting and Material Preparation: Time Telling
C. Reach the writing Stage for New Programs:
1. One program in the area of primary level life skills
2. One extension of an existing program

Present Status

During the past year, fieldtest data generally supported the efficacy of the prototypic model. (Specific data will be presented in the discussion of individual programs.) However, as problems arose, some revisions were made in the model. These revisions primarily reflected pragmatic concerns relating to the actual procedures employed (e.g., pretest format, data collection, data display). It is felt that these revisions have made the model more efficient and more broadly applicable.

Dissemination efforts this year have been largely restricted to the lattice system of task analysis, as this is the most completely developed and validated aspect of the prototypic model to date. However, dissemination of the total model has been initiated and these efforts will be continued throughout the summer. A detailed record of Team III's research dissemination for 1973-1974 is presented in Table I.

Of the three programs projected to reach the Secondary Fieldtest stage this year, only one (Shoe Tie) has actually been placed in secondary fieldtest sites. Secondary fieldtesting of the Ruler Measurement Program was delayed until the public schools open in the fall to allow for the development of a complementary program in Metric Measurement. The latter program is now in the final stages of initial fieldtesting. As the Make Change series entered the final stages of initial fieldtesting at the beginning of this year, error data indicated the need for major rewriting of many sections of this program. In its revised form (consisting of four component programs), the Make Change series will enter the final stages of initial fieldtesting in the fall.

Development of the Time Telling program has proceeded according to our projected schedule and is ready to enter secondary fieldtesting with the opening of public schools in September.

Dissemination of Team III Research, 1973 - 1974 Academic Year

Name	Title	Media	Group Served	No. Served
Smith, D. D.	The use of the modified lattice to sequence academic tasks	lecture/ slide show	California State U. Sacramento Spec. Ed. Lecture Series	250
Smith, D. D.	The lattice as a way to plan curriculum	lecture/ slide show	Workshop for the Linguistically Handicapped Children, CEC, ASHA	250
Smith, D. D.	Task analysis procedures for curriculum development	lecture/ slide show	California State Univ., CEC	150
Smith, D. D.	Prioritizing curriculum for handicapped students	lecture/ slide show	Portland State Univ., CEC	25
Snyder, L. K.	The prototypic model for instructional material development	lecture/ slide show	Seminar in Mental Retardation, EdSpe 509, UW	10
Smith, D. D.	Systems analysis procedures for middle management personnel	lecture/ slide show	Workshop for Preparation of Personnel in the Ed. of Severely Handicapped, EEU; University of Wash.	15
Snyder, L. K.	The prototypic model for instructional material development	lecture/ slide show	Same as above	15
Smith, D. D., Smith, J. O., & Haring, N. G.	The modified lattice system: An approach to the analysis and sequence of instructional objectives	manuscript	Submitted to <u>Exceptional Children</u>	

Dissemination of Team III Research, 1973 - 1974 Academic Year

Title	Media	Group Served	No. Served	Location	Date
of the modified to sequence c tasks	lecture/ slide show	California State U. Sacramento Spec. Ed. Lecture Series	250	Sacramento, California	11/1/73
tice as a way to rriculum	lecture/ slide show	Workshop for the Linguistically Handicapped Children, CEC, ASHA	250	Council Bluffs, Iowa	4/19/74
alysis procedures riculum develop-	lecture/ slide show	California State Univ., CEC	150	Northridge, California	4/25/74
izing curriculum dicapped students	lecture/ slide show	Portland State Univ., CEC	25	Portland, Oregon	5/16/74
totypic model for tional material ment	lecture/ slide show	Seminar in Mental Retardation, EdSpe 509, UW	10	Seattle, Wa.	6/4/74
analysis pro- for middle ent personnel	lecture/ slide show	Workshop for Preparation of Personnel in the Ed. of Severely Handicapped, EEU, University of Wash.	15	Seattle, Wa.	7/10/74
totypic model for tional material ment	lecture/ slide show	Same as above	15	Seattle, Wa.	7/10/74
ified lattice An approach to the s and sequence of tional objectives	manuscript	Submitted to <u>Exceptional Children</u>			1974

Name	Title	Media	Group Served	No. Served
Smith, D. D., Smith, J. O., & Haring, N. G.	A model for development of instructional materials	working paper	To be submitted to Mental Retardation	
Snyder, L. K.	The lattice system of task analysis: Application for the classroom teacher	lecture/ slide show	Education for Mildly and Moderately Handicapped, EdSpe 402, U.W.	30

Title	Media	Group Served	No. Served	Location	Date
el for development structional materials	working paper	To be submitted to Mental Retardation			1974
attice system of task sis: Application for lassroom teacher	lecture/ slide show	Education for Mildly and Moderately Handicapped, EdSpe 402, U.W.	30	Seattle, Wa.	7/23/7

One new program in the area of primary level life skills (Clothes Fastening) was written this year and is presently in the final stages of initial fieldtesting. It is hoped that this program will be ready for editing and material production in the fall.

Four supplementary programs were also written this year. Two of these (Shoe Lacing and Shoe Lace Tightening) represent extensions of the Shoe Tie program. Additionally, two sequences to teach the use of simple fractions were written as extensions of the measuring programs. These four new programs are presently in the initial fieldtesting stages and should be ready for editing and material preparation by the end of Fall Quarter.

During Team III's final year, then, all but a few programs will be fieldtested in the public schools. In addition to the supervision of this process, Team III will focus its efforts on the completion of these exemplar programs -- writing any necessary revisions (as indicated by secondary and final fieldtest data), and producing all needed materials. Thus, by July 1975, Team III expects to be able to deliver many of these programs, in the form of complete instructional packages, to NIE for general dissemination.

Finally, next year the members of Team III will be able to review and evaluate the prototypic model as it has been employed and refined in the development of these programs. Strategies for the dissemination of this final model will be planned and implemented in the 1974-1975 academic year.

Refinements of the Prototypic Model

During the past year, Team III followed the prototypic model sequence in continuing the development of several instructional programs. Data gathered from these programs clearly support the efficacy of this approach to instructional programming. While the conceptual structure of the model remained intact, the need for refinements of certain specific procedures became evident as they were put into actual practice. These refinements should serve to make the model more efficient and broadly applicable. Further evaluation through actual application will be undertaken next year. In this section, our findings will be discussed in terms of their specific implications (either validation or needed refinements) for each of the major components of the prototypic model. In the final section of this report, each of the individual programs will be discussed in detail.

Possess Prerequisite Knowledge

In addition to the specific skills already suggested, there is some indication that instructional programmers can successfully implement these procedures only if they possess certain other, more elusive qualities. These qualities include a commitment or willingness to persist in the often tedious task of writing and testing numerous revisions of each lesson.

Make Primary Decisions

Specification of the area to be programmed and the target population was an important step in the development of all Team III instructional programs. No problems were encountered with this component of the prototypic model; it remains unchanged.

Develop Lattice for Instructional Program

Several aspects of the modified lattice system adopted by Team III were validated in the past year. The prediction that the modified lattice system would provide a flexible approach to task analysis and could be adapted to a wide variety of skills was clearly supported. Successful programs with target skills such as shoe tying, time telling, and metric measurement were developed from a latticed skill sequence. In one case (time telling), when it was decided to limit the program to a narrower terminal goal, the lattice was easily modified to reflect this change. (For further discussion, see section on Time Telling Program.)

Secondary fieldtest data from the Shoe Tie Program tended to support the validity of entry behaviors as discriminative predictors of students' abilities to successfully complete an instructional sequence. The shoe tying pretest was administered to a small sample (N=5) of severely multiply handicapped students ranging in age from 3 to 4-1/2 years. Of these, only one, a 3 year old autistic girl, demonstrated mastery of all the necessary entry behaviors. On the basis of this student's performance on the first four lessons, the classroom teacher was convinced that the girl could have completed the entire instructional sequence. The program was not, in fact, completed, due to time pressures and severe behavior problems. (For further discussion, see section on Shoe Tie Program.)

Team III hopes to be able to further analyze the predictive and discriminative values of the "Entry Behaviors" criterion for program placement (as opposed to such commonly used criteria as chronological age and mental age) through a carefully controlled research study next year. Due to its relative brevity, it would seem that the Shoe Tie Program would be particularly appropriate for such a study. Furthermore, it is probable that students of widely varying chronological and mental ages, who do not know how to tie their shoes, could be found and matched on the basis of entry behaviors alone.

Informal observations at the EEU support the prediction that the lattice component of the prototypic model would prove particularly applicable for the classroom teacher. The practical value of the modified lattice was demonstrated in two ways during the past year. First, it was found that classroom teachers at the EEU were able to master the techniques of lattice construction through independent reading of a working paper, written by the Team III coordinator, which explains this procedure in detail. (A major portion of this paper has been included in the introduction to this report.) Thus it appears that the process of training teachers to use a lattice system for task analysis need not be prohibitively expensive in cost or time. Furthermore, those teachers who learned how to construct instructional lattices, and then employed the modified lattice system in their classrooms, reported that this procedure greatly facilitated the planning of effective lessons and materials. It appears, therefore, that the lattice can serve as an efficient aid to programming when time or money does not permit implementation of the entire prototypic model.

Final Pretest Package

Pretests for several of Team III's instructional programs were revised this year. None of these revisions involved changes in the fundamental pretest component of the prototypic model. However, certain practical refinements of actual procedures have facilitated implementation of this step. It became evident, for example, that in many cases teacher directions needed to be condensed and simplified in order to give more consideration to the real limitations of teacher time. Thus the directions for administering and scoring the pretest for the Ruler Measurement Program were reduced from 3 to 1-1/2 pages. Similar revisions were made in the shoe tying pretest, while the pretest for fastening skills was condensed from 3 separate assessments into one comprehensive pretest. Feedback from fieldtest administrators indicated that these revisions have increased program efficiency.

It is probable that many students in a classroom demonstrate mastery of some, but not all of the target skills assessed in a pretest. Therefore, a major component of the teacher directions for each of the pretests developed by Team III is the data analysis section. This section explains to the teacher the specific implications of a student's performance in terms of differential placement at appropriate levels in the instructional program. This year, in an attempt to achieve greater accuracy and clarity, this portion has been revised and rewritten for many Team III programs. Validation and revision of these sections, however, must wait until data have been collected from the larger secondary fieldtest samples which include students who are differentially placed in the programs on the basis of these instructions. In addition, the formats employed in these sections are still not completely satisfactory. It is hoped that next year a less cumbersome but still sufficiently detailed procedure can be developed for presenting this information.

Data collection procedures for several of the pretests were also refined this year. Team III researchers found that student ability was more readily assessed when recording of data was more discreet. Thus several revisions were made to render the data collection process less burdensome and obtrusive: a) responses to be scored were identified on the data sheets by short descriptors, rather than simply response numbers, to avoid confusion in recording responses; b) time data were eliminated for those responses on which rate did not show a significant discriminative value; and c) data sheets were printed on 5 x 8 inch cards which may be scored in the administrator's lap.

Decide on Program's Format

The programs developed by Team III were all designed for administration on a one-to-one basis. No attempt was made to design a program using a teacherless or a small group format, nor is such an attempt anticipated. However, it seems that either format could be employed with equal success, and there is no reason to question the validity of this step in the prototypic model.

Determine Initial Fieldtest Population

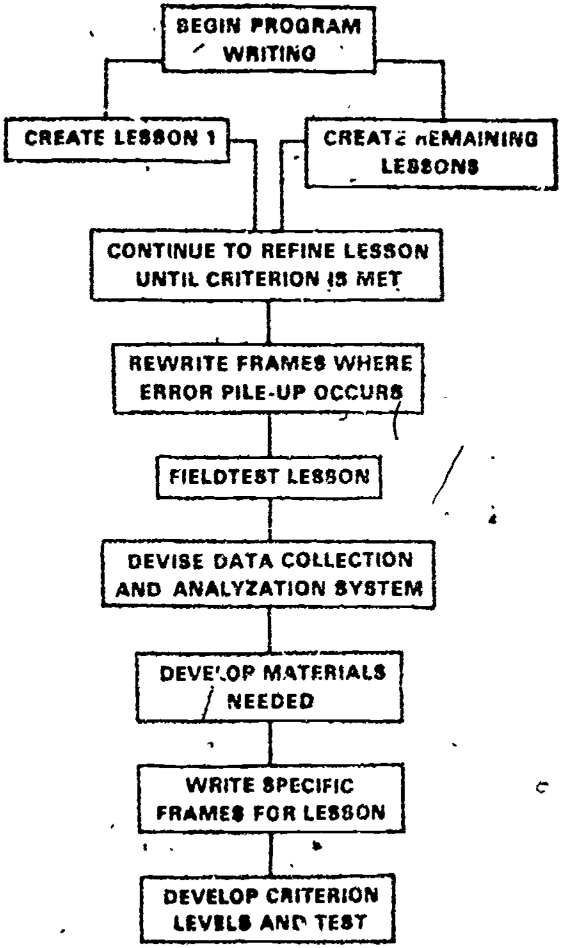
In selecting subjects for initial fieldtesting, Team III found it useful to include subjects possessing the entry behaviors assessed by the pretest, but of varying ages. Although not previously included in the entry behaviors, some specific age-related skills which may affect a student's performance in this program can be identified. For example, when the Shoe Tie Program was administered to several preschool children at the EEU, the motor skills of pinching and pulling against tension were often lacking. This problem was not encountered in earlier fieldtesting, which involved older students. In such a situation, the programmer has two choices: either add the skill to the list of entry behaviors, or add the necessary lessons to teach the missing skill. In the present example, "Pulling against tension" was added to the lattice as an entry behavior. In contrast, the ability to pinch, which was originally listed as an entry behavior, was found to be lacking in many students who possessed all the other prerequisite skills. Therefore, pinching movements were added to the lattice as a major subgoal and lesson frames were written to teach these movements. Thus selection of a varied initial fieldtest population was found to be important in evaluating the predictive accuracy of the entry behaviors criterion established for a given program, as well as in evaluating the efficacy of the actual lessons.

Initial Fieldtest

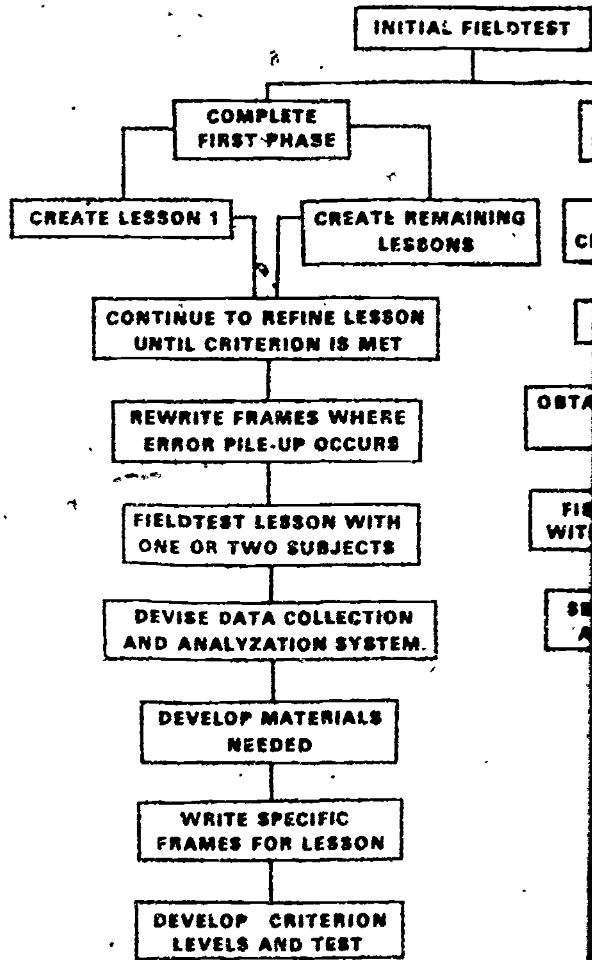
The most significant refinement of the prototypic model occurred in the Initial Fieldtest section. This refinement is reflected in the revised procedural lattice presented in the Introduction to this report (see Figure 1). This step was originally conceived as a single process, consisting of concurrent writing and fieldtesting by the programmer. The "Begin Program Writing" component of the original lattice reflected this conceptualization (see Figure 9).

Team III's experience this year, however, indicated the need for a two phase approach to this critical step in the development of instructional programs. This dual conceptualization is portrayed in the revised procedural lattice for instructional program development (see Figure 9).

The refined model incorporates the original "Begin Program Writing" step as the first phase of initial fieldtesting. As can be seen from the lattice, a second phase involving additional administrators and subjects has been added. This revision was made for several reasons. First, it was found that frequent rewriting of lessons by the programmer during the first phase necessarily resulted in a rather fragmented application of the lesson sequence. Thus the need for further initial fieldtesting of the entire instructional program, containing all of the rewritten lessons, became apparent. Furthermore, it became evident that there was a need to include one or more colleagues as administrators in order to provide a check for programmer error, as well as for clarity of teacher directions. Finally, the addition of the second phase allowed for the inclusion of a wider range of subjects at the initial fieldtest level. The importance of this aspect of initial fieldtesting has already been discussed. (See Determine Initial Fieldtest Population.)

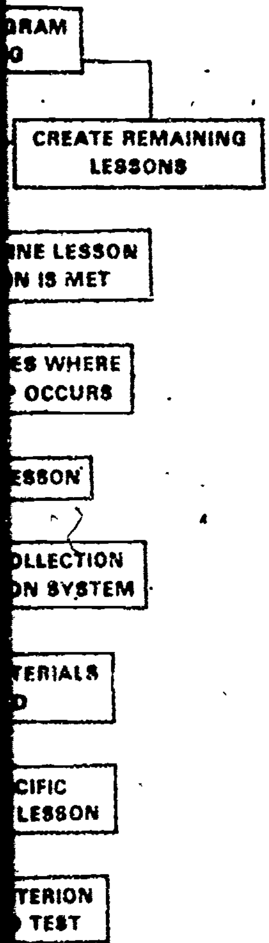


Begin Program Writing
(original)

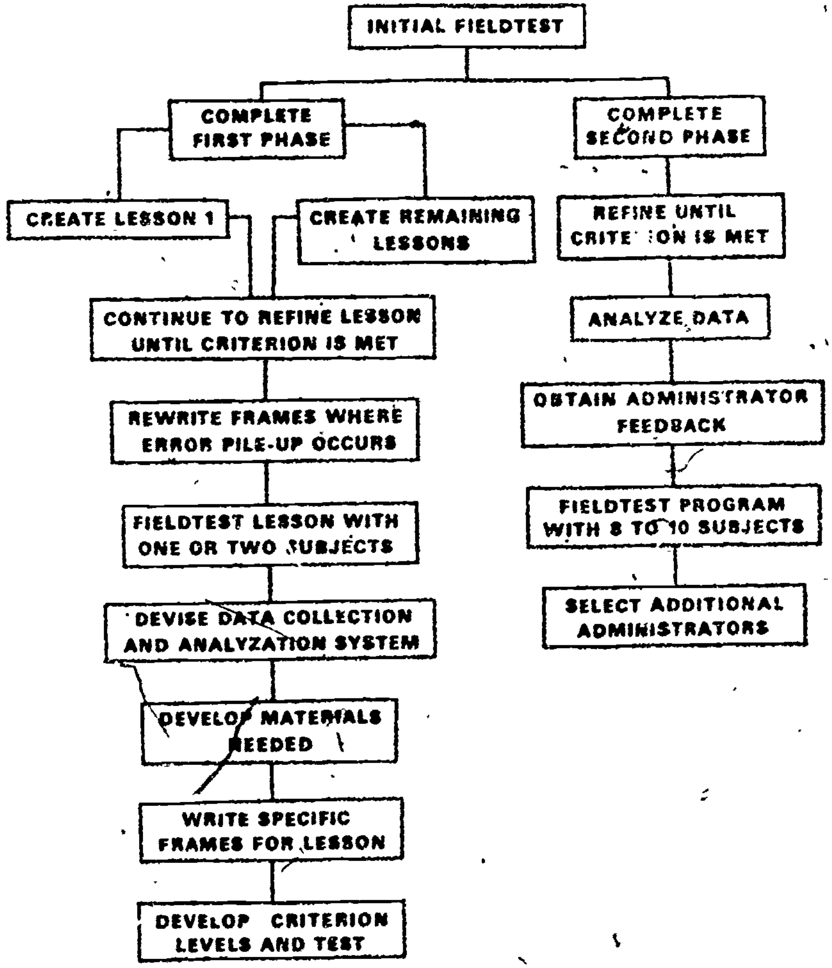


Initial Fieldtest
(revised)

REFINEMENT OF THE PROTOTYPIC MODEL



n Writing
al)



Initial Fieldtest (revised)

FINEMENT OF THE PROTOTYPIC MODEL

Specific procedures which facilitate the actual task of writing effective lessons were also refined. As with the pretests, it was necessary to condense and simplify teacher directions in the pretest and the lessons. The directions were broken into small steps and separated by spaces. Program administrators have reported greater ease in following directions which are presented in this way. Similarly, the inclusion of graphic illustrations in the teacher's manual has clarified the teacher directions for programs involving motor skills (e.g., shoe tying, buttoning). This format can be seen in the sample lessons from The Shoe Tie Program, included in Appendix A.

The 90% correct criterion level for individual lessons used by Team III was supported by fieldtest data this year. However, a smaller tolerance for error on specific frames proved essential in maintaining this high level of correct cumulative data for all students. For motor skills, the mastery criterion of three consecutive, successful repetitions proved satisfactory.

Improvements have been made this year in the methods of data collection and display. The use of 5 x 8 inch cards for data collection, as described in the section on pretest development, was introduced for lesson data as well. Additionally, cumulative data sheets allowing the teacher to see a student's progress through an entire program were developed for several programs. Examples from the Metric Ruler Measurement and the Ruler Measurement Program are included here (Figures 10 and 11).

The process of data collection for motor skill programs was simplified for use in secondary fieldtest settings. Data are not needed for each response at this level of program development, so the teacher is asked to record the student's performance only on specifically indicated criterion responses. The "Shoe Tie Program Data Sheet" (included in Appendix A) is as an example of this format for data collection and display.

The time telling program involves two types of student response: those elicited by the teacher, in a tutorial situation, and those produced independently by the student using worksheets. For some students there were distinct differences in the patterns of these two modes of responding. Therefore data for this program are now displayed on two charts, one for lesson responses and one for worksheet data. This procedure is one which the instructional programmer should consider for any program involving the use of worksheets as well as lesson responses. Copies of the cumulative data sheets for the Let's Tell Time program are included here (Figures 12a and 12b).

Secondary Fieldtest

Although only one program developed by Team III (The Shoe Tie Program) has actually been submitted to secondary fieldtesting, several others are now ready to enter this stage. To date, only one significant problem has been encountered in the implementation of this step of the prototypic model -- the selection of teachers to administer the programs in secondary fieldtest sites. Specifically, the problem was to locate a sufficient

RULER MEASUREMENT PROGRAM
COMPREHENSIVE DATA SHEET

Teacher ______________________ **Date Begun** ______________

Student ______________________ **Date Finished** ______________

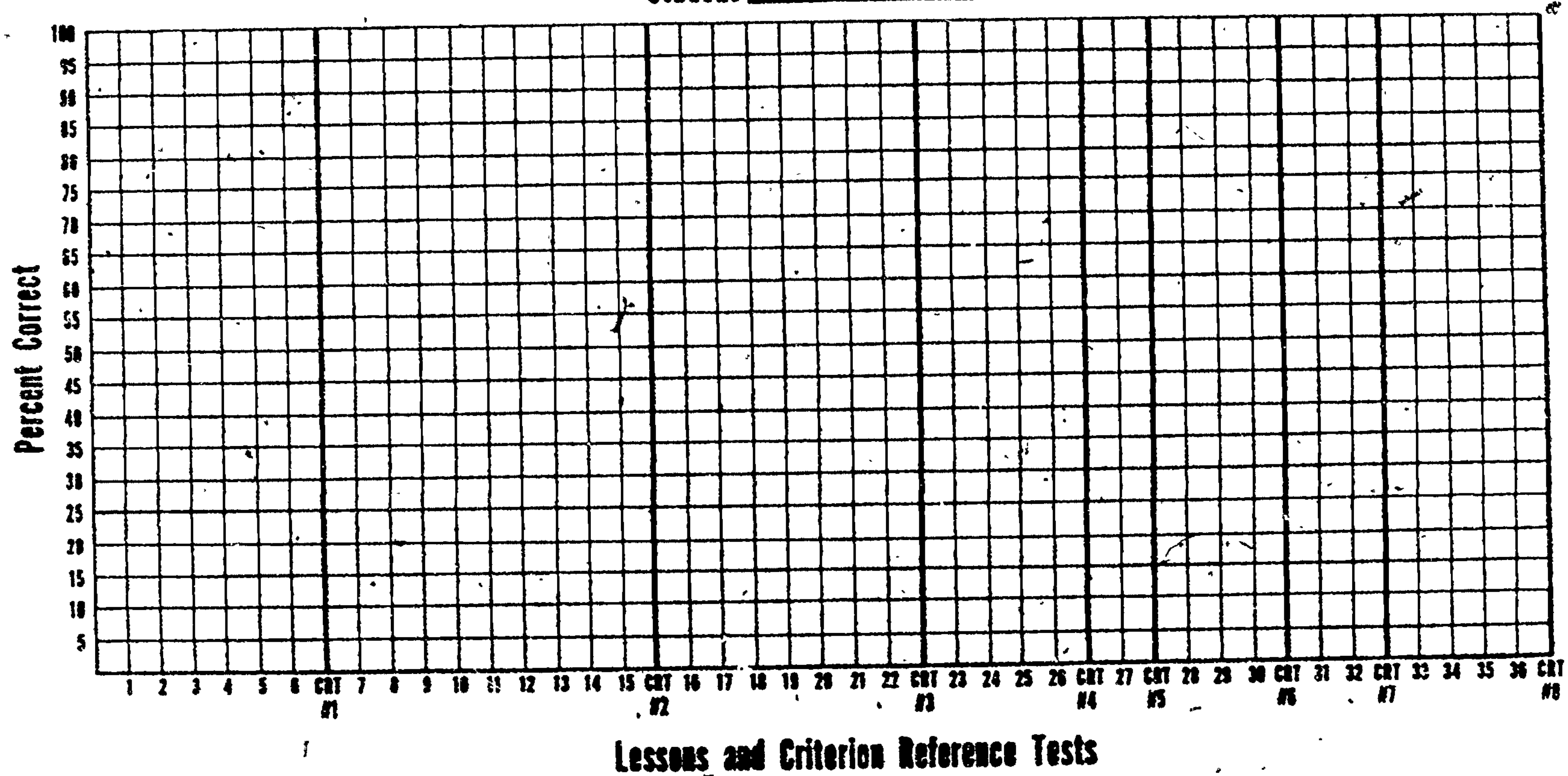


Figure 10

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METRIC RULER MEASUREMENT PROGRAM
COMPREHENSIVE DATA SHEET

Teacher ______________ **Date Begun** ______________

Student ______________ **Date Finished** ______________

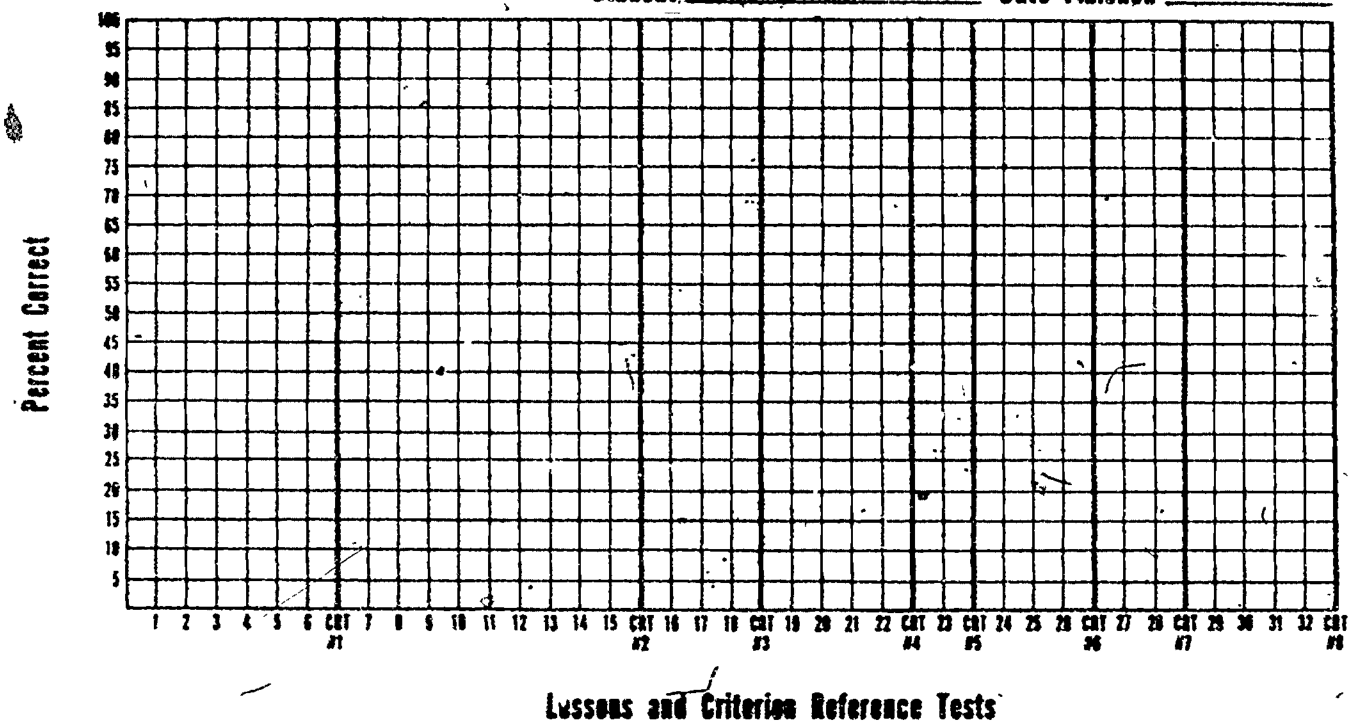
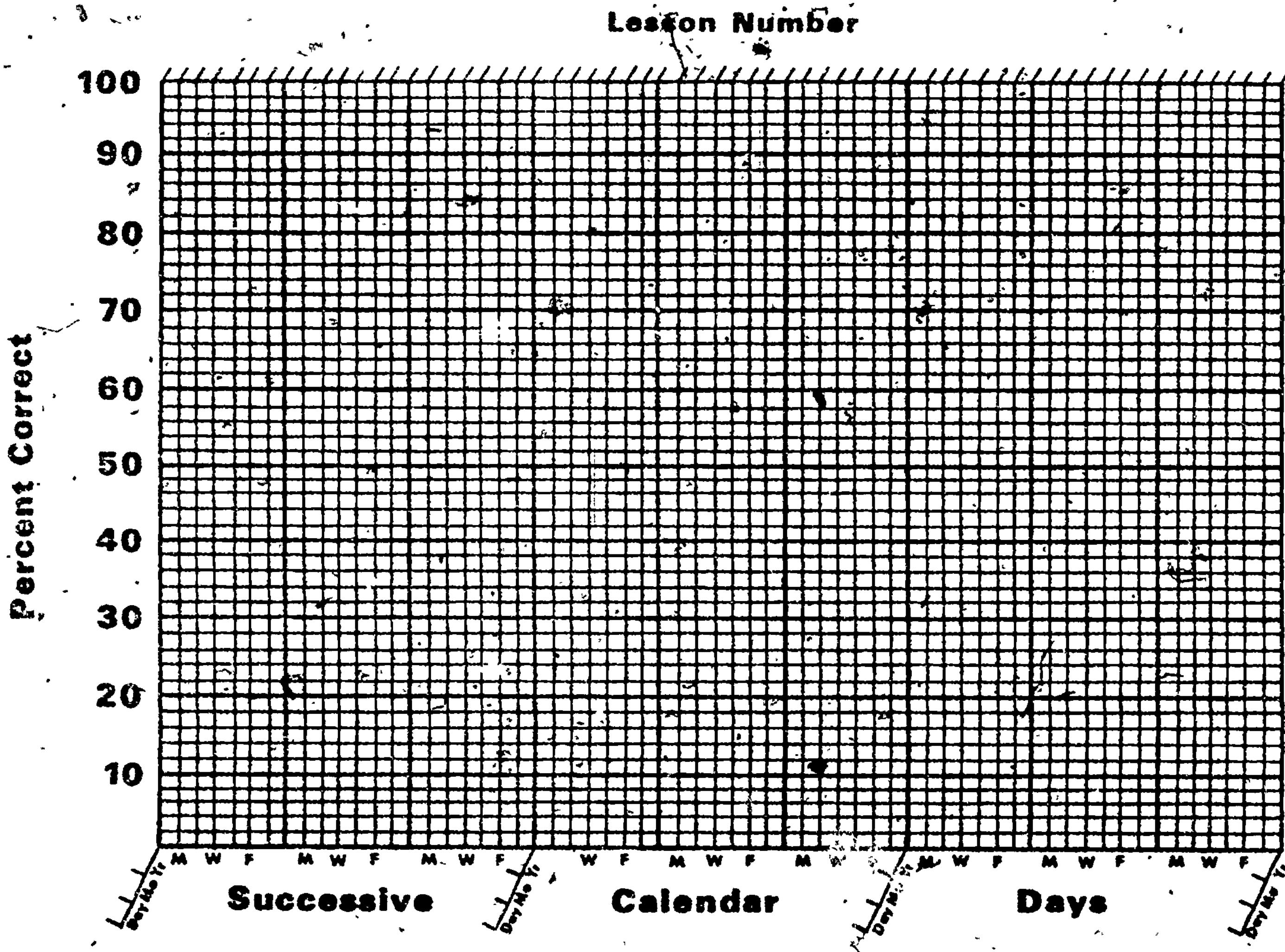


Figure 11



Comprehensive Data Sheet for Time Program Lessons

Figure 12a

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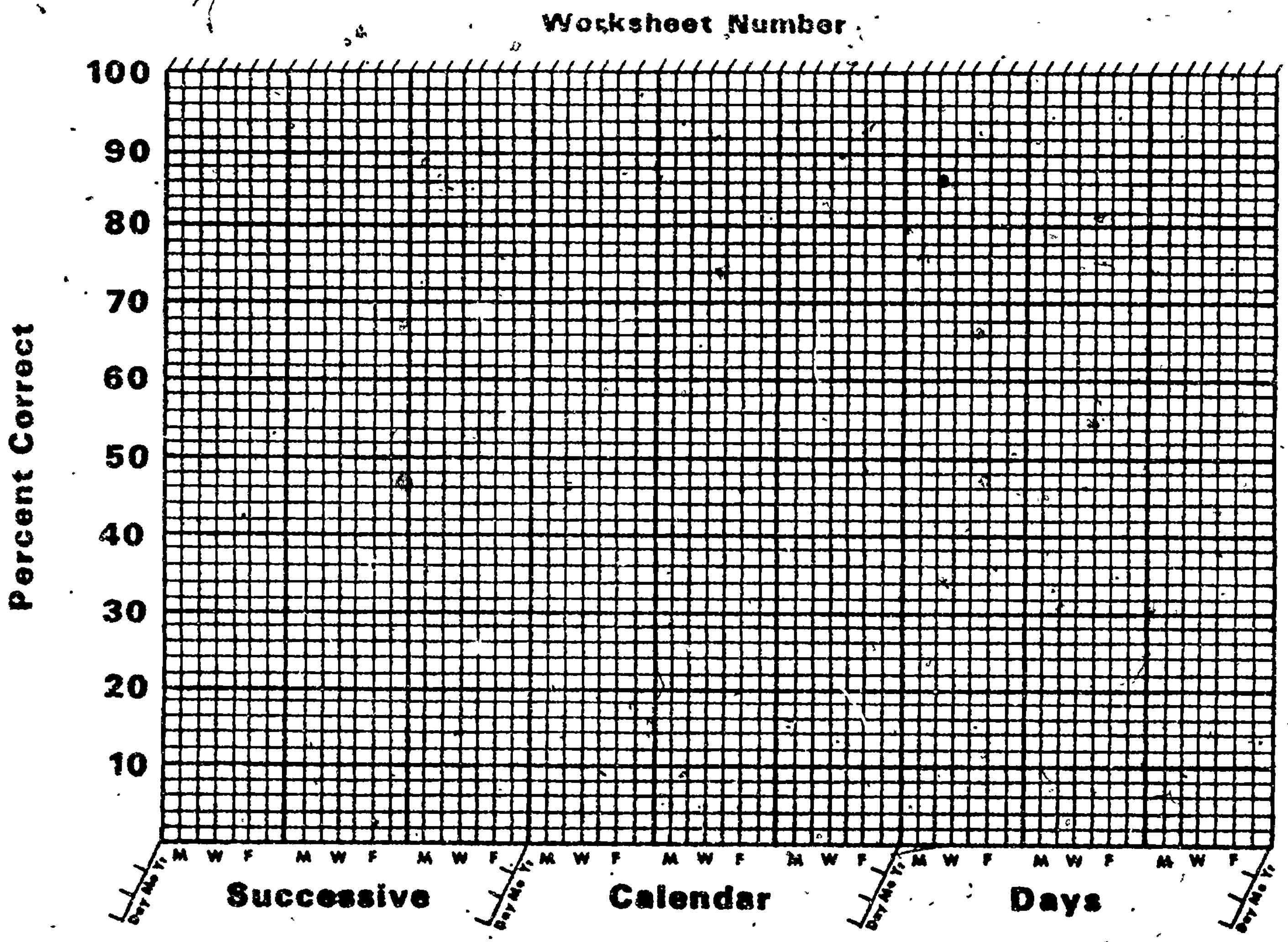


Comprehensive Data Sheet for Time Program Worksheets

Figure 12b

number of teachers, in appropriate educational settings, who have both the time and the commitment to administer these programs in accordance with the programmer's exact specifications. Rigorous adherence to the correct procedures for administration and data collection is essential if this step is to provide the types of valid information needed by the programmer. This problem appears to have been fortuitously resolved for Team III next year. Due to the funding of a new grant at the EEU, access to a large number of special education teachers in cooperating public schools has been facilitated. However, for general application of the prototypic model, it seems that some consideration needs to be given to the possibility of providing contingent reimbursement (e.g., tuition credits, teacher aide time, money, etc.) for secondary fieldtest personnel.

Final Fieldtest of the Entire Program

As none of the Team III programs has yet completed the secondary fieldtest stage, it is not possible to evaluate the efficacy and efficiency of the final fieldtest of the entire program. It is hoped that several programs will reach this stage next year, allowing for validation or needed refinement of this component of the prototypic model.

Instructional Program Developed for Specific Learning Task

No Team III program has yet reached this stage of development. However, one area of concern which is already foreseen relates to the dissemination of a completed program. The instructional programmer, concerned with the most effective dissemination of the program, should begin early to investigate a variety of avenues for dissemination. Some vehicles for dissemination might include government clearinghouses, regional instructional materials centers, commercial publishing companies, or the sponsoring agency itself. Considerations such as cost and complexity of program materials, range and number of students for whom the program is potentially applicable, and any legal restrictions due to source of research funding will influence the programmer's decision in this matter. Whichever avenue is eventually selected, the decision is an important one and deserves serious attention as a new program enters the final stages of development.

Application of the Prototypic Model: Instructional Program Development

The preceding sections of this report dealt with the focus of Team III's research this year: the prototypic model for curriculum development. Detailed descriptions of each major component of the model were presented. Additionally, the implications of this year's research were discussed in terms of validation or needed refinement of each component.

In this final section, attention is turned toward the development of the individual instructional programs which served as the vehicles through which this model was evaluated and refined. For each program developed by Team III, the following information is presented: a) the terminal goal and target population of the program; b) the skill sequence which is taught in the program; c) the pretest procedures employed in the program; d) the lesson procedures and materials developed for the program; e) the results of this year's fieldtesting; and f) the program's current status.

The following features are common to all Team III programs.

1. For all these programs, the target population is defined in terms of entry behaviors and learning characteristics. No program developed by Team III is specific to any particular chronological or mental age group.

2. The pretest for each program is designed to assess the student's basal skill level for both the entry behaviors and the major goals of the program.

3. The teacher's role is clearly specified in all Team III programs. Directions, criteria, and materials are all provided. Statements to be made by the teacher are printed in capital letters and correct student responses are defined.

4. These programs are carefully worded and structured so teacher aides, volunteers, and helpers from other classrooms can serve as administrators.

5. The format selected for all these programs requires administration on a one-to-one basis.

The Shoe Tie Program

Terminal Goal and Target Population

The goal of the Shoe Tie Program is to teach the student to tie his shoes. Supplemental lessons have been written, although not yet completely fieldtested, to teach the auxiliary shoe tying skills of shoe lacing and shoelace tightening. The prerequisite skills required of the student are the abilities to imitate others, grasp, and pull against tension. It is questionable whether individuals with poor motor control will be able to complete this program. A more definitive statement cannot be made until such individuals are assessed by the pretest.

Skill Sequence

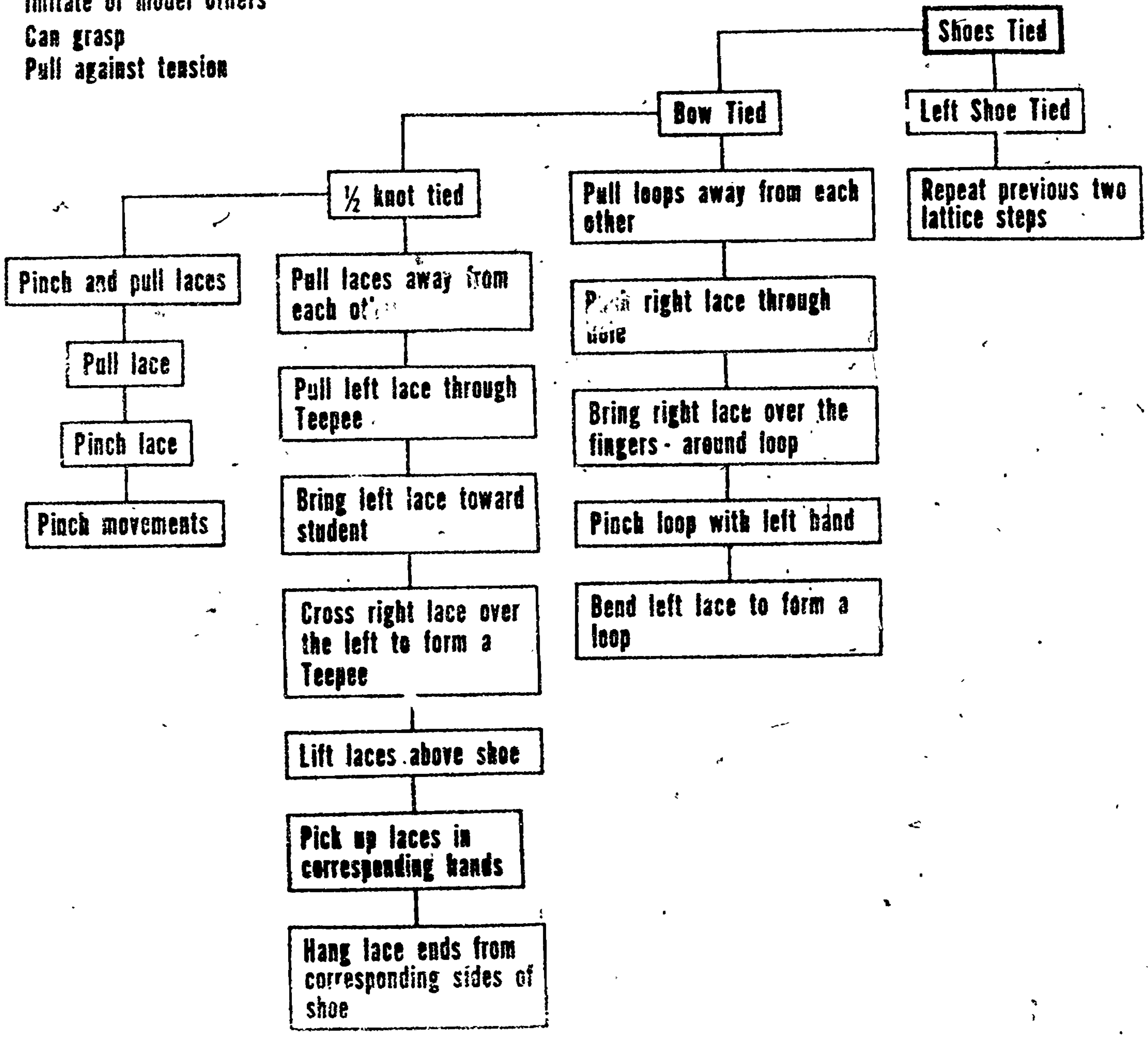
The Shoe Tie Program follows a skill sequence which progresses from pinching movements to actually tying a bow-knot on a shoe while it is being worn. This sequence is graphically portrayed in the lattice for Shoes Tied (see Figure 13). This lattice represents a substantial revision of the original task analysis for Shoes On and Shoes Tied, which served as a blueprint for the first three versions of the Shoe Tie Program (see Figure 14).

Lattice for SHOES TIED

Figure 13

Entry Behaviors

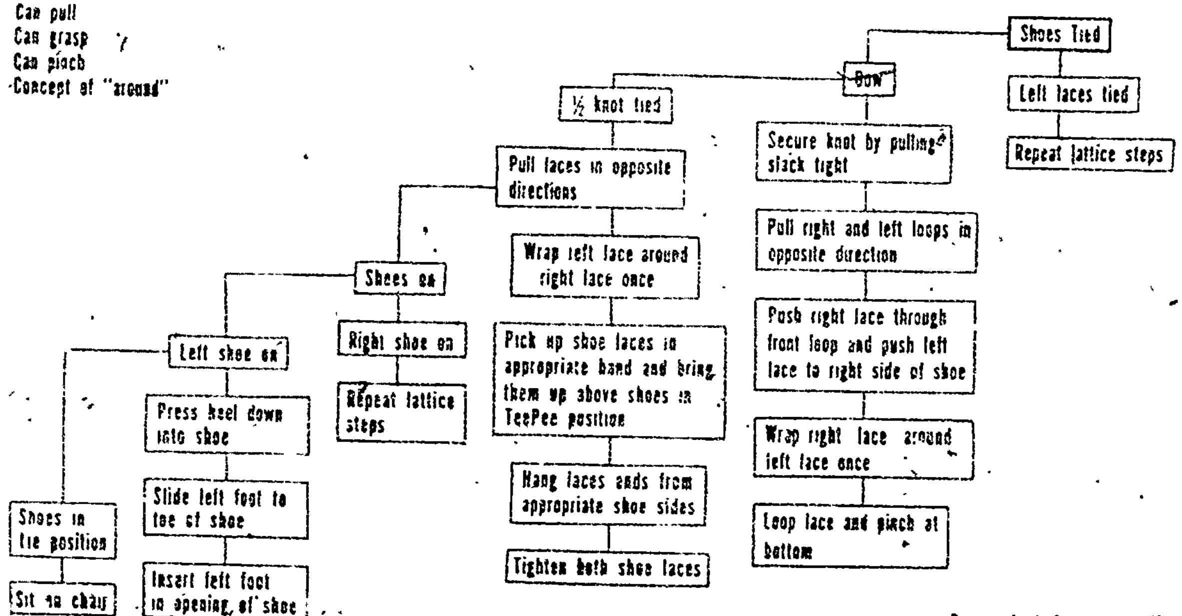
Imitate or model others
Can grasp
Pull against tension



Entry Behaviors

Can imitate or model others
Can pull
Can grasp
Can pinch
Concept of "around"

SHOES ON AND SHOES TIED



Program for loafers steps at "Shoes on"

Figure 14

Several changes were made in this lattice during the past year. The task analysis was expanded in two ways. First, since many subjects possessed all entry behaviors except for the proper pinching movements, it was decided to treat this skill as a major subgoal of the instructional program. Second, it was found that the major subgoal, "1/2 knot tied," was more complex than originally conceptualized. Therefore, the enroute objectives for this skill were broken down into more specific components. Additionally, three of the original entry behaviors were changed: a) "Can pull" was refined to "Pull <u>against tension</u>," because this proved to be a critical distinction; b) "Concept of around" was deleted, because it did not prove to be a significant discriminative factor; and c) "Can pinch" was deleted, because the program was revised to teach this skill. Finally, those components of the lattice dealing with "Shoes On" and not "Shoes Tied" were deleted, as they did not relate to the specific terminal goal of this program.

<u>Pretest Procedures</u>

The pretest for the Shoe Tie Program consists of five sections. The information collected through this pretest answers the following questions:

1) Is the student able to tie a shoe?
2) Is the student able to untie a shoe?
3) Does the student have the fine motor proficiency required to string beads with either hand? (The proficiency criterion for this skill has been set at three beads strung within 30 seconds.)
4) Is the student able to pinch a shoelace?
5) Is the student able to pull a lace against tension with either hand?
6) Is the student able to lace a shoe?
7) Is the student able to tighten the laces on a shoe?
8) Is the student able to put on a shoe?

Thus, an analysis of the pretest data reveals not only whether an individual has the prerequisite skills for entrance in the program, but also whether he has already mastered skills taught in the program. In the latter case, the pretest data facilitates the placement process. The data sheet developed this year for the shoe tie pretest is designed to fit on two 5 x 8 inch cards, which can be placed in the teacher's lap. This form is divided into five sections corresponding to the five pretest sections; each expected student response is labelled with several identifying words (see Appendix A).

<u>Lesson Procedures and Materials</u>

The lessons in the Shoe Tie Program are presented in the three column format described earlier in this report. In this program, however, a fourth column is included for graphic illustration. (Appendix A includes sample lessons from this program.)

The lessons in this program correspond to the components identified in the task analysis, as represented by the lattice for Shoes Tied (Figure 13). Since the use of a backwards chaining procedure is most appropriate in a program designed to teach shoe tying, portions of the latticed sequence are taught in reverse. In Lesson #3, for example, the student tightens the bow already tied by the administrator. In Lesson #5, the student pushes the second lace through and completes the bow already started by the administrator. In Lesson #8, he tightens the half-knot (already tied by the administrator) and completes the bow. Finally, in Lesson #10, the student ties the entire bow-knot.

In addition to changes corresponding to the lattice revisions previously discussed, many individual lesson frames were refined during the past year. Sections of the lessons were condensed and rewritten for greater clarity. Remediation suggestions were written for lessons which produced consistent types of errors for some students, but not for others. Finally, a three lesson version of the program, which was written to meet the needs of students already possessing most of the shoe tying skills, but needing remediation, was discarded. This short version proved to be unnecessary, because the researchers found that the revised program's 11 lessons are easily adapted and combined to meet the needs of most students.

The only new material developed this year for the Shoe Tie Program was the "Remedo-Board." This device was constructed because many students nearly ready to begin the sequence did not have the necessary pinching and pulling skills for the shoe tying process. The "Remedo-Board" is a simple device designed to familiarize students with the pinching and pulling motions used to tie shoelaces. It consists of a piece of wood drilled with two holes in which knotted shoelaces are secured for practicing these motions.

Two additional refinements were made to render this program more manageable for the classroom teacher in a secondary fieldtest setting. First, an illustrated glossary of terms was added to the beginning of the teacher's manual, explaining the specific terminology and movements employed in the lessons. Also, a new data sheet was developed which requires only the scoring of criterion responses for each lesson. A copy of this form and an explanation of the scoring procedure used with it are included in Appendix A.

Initial Fieldtest Results

Subjects. At the beginning of the year, six students at the EEU participated in the second phase of initial fieldtesting of the Shoe Tie Program. Four of these students were children enrolled in the Down's Syndrome Kindergarten program; two of these youngsters were five years old and the others were six years old. The fifth subject, from an elementary classroom was an eight year old child, diagnosed as mentally retarded with behav ral problems. The sixth student was an 18 year old emotionally disturbed young man in a secondary classroom. These students represent a cross-section in chronological age, mental age, and motor control.

Procedures. The Shoe Tie Program was under the immediate supervision of Mike Roe, one of the Team III interns. Five instructors administered the in-house testing. Two of the five were Team III members; the remaining three were project or field study students working under the supervision of Team III.

Lessons provided the instructions used during the in-house testing. Any additional instructions or clarification provided by the instructors were either incorporated into the lessons or were added as possible remediation methods.

Results. One of the four kindergarten students, J., successfully completed the entire Shoe Tie Program in 21 sessions (Figure 15). After 44 sessions, 5 year old P. completed all but the last lesson, which teaches untying. The instructor reported that this boy had great difficulty in Lesson #10, which requires the student to tie his own, rather than the model shoe. It was not possible to obtain the parent follow-through at home needed to overcome this problem; therefore, P. did not finish the lesson sequence.

Neither of the two remaining kindergarten subjects completed this program. Problems of absenteeism, uncooperative behavior, and changing administrators each quarter may account for the program's failure to teach these students to tie their shoes. The data for one of these students, K., are presented in Figure 16.

The 8 year old student who participated in initial fieldtesting, J., successfully completed the entire lesson sequence in 11 sessions (Figure 17). The 18 year old subject, T., learned to tie his shoes in 7 sessions (Figure 18). Both of these students entered the program at Lesson #3, having demonstrated proficiency on the pretest in the skills taught by the first two lessons.

Discussion. The data indicate that this program is effective in teaching the skill of shoe tying to students who possess the necessary entry behaviors, regardless of chronological age. There was a great difference, however, between younger (ages 5 and 6) and older (ages 8 and 18) subjects in the number of sessions needed to achieve skill mastery. There is some question as to the practicality of this program for very young children, given the limited amount of time which a teacher has to spend with this age group (usually in school for only one-half day).

It is possible that some of the problems encountered in the initial fieldtesting were directly related to the factor of limited student rapport with the unfamiliar administrators. The impact of this factor can be more accurately assessed after the program is fieldtested with young children in the public schools. Since the administrators in the secondary fieldtest sites will be teachers or paraprofessionals with whom rapport can be assumed, this factor would not account for any slower progression through the shoe tie lessons.

The importance of parent cooperation was underscored by the case of one child whose parents continued to tie his shoes for him at home. This child learned to tie the model shoe, but never successfully applied this skill to independently tying his own shoes.

SHOE TIE PROGRAM DATA SHEET

Student J
Age 6

● Criterion correctly completed
△ Incorrect response

Lesson #11
- 36 Unties own shoe
- 35. Unties half knot on own shoe
- 34 Hooks half knot on own shoe
- 33. Unties bow knot on own shoe

Lesson #10
- 32 Ties bow knot on own shoe
- 31. Ties half knot on own shoe

Lesson #9
- 30 Ties bow knot
- 29 Tightens half knot
- 28. Brings lace through tongue
- 27 Makes tongue

Lesson #8
- 26 Ties the bow knot
- 25 Tightens half knot
- 24 Brings lace through tongue

Lesson #7
- 23 Tightens bow
- 22 Pushes lace through hole
- 21 Brings lace over fingers
- 20 Makes loop

Lesson #6
- 19 Tightens bow
- 18 Pushes lace through hole
- 17 Brings lace over fingers
- 16 Independently holds first loop in place

Lesson #5
- 15 Tightens bow
- 14 Pushes lace through hole

Lesson #4
- 13 Tightens bow
- 12 Pulls loop away from hole
- 11 Holds first loop in place with assistance

Lesson #3
- 10. Tightens bow
- 9. Pinches both loops of bow

Lesson #2
- 8. Pulls two loops simultaneously with corresponding hands
- 7 Pulls loop with "weak" hand
- 6 Pulls loop with "strong" hand
- 5 Pinches two loops simultaneously with corresponding hands
- 4. Pinches loop with "weak" hand
- 3 Pinches loop with "strong" hand

Lesson #1
- 2. Pinches and releases shoe lace
- 1. Pinches and releases on verbal command

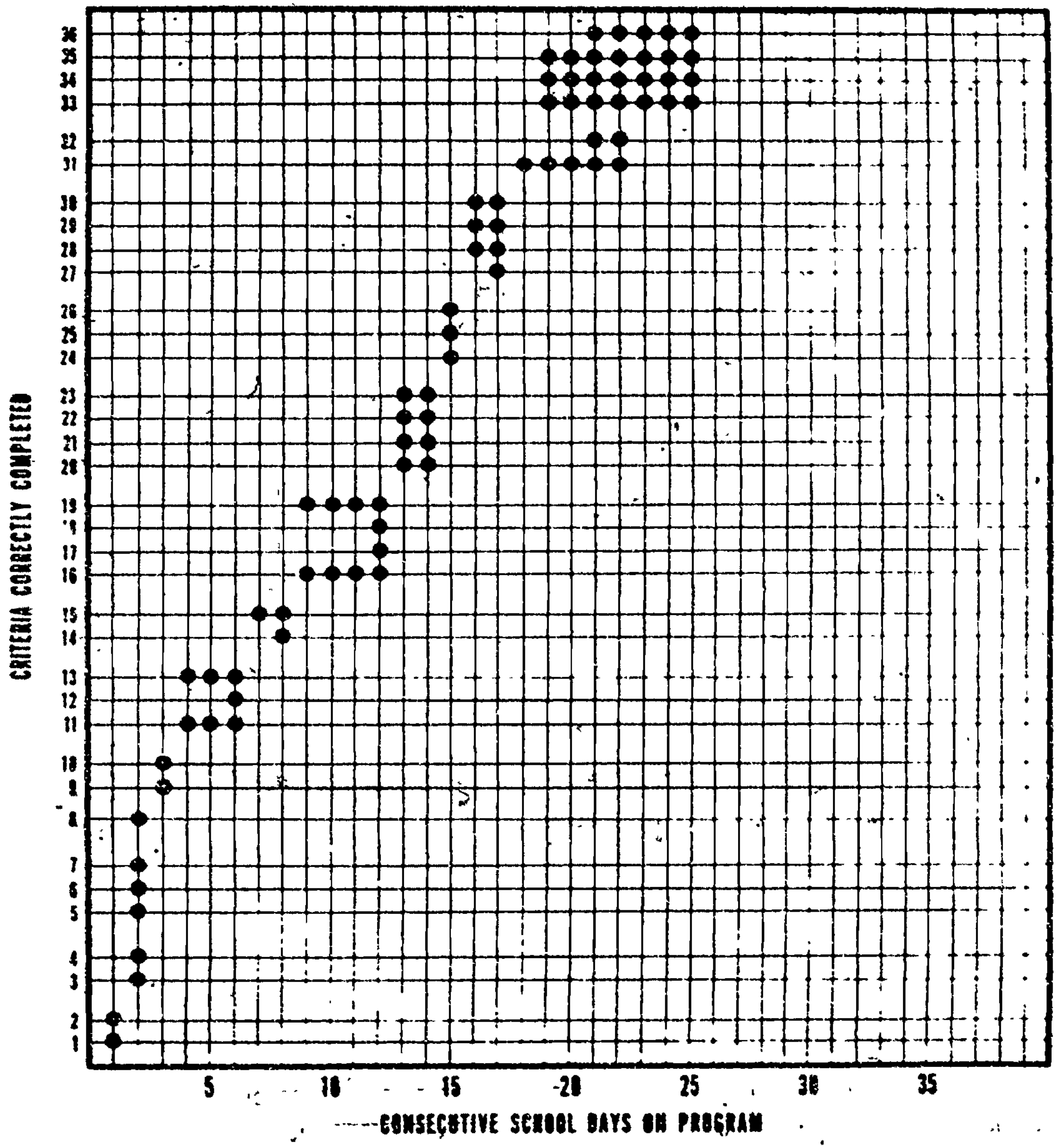


Figure 15

SHOE TIE PROGRAM DATA SHEET

Student K

Age 6

● Criterion correctly completed
▲ Incorrect response

Lesson #11
- 36. Unties own shoe
- 35. Unties half knot-on own shoe
- 34. Hooks half knot on own shoe
- 33. Unties bow knot on own shoe

Lesson #10
- 32. Ties bow knot on own shoe
- 31. Ties half knot on own shoe

Lesson #9
- 30. Ties bow knot
- 29. Tightens half knot
- 28. Brings lace through teepee
- 27. Makes teepee

Lesson #8
- 26. Ties the bow knot
- 25. Tightens half knot
- 24. Brings lace through teepee

Lesson #7
- 23. Tightens bow
- 22. Pushes lace through hole
- 21. Brings lace over fingers
- 20. Makes loop

Lesson #6
- 19. Tightens bow
- 18. Pushes lace through hole
- 17. Brings lace over fingers
- 16. Independently holds first loop in place

Lesson #5
- 15. Tightens bow
- 14. Pushes lace through hole

Lesson #4
- 13. Tightens bow
- 12. Pulls loop away from hole
- 11. Holds first loop in place with assistance

Lesson #3
- 10. Tightens bow
- 9. Pinches both loops of bow

Lesson #2
- 8. Pulls two loops simultaneously with corresponding hands
- 7. Pulls loop with "weak" hand
- 6. Pulls loop with "strong" hand
- 5. Pinches two loops simultaneously with corresponding hands
- 4. Pinches loop with "weak" hand
- 3. Pinches loop with "strong" hand

Lesson #1
- 2. Pinches and releases shoe lace
- 1. Pinches and releases on verbal command

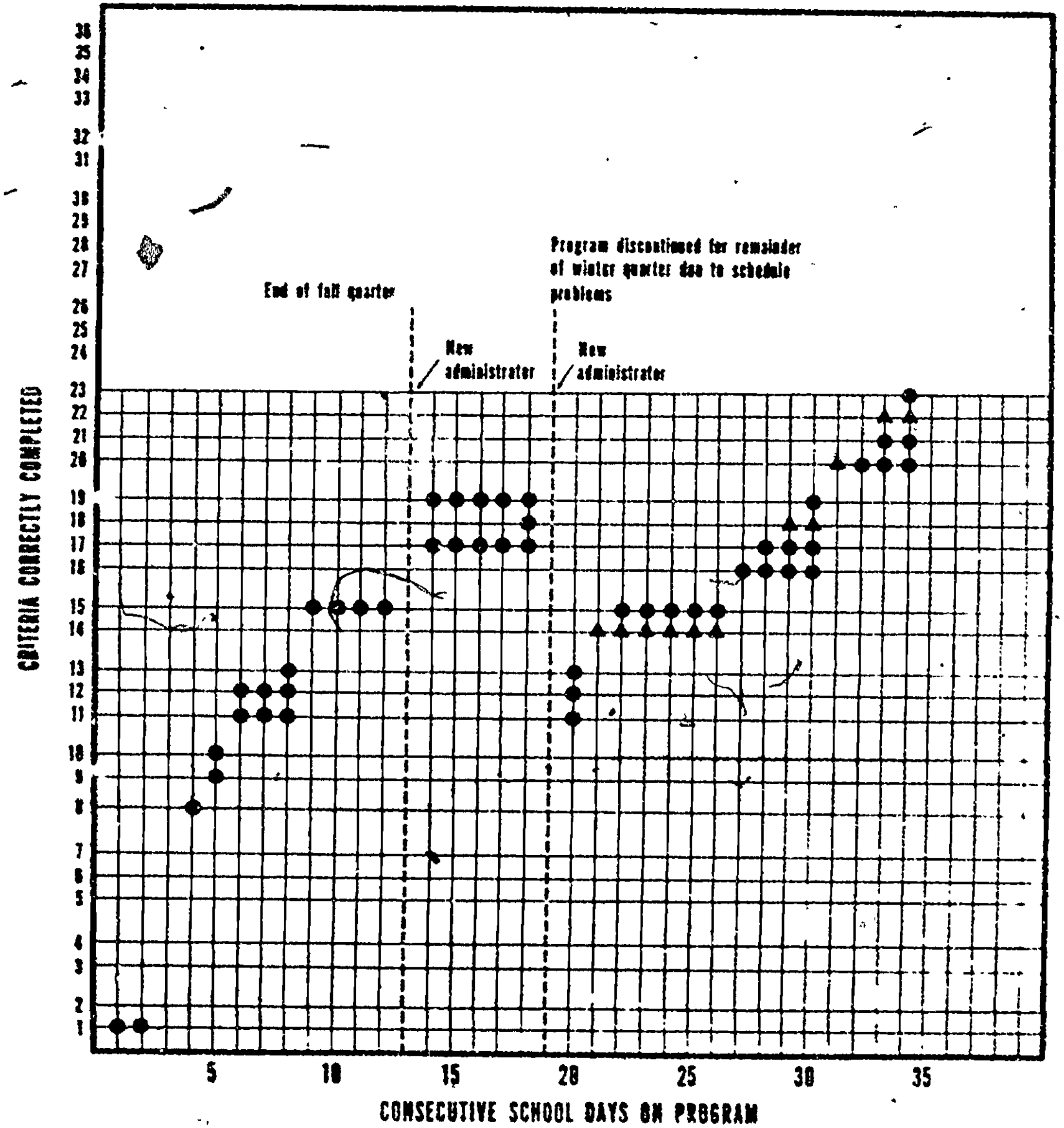


Figure 16

SHOE TIE PROGRAM DATA SHEET

Student J

Age 8

● Criterion correctly completed
△ Incorrect response

Lesson #11
- 36 Unties own shoe
- 35 Unties half knot on own shoe
- 34 Yanks half knot on own shoe
- 33 Unties bow knot on own shoe

Lesson #10
- 32 Ties bow knot on own shoe
- 31 Ties half knot on own shoe

Lesson #9
- 30 Ties bow knot
- 29 Tightens half knot
- 28 Brings lace through teepee
- 27 Makes teepee

Lesson #8
- 26 Ties the bow knot
- 25 Tightens half knot
- 24 Brings lace through teepee

Lesson #7
- 23 Tightens bow
- 22 Pushes lace through hole
- 21 Brings lace over fingers
- 20 Makes loop

Lesson #6
- 19 Tightens bow
- 18 Pushes lace through hole
- 17 Brings lace over fingers
- 16 Independently holds first loop in place

Lesson #5
- 15 Tightens bo
- 14 Pushes lace through hole

Lesson #4
- 13 Tightens bow
- 12 Pulls loop away from hole
- 11 Holds first loop in place with assistance

Lesson #3
- 10 Tightens bow
- 9 Pinch: both loops of bow

Lesson #2
- 8 Pulls two loops simultaneously with corresponding hands
- 7 Pulls loop with "weak" hand
- 6 Pulls loop with "strong" hand
- 5 Pinches two loops simultaneously with corresponding hands
- 4 Pinches loop with "weak" hand
- 3 Pinches loop with "strong" hand

Lesson #1
- 2 Pinches and releases shoe lace
- 1 Pinches and releases on verbal command

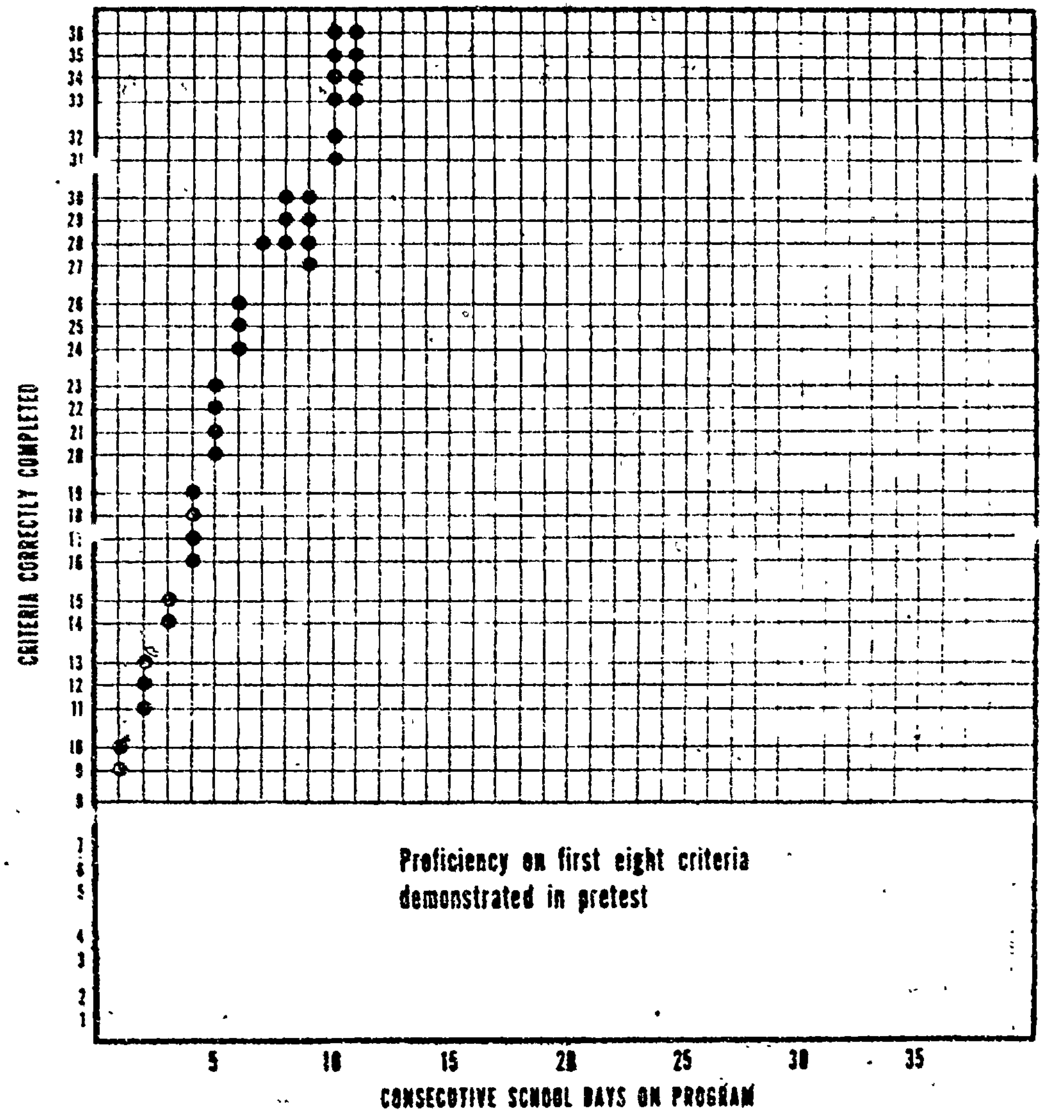


Figure 17

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SHOE TIE PROGRAM DATA SHEET

Student ____T____
Age ____18____

● Criterion correctly completed
△ Incorrect response

Lesson #11
36. Unties own shoe
35. Unties half knot on own shoe
34. Hooks half knot on own shoe
33. Unties bow knot on own shoe

Lesson #10
32. Ties bow knot on own shoe
31. Ties half knot on own shoe

Lesson #9
30. Ties bow knot
29. Tightens half knot
28. Brings lace through loop
27. Makes loop

Lesson #8
26. Ties the bow knot
25. Tightens half knot
24. Brings lace through loop

Lesson #7
23. Tightens bow
22. Pushes lace through hole
21. Brings lace over fingers
20. Makes loop

Lesson #6
19. Tightens bow
18. Pushes lace through hole
17. Brings lace over fingers
16. Independently holds first loop in place

Lesson #5
15. Tightens bow
14. Pushes lace through hole

Lesson #4
13. Tightens bow
12. Pulls loop away from hole
11. Holds first loop in place with assistance

Lesson #3
10. Tightens bow
9. Pinches both loops of bow

Lesson #2
8. Pulls two loops simultaneously with corresponding hands
7. Pulls loop with "weak" hand
6. Pulls loop with "strong" hand
5. Pinches two loops simultaneously with corresponding hands
4. Pinches loop with "weak" hand
3. Pinches loop with "strong" hand

Lesson #1
2. Pinches and releases shoe lace
1. Pinches and releases on verbal command

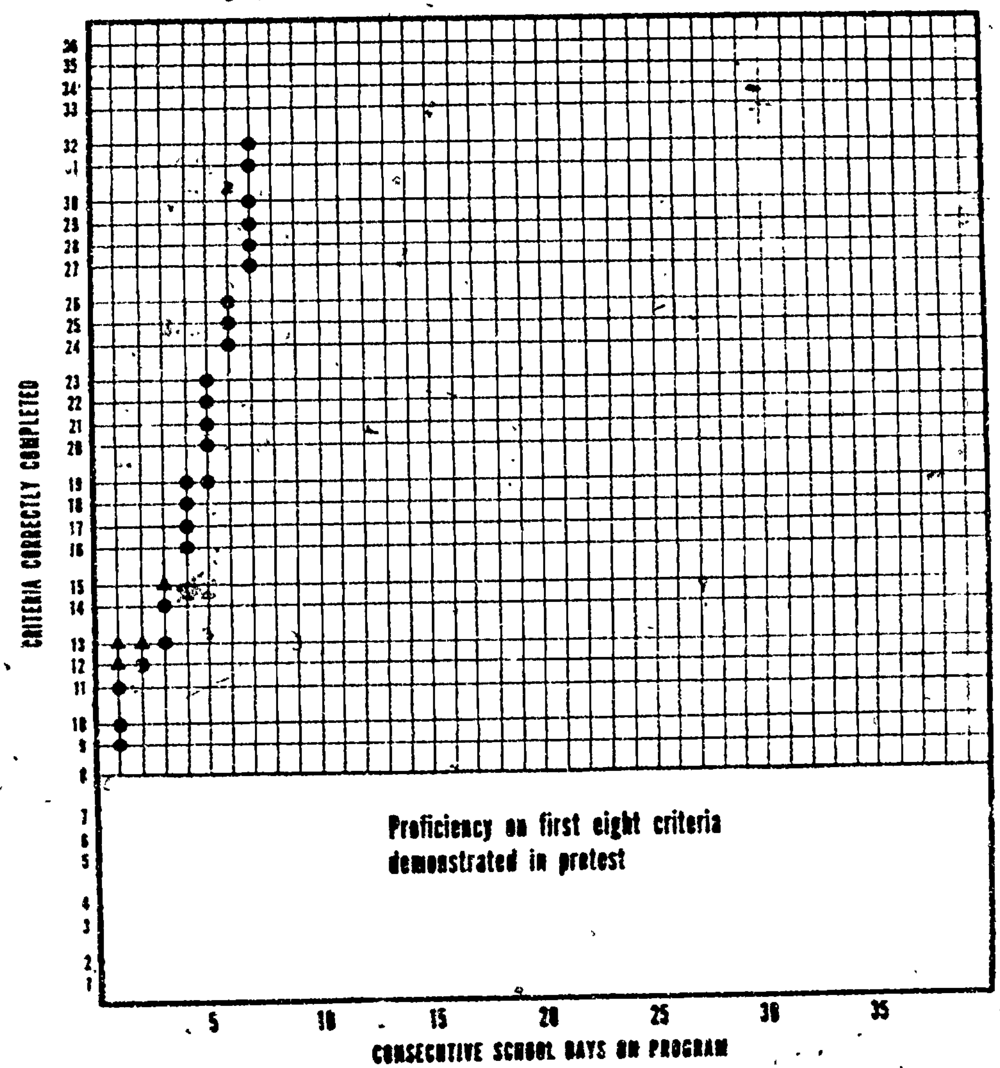


Figure 18

Secondary Fieldtest Results

Subjects. The Shoe Tie Program is now being fieldtested on a large number of handicapped students, ranging in age from 3 to 13 years old. These students are all enrolled in public school special education programs in the state of Washington.

Procedures. During the past year, the Shoe Tie Program was used by many different administrators, including teachers, high school volunteers and student teachers. Procedures were identical to those employed in initial fieldtesting, except that administrators had minimal contact with the programmer. Therefore, the instructions found in the Shoe Tie Program manual provided the only direction for administration of the lessons.

Results. Because this program did not reach the public schools until late in the school year, very little of the secondary fieldtest data is assembled. As previously discussed, results have been received from one teacher who administered the pretest to five students, ranging in age from 3 to 4½ years. Of these, only one student possessed all the necessary entry behaviors. Because this student demonstrated mastery of the skills taught in the first two lessons, she entered the program at Lesson #3. For two days, she successfully progressed through Lesson #3 and the first part of Lesson #4. On the succeeding six days, however, the teacher reported severe behavior problems (this child has been diagnosed autistic), and no further progress was made. Therefore, the program was terminated for this child, although the teacher offered her subjective opinion that the child could have successfully progressed through the entire sequence had behavior not been such a problem.

Additionally, two students in the same class who did not possess all the necessary entry behaviors (both required more than the allotted 30 seconds to complete the bead-stringing task) were placed in the program on an experimental basis. One of these students successfully completed the first four lessons in as many days, but was removed from the program after seven days with no progress on Lesson #5. The other student achieved the criteria for Lessons #1 and #2, but was unable to complete Lesson #3.

Data have also been received from a teacher who administered the program to a 13 year old Down's syndrome girl who demonstrated all requisite entry behaviors. Because this student was absent for 2½ weeks, she did not have time to complete the entire sequence before the end of the school year; she will continue the program next year. After 23 data days, however, this girl correctly completed all but one of the first 30 criteria (through Lesson #9).

Discussion. It appears that the entry behaviors for the Shoe Tie Program may screen out many preschool handicapped children. The efficacy of the program remains to be proven for those children who possess the necessary entry behaviors. However, the teacher who reported these preschool results expressed concern over the amount of time which would apparently be required for these very young children to complete the entire Shoe Tie Program. She suggested that this expenditure of time may not be warranted in light of the other learning tasks which have greater priority for this age group. Such a tentative conclusion would not be out of line with Team III's initial fieldtest findings. This problem will be given greater consideration as more secondary fieldtest data become available and plans are made for final revisions.

Although final results will not be available until next fall, it appears that the program was effective with one 13 year old handicapped student included in the secondary fieldtest population. This student's teacher was enthusiastic about the program and encountered no problems in interpreting the directions as printed in the manual.

Current Status

The Shoe Tie Program entered the secondary fieldtest stage of development this year, but data for only a few students have been received. When the public schools reopen in September, secondary fieldtesting will be resumed and more data collected. Any necessary revisions will be made before the program is submitted to a final fieldtest. The program will then be prepared for dissemination.

Make Change Program

Terminal Goal and Target Population

The Make Change Program consists of four separate, sequential mini-programs. These programs and their respective terminal goals are: a) Coin Discrimination --to discriminate by correctly naming and selecting the common coins; b) Bill Discrimination -- to discriminate by correctly naming and matching bills of one, five, ten, and twenty dollar denominations; c) Money Values -- to identify by correctly naming, writing, and matching the correct value for the common coins and bills of one, five, ten, and twenty dollar denominations; d) Coin Combinations --to compute by counting the value of all coin combinations through 25 cents.

The Make Change Program is intended for use with any student who possesses the following entry behaviors: addition skills, rote counting to 100, counting from any number, shape discrimination, and counting by 5's and 10's. The mini-programs are written sequentially so successful completion of each lesson's criteria serves as a prerequisite for the following lessons as well as the subsequent mini-programs. Supplemental remediation sections added to the program this year insure that the program will be applicable to students with general and specific learning disabilities.

Skill Sequence

The Make Change Program follows the sequence of skill development as identified in the task analysis and displayed in the lattice for Make Change (Figure 19).

The four mini-programs correspond to the first three major subgoals along the ridgeline of the Make Change Lattice. This portion of the lattice is presented in Figure 20.

MAKE CHANGE

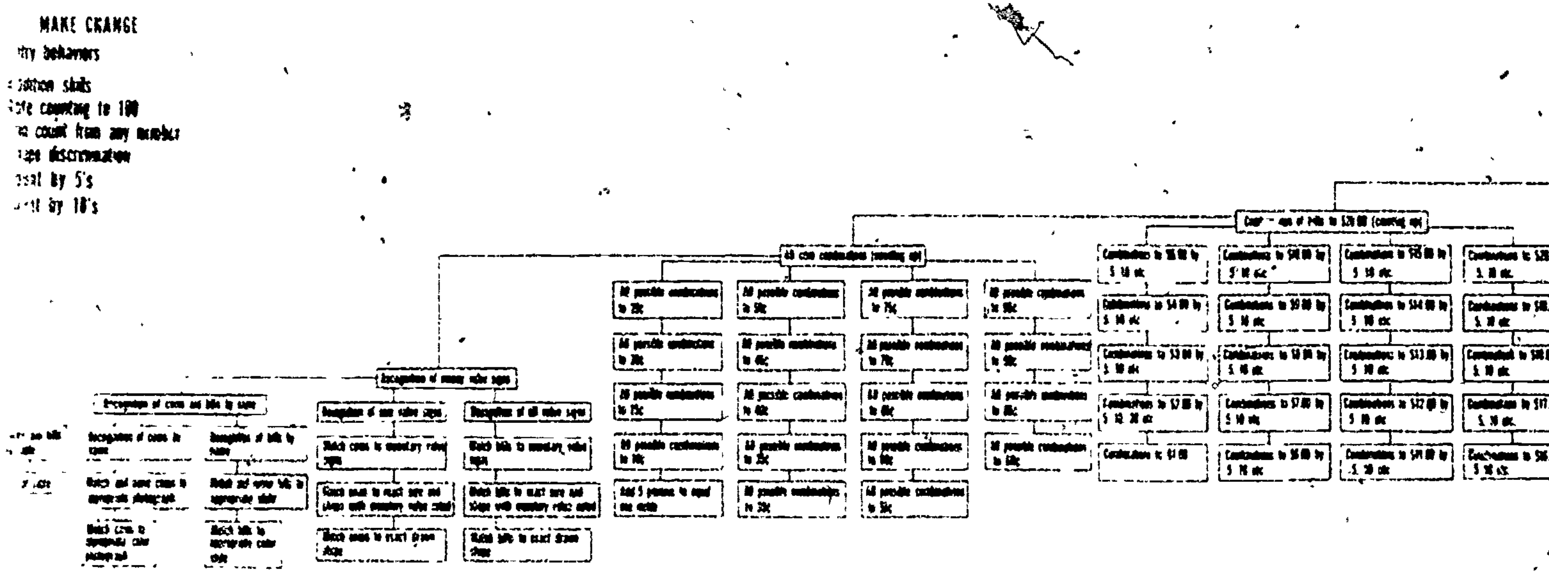


Figure 19

MAKE CHANGE

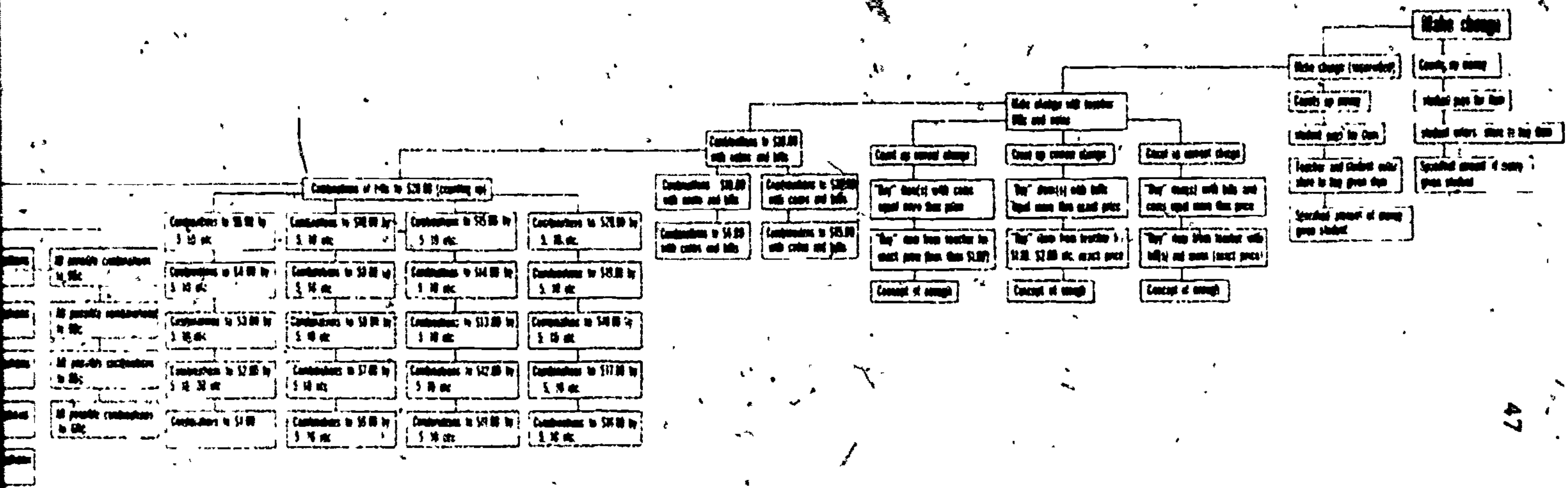
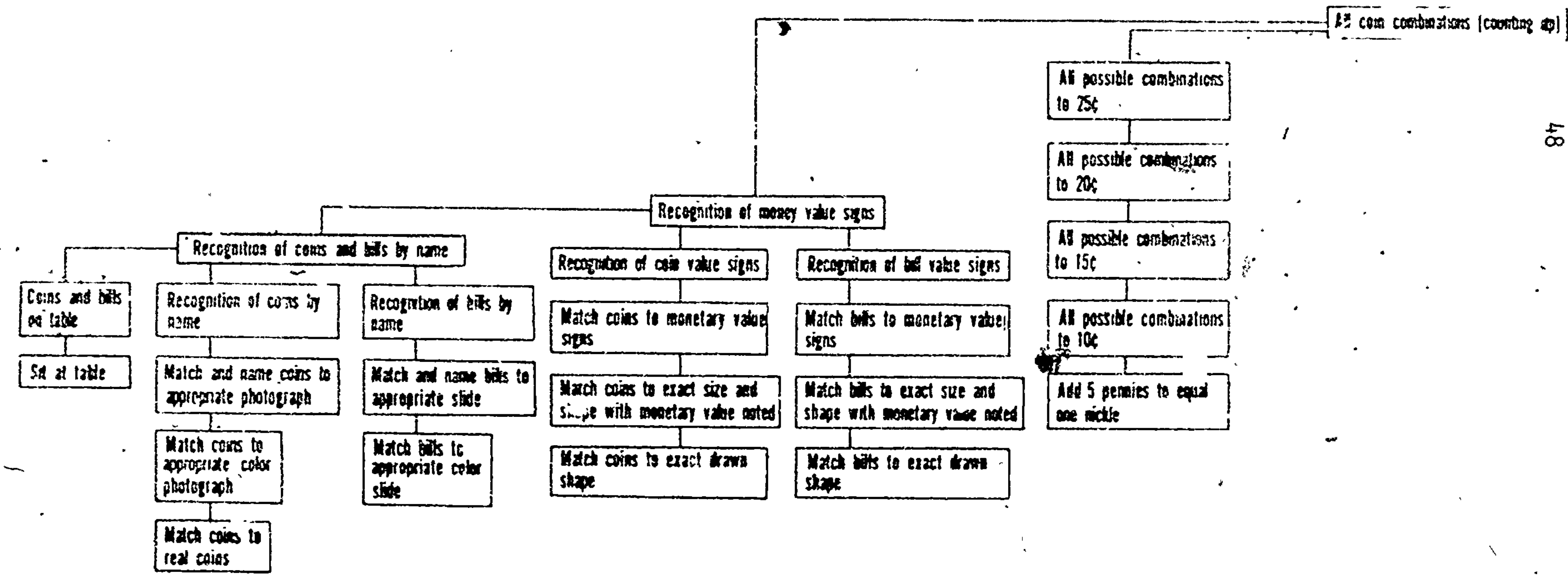


Figure 19

MAKE CHANGE

Entry behaviors

Addition skills
Rote counting to 100
Can count from any number
Shape discrimination
Count by 5's
Count by 10's



Portion of Lattice For Which Lessons Are Written

Upon completion of the first two mini-programs, Coin Discrimination and Bill Discrimination, the student has mastered the enroute objectives for the first major subgoal, "Recognition of bills and coins by name." The third mini-program, Money Values, corresponds to the next subgoal on the ridgeline, "Recognition of money value signs." The last mini-program in this instructional sequence is Coin Combinations. To date, lessons are written for only the first set of enroute objectives, "All possible combinations to 25¢," under the third major subgoal, "All coin combinations (counting up)." The relationship between the mini-programs and the lattice for Make Change is shown in Figure 21.

Pretest Procedures

The Make Change pretest provides a comprehensive assessment of a student's ability to benefit from any or all of the four mini-programs. Specifically, the pretest answers the following questions:

1) Can the student count from one to one hundred?
2) Can the student fill in missing numbers in a sequence of numbers from one to one hundred?
3) Can the student count by tens and by fives?
4) Can the student demonstrate shape and size discrimination skills?
5) Can the student name the coins when presented face or back up?
6) Can the student name the bills when presented face or back up?
7) Can the student recognize money value signs?
8) Can the student make change with coins and bills up to $20 inclusive?

The answers to these questions enable the administrator to determine whether a student already possesses any of the program's target goals, or whether he possesses the necessary entry behaviors for placement in the program.

The Make Change pretest underwent substantial revision this year. The pretest sections were re-sequenced in a more logical order. The pretest was revised so it can be administered in two days, thus avoiding the tedium and fatigue encountered when the original version of this long pretest was administered. The two divisions of the revised Pretest are: Part I, Assessment of Prerequisite Skills for the Make Change Program; and Part II, Assessment of Proficiency in the Target Skills of the Program.

Pretest section 10, which tests the ability to make change, was widened in scope and re-worded to be more comprehensive and more easily administered. (Because it now seems necessary to limit the scope of the instructional program to coin combinations only through 25 cents, further pretest revisions will have to be made to reflect this reduced terminal goal.) The section assessing shape discrimination and fine motor skills was shortened with no loss in efficiency or predictive accuracy indicated by the pretest.

CORRESPONDENCE OF FOUR MINI-PROGRAMS TO THE LATTICE FOR MAKE CHANGE

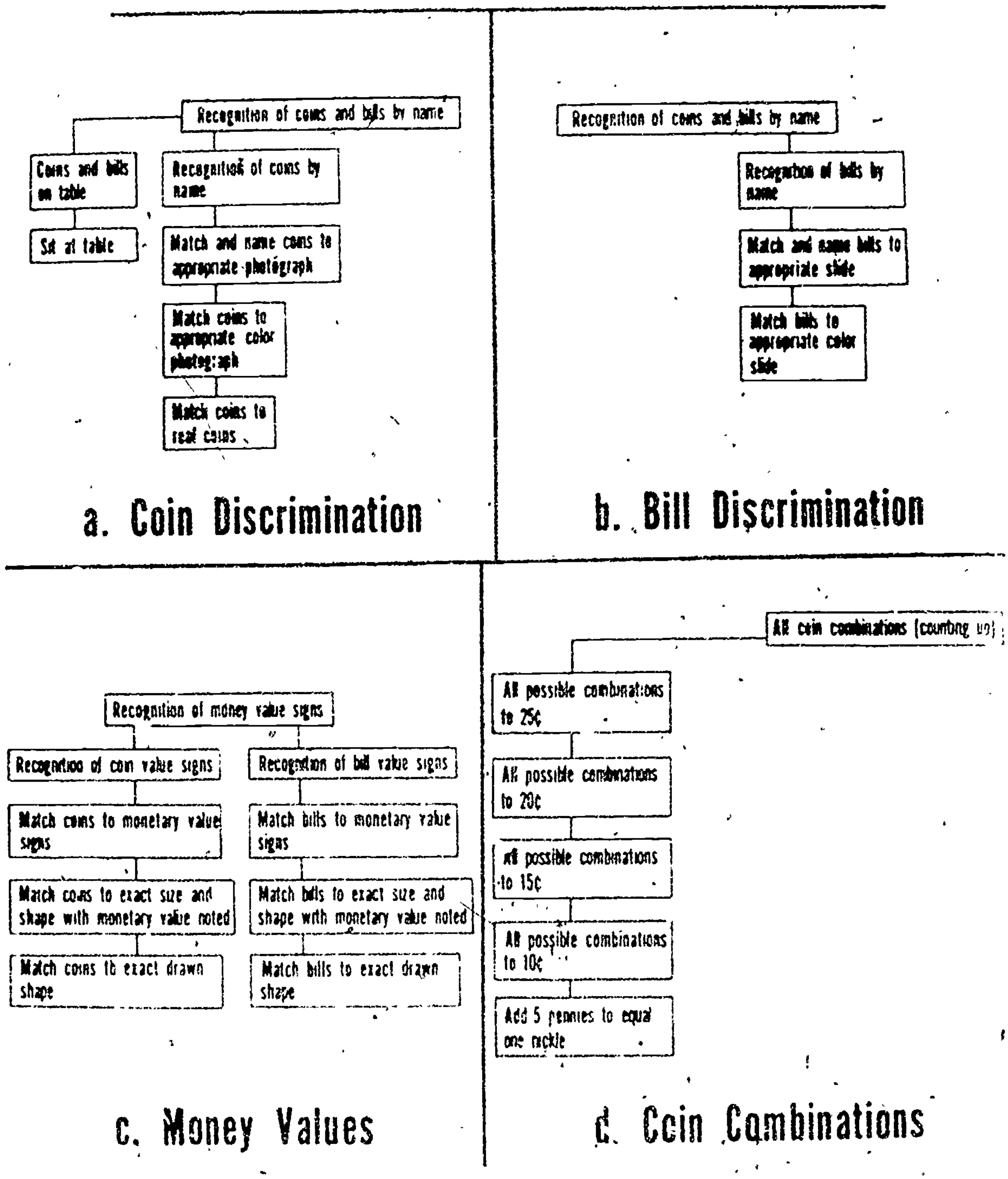


Figure 21

The pretest data sheets were also revised this year because the original ordering of sub-sections and the actual presentation of responses proved too awkward in actual fieldtesting. The new pretest data sheets are similar to the originals. The need for a large amount of data on specific responses (e.g., which numbers in counting or filling in missing numbers are missed or counted incorrectly) militated against trying to condense the data onto a card system.

An important addition to the pretest this year was a new section on placement. This section tells the instructor how to place a student, on the basis of pretest data, at the appropriate lesson in the four section Make Change Program.

Lesson Procedures and Materials: Coin Discrimination

The first mini-program in the Make Change Program is the Coin Discrimination Program which consists of six lessons. The purpose of this mini-program is to teach the discrimination of coins used in our monetary system to students who lack coin discrimination (as indicated by the pretest), as well as to students who require systematic remediation on this skill.

The Coin Discrimination Program underwent substantial revisions in the past year. Fieldtesting of the original program at the beginning of the year revealed that the unimodal approach (worksheets only) did not provide enough variety for sustained attention. Therefore, visual aids using colored pictures of coins were developed and incorporated into the lessons. These aids provide a realistic approach to change making since visual characteristics of real money are more closely approximated by the new aids than by the worksheets. Another revision reflects the need for procedures to remediate confusion between a nickel and dime, and a nickel and quarter. Data from the original program showed that this confusion was a common problem so new lessons were written, tested, and revised. Finally, it was found that the wording of the original lessons needed substantial revision for greater clarity.

In its revised form, the Coin Discrimination Program begins by teaching the student to visually discriminate between coins (penny, nickel, dime, quarter, and half-dollar) without attaching a label to them. The student then learns to name and label the penny and nickel. The dime is introduced after the penny and nickel. New visual aids (cards picturing the coins in different positions) were developed this year to facilitate discrimination. The student uses these aids, in addition to real coins and worksheets, to acquire the desired discrimination skills. He circles and names the coins on the worksheet as he learns them, and matches the real coins to the pictured coins on the aids.

Once again, the student works with real coins, pictures of coins, and worksheets. Skills are tested in a cumulative fashion so the student discriminates between and labels all three coins: penny, nickel, and dime. The quarter and half-dollar are introduced next. The student labels these coins using real coins, picture aids, and worksheets. With these aids, the student names and matches the coins. Finally, a criterion test is included to test the student's ability to identify the five coins on request.

In summary, the Coin Discrimination Program was rewritten this year to improve clarity of instructions, provide new aids to increase ease in discrimination, present new worksheets utilizing color cues (i.e., silver-colored coins vs. copper-colored penny), and include new remediation procedures. A varied mode of presentation (worksheets, actual coins, and visual aids) was found to increase the students' potential for better attending throughout the program. A series of new remediation lessons was also developed to help the student who experiences trouble discriminating between two specific coins (e.g., nickel and quarter). Finally, new data sheets were developed to fit on 5 x 8 inch cards.

Lesson Procedures and Materials: Bill Discrimination

The second section of the Make Change Series teaches students to discriminate and identify the one, five, ten, and twenty dollar bills. During the past year, major revisions were made in the wording of the lesson instructions and remediation sections. In addition, an improved method of matching bills with projected images of the bills was written into the lessons. Further fieldtesting allowed some parts of the lessons to be abbreviated with no observed decrease in performance by the students. Data sheets for this mini-program were revised to fit on 5 x 8 inch cards.

The Bill Discrimination Program begins by teaching the student to discriminate visually between the one, five, ten, and twenty dollar bills. The student matches real bills (presented both face and back side up) with color slides of the bills projected to the same size as the actual bills. The student first learns to name the one and five dollar bills as he matches them to their appropriate slides. Next, using the same procedures, the student learns to identify the ten, then the twenty dollar bills. Finally, a criterion test administered in the seventh lesson requires the student to identify the one, five, ten, and twenty dollar bills on request.

Lesson Procedures and Materials: Money Values

In this mini-program, students are taught to identify and write money value symbols (dollar and cent sign) and to use these signs in conjunction with actual numbers of cents and dollars. The student is also taught the equivalency of the various coins with their cents value --a penny is equal to one cent; a nickel is five cents, a quarter is twenty-five cents, and a half-dollar is fifty cents.

This year the Money Value Program underwent extensive revision to improve the sequencing of lessons and the actual content of many lessons because of error pile-up in initial fieldtesting of the original version. One lesson was replaced with several new lessons which teach, in increments, the skills of writing cent and dollar signs in isolation and in conjunction with actual money values. New worksheets were designed for the criterion test, the dollar writing section and the cents writing section. Also, the sequencing of several lessons was altered to maximize learning efficiency.

The first lesson of the Money Value Program reviews coin discrimination. The student then learns to identify and write the cent symbol (¢).

The student is also taught the value of each of the coins (a penny is one cent, a nickel is five cents, and so on up to fifty-cent pieces.) The student then learns to write the cent sign with the appropriate number of cents for each of the coins, using worksheets provided in the program. As the student learns to identify and write the money values for each of the coins, he also learns to name them by their appropriate money values.

After the student demonstrates proficiency in identifying and writing the money value of coins, he is introduced to the dollar symbol. He first learns to discriminate the symbol and then to write it in isolation. Finally, he learns the correct procedure for writing this sign in conjunction with numbers and place holders (e.g., $1.00, $5.00). The student also matches aids (depicting value symbols) to slides of the various bills and learns to identify any of the bills on a worksheet when the corresponding value is dictated to him. This mini-program concludes with a criterion test which assesses the student's recognition of each of the coins and bills, as well as his skill in writing the correct money value signs (¢ and $) in isolation and in conjunction with actual numbers of cents and dollars.

Lesson Procedures and Materials: Coin Combinations

The final mini-program in the series is the Coin Combinations Program. The purpose of this section is to teach students to use coins in all possible combinations to make change. This section is developed through coin combinations totaling twenty-five cents; it consists of twenty-six sequenced lessons plus four criterion tests.

Although some preliminary work on this section was accomplished during the 1972-1973 year, most of the lessons were developed during the past year, while previously written lessons were initially fieldtested. On the basis of the fieldtest results, several lessons were rewritten to include the use of actual coins, or a combination of written responses and coin placements, rather than written responses alone. The researchers found that rewriting in terms of the actual use of real coins not only added variety to the sequence, but gave the student important practice in the use of real coins in the learning of coin combinations. Many lessons were originally written for the use of coin face rubber stamps which were found to be expensive items requiring close monitoring in classroom use. These lessons were rewritten to introduce the use of actual coins in place of the rubber stamp, thus increasing the practicality of the program while decreasing its cost.

The Coin Combinations Program begins by teaching the student to add several pennies. The number of cents is increased by increments and, with each lesson in the program, practice is provided in writing the number of cents with both a cent sign (¢) and a decimal point (e.g., .04). The first few lessons teach coin combinations with pennies up to five cents. Then the value of a nickel is introduced and succeeding lessons teach adding pennies to a nickel. When all coin combinations up through ten cents have been taught using pennies and nickels, the dime is introduced and its value reviewed. Coin combinations to 15 cents using all previous possible coin combinations (pennies, nickels, and dimes) are then taught. In a like manner, coin combinations up through 25 cents are taught using all possible combinations of dimes, nickels, and pennies. Finally, the equivalency of a quarter and twenty-five cents is reviewed, and the criterion test is presented to assess mastery of all coin combinations up through twenty-five cents.

The final increments of a few cents per lesson proved practical for the slow learner who does not assimilate the change making process when larger steps are taken. The twenty-six lessons also seem appropriate for the student with poor adding skills who requires small increments and repetition that allows for over-learning. When the sequence was used in abbreviated form for more advanced students this year (several lessons being skipped occasionally), the data suggested that the program adapts well to such use. Thus, the program appears to meet the needs of handicapped students who have the requisite entry skills, yet widely varying abilities.

Initial Fieldtest Results: Coin Discrimination

Subjects. Two students completed the Coin Discrimination Program this year. One was an eleven year old boy considered to be learning disabled; the other was a thirteen year old boy categorized as mentally retarded. Both boys attended intermediate classes at the EEU.

Procedures. The Make Change Program was under the immediate supervision of Walter Berlin, one of the Team III interns. As program writer, Walter administered the Coin Discrimination program to both subjects. Several revisions were made in the lesson instructions because error pile-up occurred in the first administration. These revisions were incorporated into the lessons which were used in the second administration of the program with another child. These revised lessons provided all instructions used in the second administration (i.e., no further revisions were made).

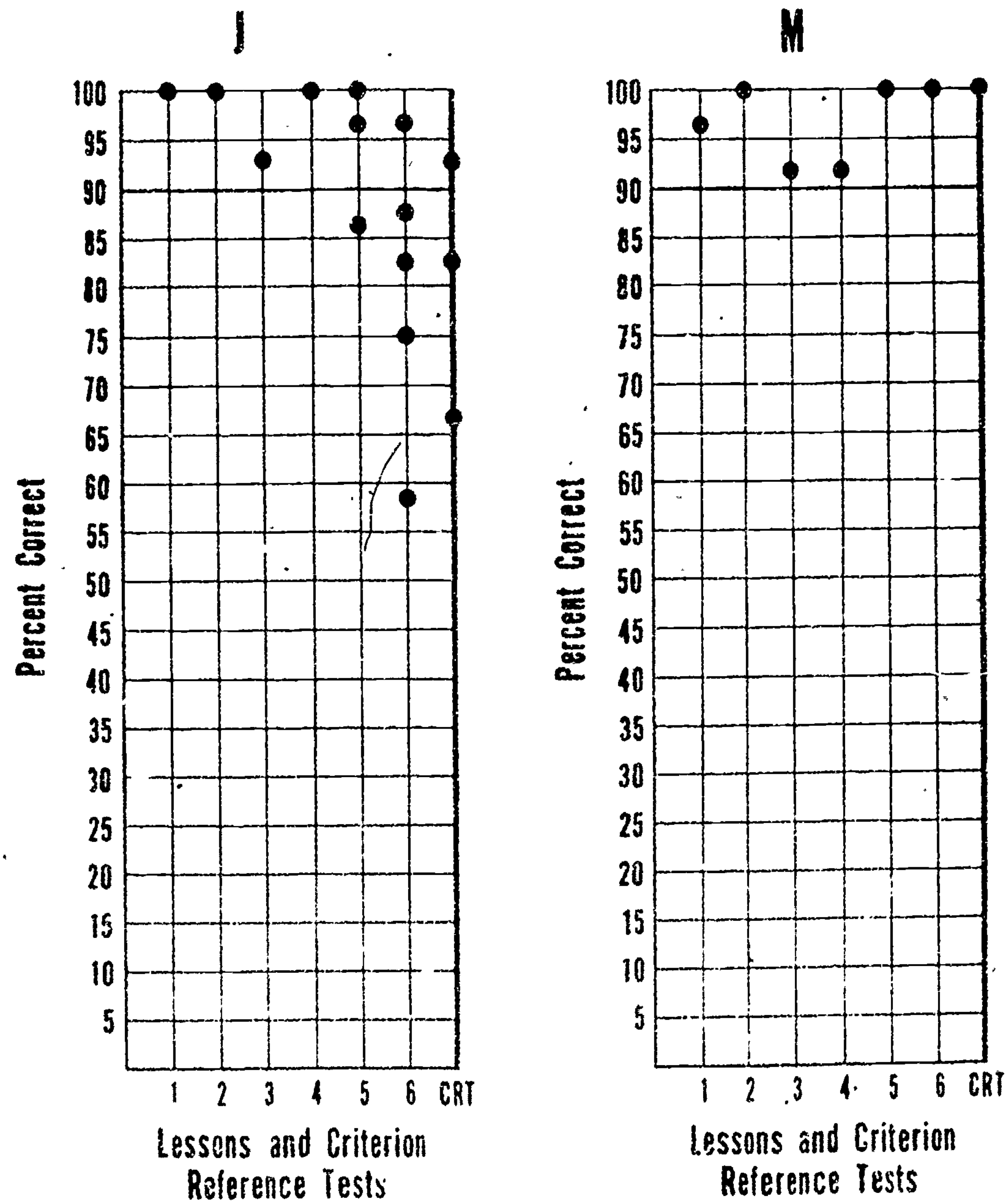
Results. The first subject to go through the revised Coin Discrimination Program (J.) scored above the 90% criterion level for correct responses on Lessons 1, 2, 3, and 4. However, errors exceeded 10% in Lessons 5 and 6 and the criterion test, so each of these had to be readministered several times before the student achieved a satisfactory level of performance. J.'s cumulative data are presented in Figure 22.

The revised lessons produced better results when they were administered to the second subject, M. (see Figure 22). M. completed the entire mini-program in eight lessons. Lesson #5 was administered twice; although the subject performed above the 90% criterion level, the programmer felt the student should be able to respond correctly at the 100% correct level on this lesson.

Discussion. The first phase of initial fieldtesting indicates that the revised Coin Discrimination sequence effectively teaches discrimination of the common coins used in our monetary system. Because the final revision was administered to only one student, it seems appropriate to continue the first phase of initial fieldtesting next year.

MAKE CHANGE PROGRAM: COIN DISCRIMINATION

Initial Fieldtest Data



Note: Scores are displayed for each administration of lessons which required more than one administration to meet criterion

Figure 22

Initial Fieldtest Results: Bill Discrimination

Subjects. Three students received instruction from this program. Two of these were the subjects involved in fieldtesting the Coin Discrimination sequence, and the third was a ten year old boy considered to be both learning disabled and emotionally disturbed. All attended intermediate classes at the EEU.

Procedures. During the first phase of initial fieldtesting, the Bill Discrimination program was administered three times -- twice by the program writer and once by the other Team III intern. The instructions provided in the six lessons and one criterion test determined all procedures. No additional instructions or materials were employed with the three subjects.

Results. Two subjects progressed through the program in seven sessions, never performing below the 90% correct criterion level. One subject, however, had to repeat both Lessons #3 and #4 when he scored below criterion (50%correct and 60% correct, respectively) on the first administration of these lessons. The data for these three subjects are presented in Figure 23.

Discussion. The data from the first phase of initial fieldtesting indicate this program is effective in teaching bill discrimination. Students found the mode of presentation (slide projection) to be of high interest, and several students asked to have the program lessons repeated immediately after the first run-through. The Bill Discrimination Program is now ready to begin the second phase of initial fieldtesting at the EEU, with particular attention being paid to Lessons #3 and #4.

Initial Fieldtest Results: Money Values

Subjects. Five students participated in this program: the three who served as subjects in the Bill Discrimination Program, a twelve year old boy considered to be learning disabled, and an eleven year old, emotionally disturbed boy. All attended classes at the EEU.

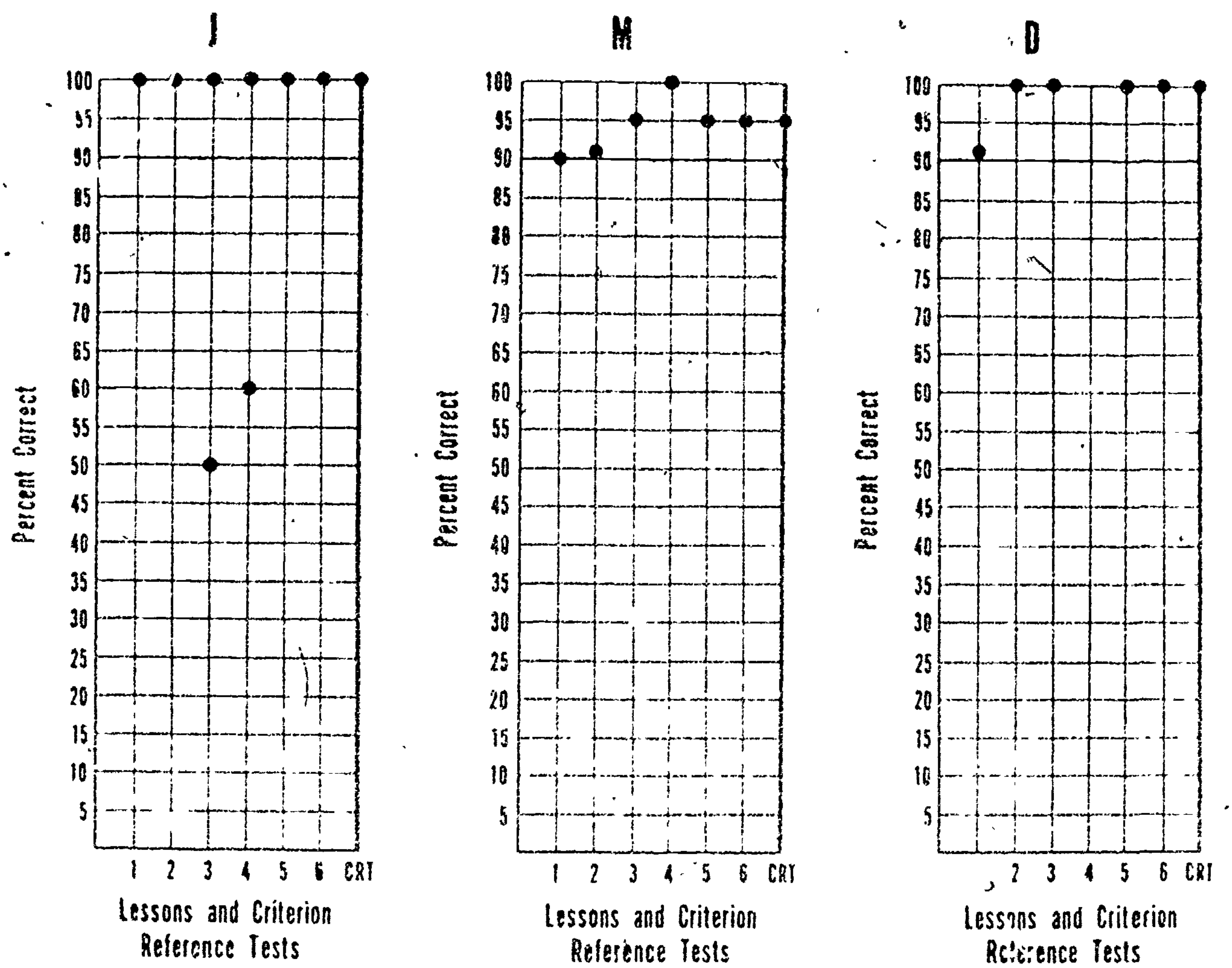
Procedures. The program writer administered this mini-program to the first two subjects. The program was then administered once by an undergraduate student and twice by the other Team III intern. In all cases, only the program lessons were used. No additional information or instructions were provided.

Results. All subjects achieved 90% correct or higher on each lesson of this mini-program. In several instances, however, this score was achieved only after the second administration of a lesson. The mean data for these five subjects are presented in Figure 24. The highest and lowest percent correct achieved is also included for each lesson.

Discussion. The cumulative data reveal the high level of performance by these five students, despite their initial disparity in age and diagnostic category. Thus the data indicate that this mini-program is effective for a wide range of students as long as they possess the necessary entry skills.

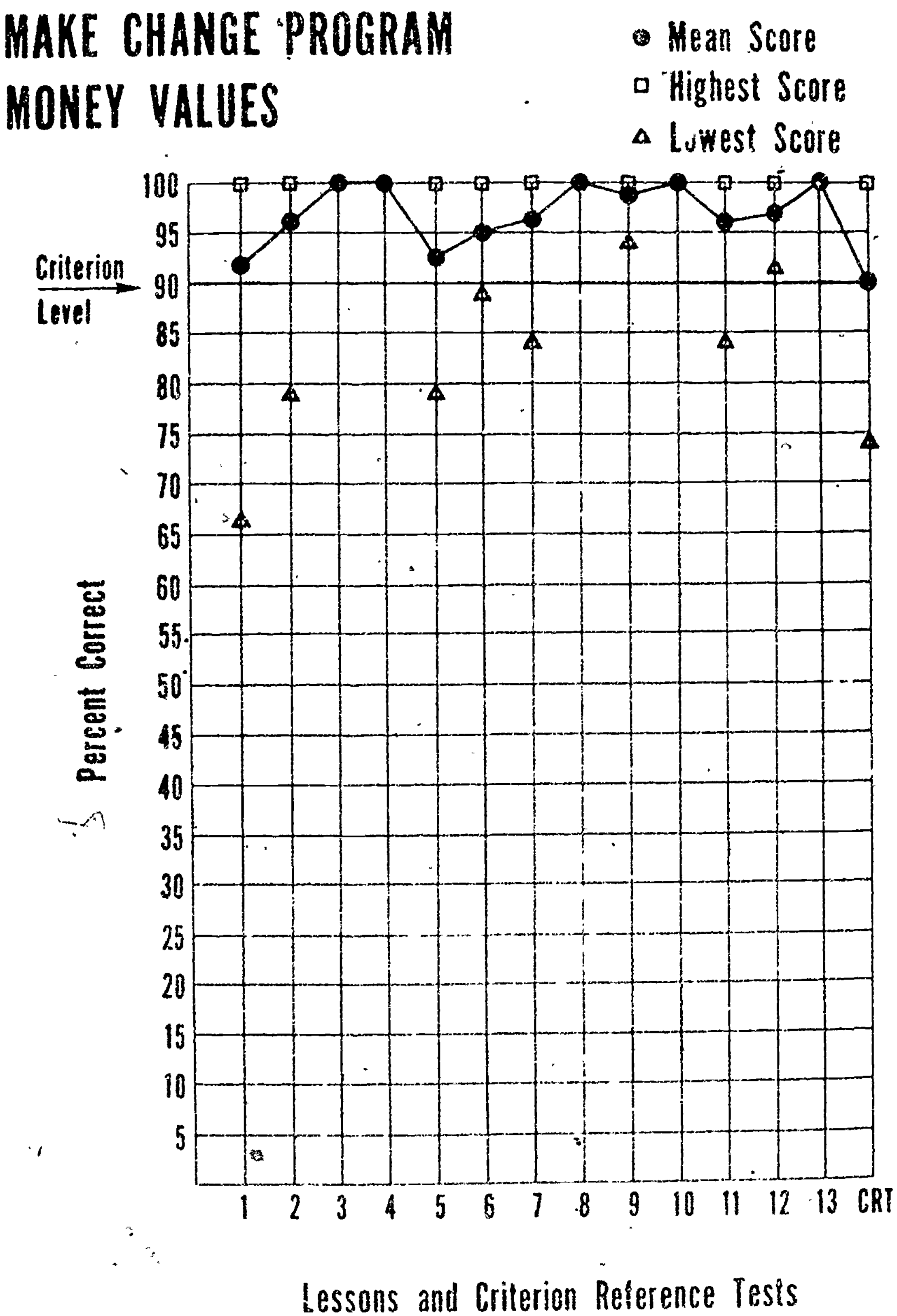
MAKE CHANGE PROGRAM: BILL DISCRIMINATION

Initial Fieldtest Data



Note: Scores are displayed for each administration of lessons which required more than one administration to meet criterion

Figure 23



Summary of Initial Fieldtest Data for Five Subjects

Figure 24

The Money Values Program is now ready to enter the second phase of initial fieldtesting. During this stage, particular attention will be paid to those lessons in which there was a wide range in student performance as shown in Figure 24.

Initial Fieldtest Results: Coin Combinations

Subjects. Four students participated in the first phase of initial fieldtesting for this section of the Make Change Program: the three subjects involved in the fieldtesting of the Bill Discrimination Program, and the twelve year old learning disabled boy who participated in the Money Values Program. All were students in intermediate classrooms at the EEU.

Procedures. The lessons were administered to the first two students by the program writer. The other Team III intern served as instructor for the third student, and an undergraduate student conducted the fourth administration. This last administration was not completed, due to the closing of school for summer recess. Therefore, after Lesson #8, data are available for only three subjects. In all cases, the procedures and materials used were those included in the 26 lessons and 4 criterion tests which compose this mini-program. Any additional instructions were incorporated in subsequent rewriting of lesson frames and are included in the revised lessons for this mini-program.

Results. The results of this phase of initial fieldtesting for the revised Coin Combinations Program are presented in Figure 25. Again, all students achieved criterion for each lesson taught, but in two cases a second administration was needed to achieve this 90% correct level on Lessons 1 and 26. Correct performance remained above 90% on all other lessons, as well as the four criterion tests.

Discussion. The very high level of performance by the four students, as shown on the cumulative data chart, indicates that the program provides students continued success in learning to make change. The four subjects involved in this first phase of initial fieldtesting represented a variety of chronological ages and diagnostic categories. It appears that this lesson sequence is appropriate for teaching change making skills up through twenty-five cents to students who possess the requisite entry skills.

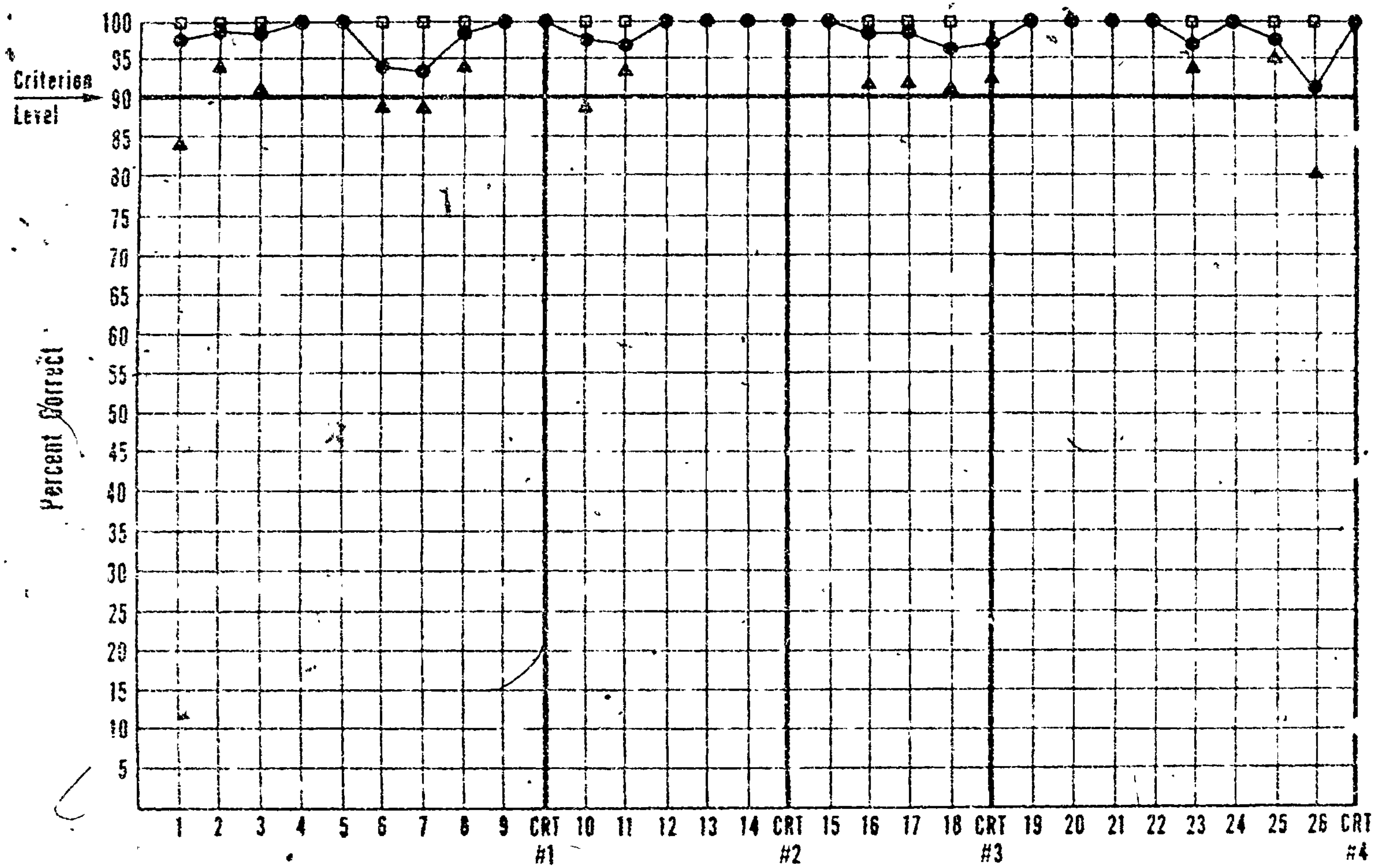
Since three subjects have successfully completed the entire Coin Combinations mini-program, these lessons will be submitted to the second phase of initial fieldtesting at the EEU in the Fall.

Current Status

After substantial revision, the entire Make Change Program was developed through the first phase of initial fieldtesting during the past year. Thus, the four mini-programs which constitute this series will be submitted to the second phase of initial fieldtesting at the EEU next year. Because a new program writer will take responsibility for this program in the fall, some additional first-phase initial fieldtesting may also be desirable.

MAKE CHANGE PROGRAM
COIN COMBINATIONS

● Mean Score
□ Highest Score
△ Lowest Score



Summary of Initial Fieldtest Data for Four* Subjects

* After Lesson 8 Three Subjects

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The Time Telling Program

Terminal Goal and Target Population

The terminal goal of the Time Telling Program is to teach students to read the time from a conventional clock (i.e., not a digital clock) to the nearest whole minute. In this program, the student is taught to use not only the formal "hour:minute" convention for expressing time, but also such commonly accepted phrases as "half past" and "quarter to".

This instructional program is intended for use with any student who does not know how to use or tell time and who possesses the following requisite entry behaviors:

1. Number recognition 1 - 59
2. Rote count 1 - 59
3. Write numbers sequentially 1 - 59
4. Count by 5's to 60
5. Count by 10's to 60
6. Discriminate between red and black

In order to assure the utility of this program with students who have general or specific learning disabilities, the lessons were designed to allow for substantial overlearning and frequent review. Supplemental remediation procedures are provided for students who need this extra assistance.

Skill Sequence

The lessons in the Time Telling Program follow the sequence of skills identified through the task analysis graphically displayed in the lattice for Time Telling (Figure 7). This lattice represents an abbreviation of the larger lattice constructed by Team III last year, which had a terminal goal of "Understanding Time" (Figure 26). Considerations of research priorities and limited time dictated the decision to omit the "understanding time" component from the instructional program developed by Team III. In all other respects, this program directly corresponds to the skill sequence displayed in the lattice for Time Telling.

Pretest Procedures

The pretest for the Time Telling Program serves two functions. First, it assesses a student's basal skill level. Second, the pretest indicates where the student should be placed in the program, if the need for advanced placement is indicated by the pretest data.

The pretest consists of nine sections and requires approximately 15 minutes to administer. Specific questions answered by each of these sections are:

1) Can the student identify the numbers from 1 to 12?
2) Can the student count from 1 to 12?
3) Can the student write the numbers from 1 to 12?
4) Can the student count by tens from 10 to 50?

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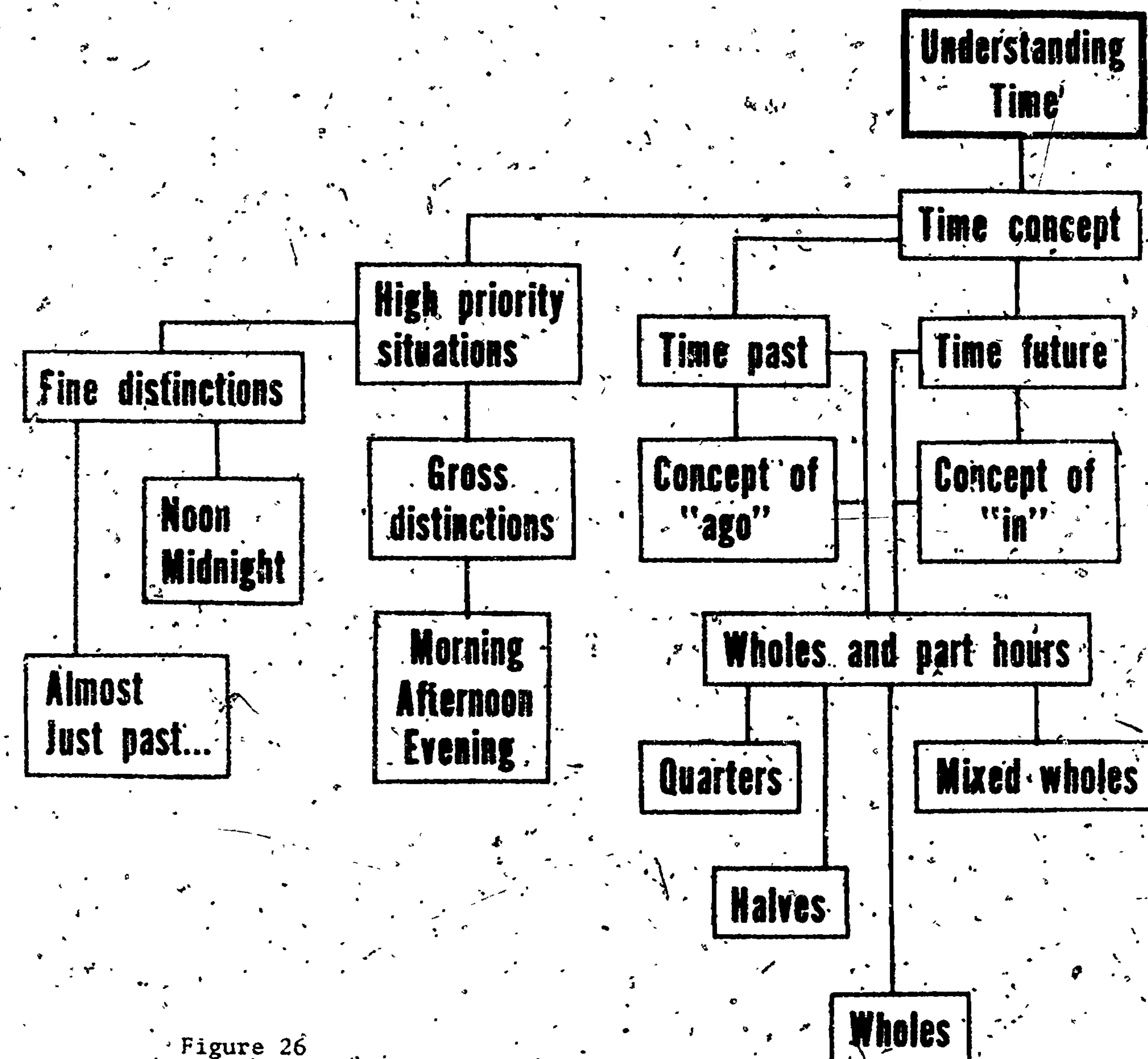

Understanding Time
Time concept
High priority situations
Time past
Time future
Fine distinctions
Gross distinctions
Concept of "ago"
Concept of "in"
Noon Midnight
Morning Afternoon Evening
Wholes and part hours
Almost Just past...
Quarters
Mixed wholes
Halves
Wholes

Figure 26

5) Can the student count by fives from 5 to 55?
6) Can the student identify the numbers from 5 to 55 by fives?
7) Can the student identify the hour and minute hands?
8) Can the student identify the times shown on clocks set to different intervals of five minutes after each of the hours?
9) Can the student write the times shown on clocks set to different intervals of five minutes after each of the hours?

During the past year, the Time Telling pretest underwent substantial editing for the purpose of condensing and clarifying teacher directions for scoring and interpreting results of a student's performance. The data sheets for the pretest were also revised to fit on 5 x 8 inch cards because the original forms proved too cumbersome and obtrusive. No revisions were made in the actual content of the pretest sections.

Lesson Procedures and Materials

The Time Telling Program consists of five sections corresponding to the major subgoals of the lattice for this skill. The Clock Hand Discrimination section consists of 3 lessons which teach the student to identify the hour and minute hands. The Hour Hand section, comprised of 6 lessons, focuses on the hour hand in isolation. The next section of 20 lessons, Minute Hand, teaches the minute hand, to the nearest whole minute, in isolation. The 6 lesson Time section teaches students to tell time using both the hour and minute hands. The final section, Gross Minute, consists of 5 lessons which teach the use of non-exact phrases for expressing time.

The teacher's manual was carefully edited this year to achieve greater clarity in the wording of directions for the administration of these 40 lessons. No changes were made in the actual content or sequencing of the lessons.

The time telling program's data collection and data display systems were modified this year. The need for a more convenient and compact instrument for response recording was identified during the initial fieldtesting of the program. As a result, the large 3 column data sheet was replaced by a new system which allows the administrator to record responses on 5 x 8 inch cards. These data cards are sufficiently rigid and small enough to be scored in the teacher's lap. They have proven so satisfactory that they have been adopted for most of Team III's instructional programs.

Analysis of initial fieldtest data indicated that many students demonstrated two distinctly different patterns of correct responding--responses elicited in a one-to-one tutorial situation, and those produced independently on written worksheet tasks. Therefore, two separate percent graphs are used to display the cumulative data for these distinct modes of responding. The form developed to display this information is presented in Figure 12.

In addition to the teacher's manual, the Time Telling Program package consists of a student workbook and numerous aids. These materials represent a carefully developed and tested sequence of color and number cues which are gradually faded as the student progresses through the lessons. Prior to the opening of school last fall, these materials had been produced in large numbers by the media department at EEU. Because the aids serve such a critical role in the program, one more initial fieldtesting was conducted using the professionally produced versions of the worksheets and clock aids. The purpose of the additional fieldtest was to check for any change in effectiveness caused by this production process.

Initial Fieldtest Results

Subjects: At the beginning of the year, two students were selected from EEU classrooms to serve as subjects for the last in-house fieldtesting of the Time Telling Program. One of these, an eleven year old boy with Down's syndrome, attended an intermediate classroom. The other student was a nine year old girl diagnosed as emotionally disturbed. By teacher request, the program was also administered to several students in intermediate and secondary classes at the EEU. All subjects possessed the requisite entry behaviors, but lacked the time telling skills taught in this program.

Procedures. The program was administered to two students by Dr. Deborah Smith, the program's writer. Additional administrations were conducted by classroom teachers at the EEU. Procedures specified in the program lessons were adhered to strictly and no additional instructions, materials or reinforcement were employed.

Results. The two subjects of this fieldtesting performed consistently at or above the 90% correct criterion level on all lessons administered. One of these students did not complete the program because she was withdrawn from the EEU to return to a regular class. The other subject completed the sequence, although the exact minute lessons were omitted since he lacked the prerequisite counting skills.

The teachers who administered the Time Telling Program in their own classrooms reported that their students successfully completed the lesson sequence. Several of these teachers have requested the additional materials needed to implement this program with more of their students.

Discussion. The Time Telling Program was developed through the second phase of initial fieldtesting during the 1972-73 academic year. However, the mass production of materials for dissemination to secondary fieldtest sites necessitated the use of a production process different from that used to prepare the original set of instructional materials for this program. Before distributing the instructional program packages for secondary fieldtesting, the program writer decided to administer the program, using these new materials, to two more subjects at the EEU. Also, several EEU teachers administered the program to students in their classes.

The results indicated that the new materials, used in conjunction with the program lessons, are effective in teaching the skill of time telling to students possessing the requisite entry behaviors. Furthermore, the program was enthusiastically received by those teachers at the EEU who employed it in their own classrooms this year. Therefore, the program lessons were submitted to final editing, and the teacher's manuals and new data/cards were prepared for mass production.

Current Status

The initial fieldtest stage of development was completed for the Time Telling Program this year. Instructional materials and student workbooks were produced in sufficient quantity for secondary fieldtesting and sites for this fieldtesting were selected. However, delays encountered in the production of teacher's manuals and data cards prevented the program from entering the public schools this year. Secondary fieldtesting will begin as soon as schools re-open in the fall.

Clothes Fastening Program

Terminal Goal and Target Population

The terminal goal of the Clothes Fastening Program is to enable a student to develop sufficient proficiency in the fastening skills of buttoning, unbuttoning, zipping, unzipping, snapping and unsnapping to apply these skills to his everyday dressing and undressing needs. In order to teach these skills, three mini-programs were written. These programs and their respective terminal goals are: (a) zipping--to independently zip and unzip the front closing of a garment while it is being worn; (b) snapping--to independently snap and unsnap the front closing of a garment while it is being worn; and (c) buttoning--to independently button and unbutton the front closing of a garment while it is being worn.

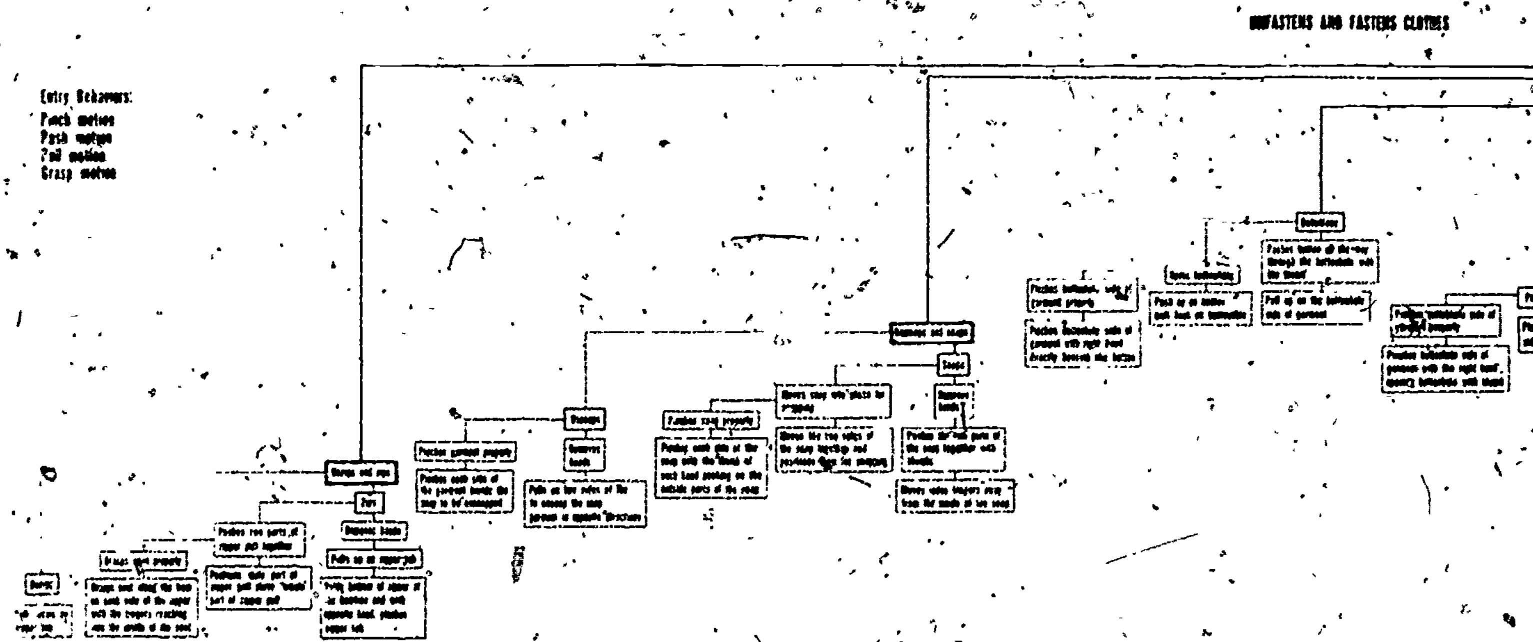
This instructional program is intended for use with students who have failed to learn these fastening skills, but possess the following entry behaviors: can pinch, can pull, can push, can grasp, and can imitate.

Skill Sequence

The lessons in this program correspond to the specific component skills identified through a systematic task analysis. This skill sequence is displayed in the lattice for "Unfastens and Fastens Clothes" (see Figure 27).

The present instructional program does not encompass every major subgoal along this lattice ridgeline. The specific lattice segments which correspond to each of the three mini-programs are presented in Figures 28, 29, and 30.

The relative efficacy of forwards versus backwards chaining of these fastening skills has not yet been fully determined. It seems that the backwards chaining approach to programming will be most effective for these fine motor skills. If this proves to be the case, the final lesson sequence will represent a reversal of portions of the lattice sequence (i.e., the last step in a particular motor chain would be taught first, etc.), as is the case with the Shoe Tie Program.



UNFASTENS AND FASTENS CLOTHES
Entry Behaviors:
Pinch motion
Push motion
Pull motion
Grasp motion

Figure 27

UNFASTENS AND FASTENS CLOTHES

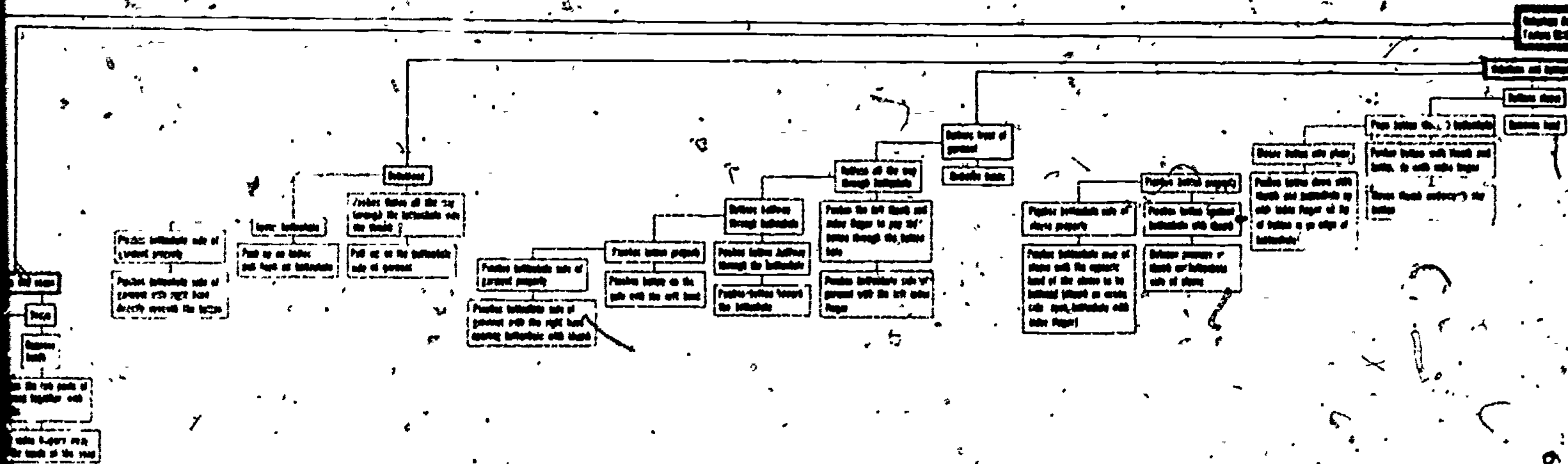


Figure 27

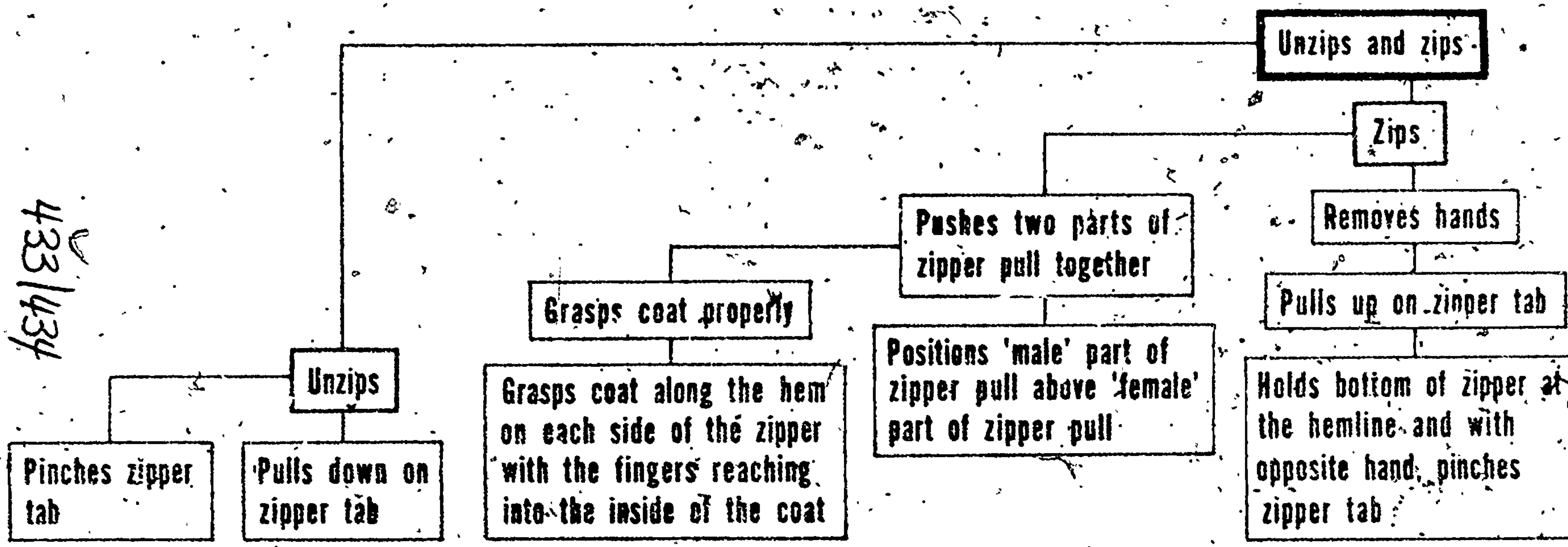

Unzips and zips
Zips
Removes hands
Pulls up on zipper tab
Holds bottom of zipper at the hemline and with opposite hand, pinches zipper tab
Pushes two parts of zipper pull together
Positions 'male' part of zipper pull above 'female' part of zipper pull
Grasps coat properly
Grasps coat along the hem on each side of the zipper with the fingers reaching into the inside of the coat
Unzips
Pulls down on zipper tab
Pinches zipper tab

Figure 28

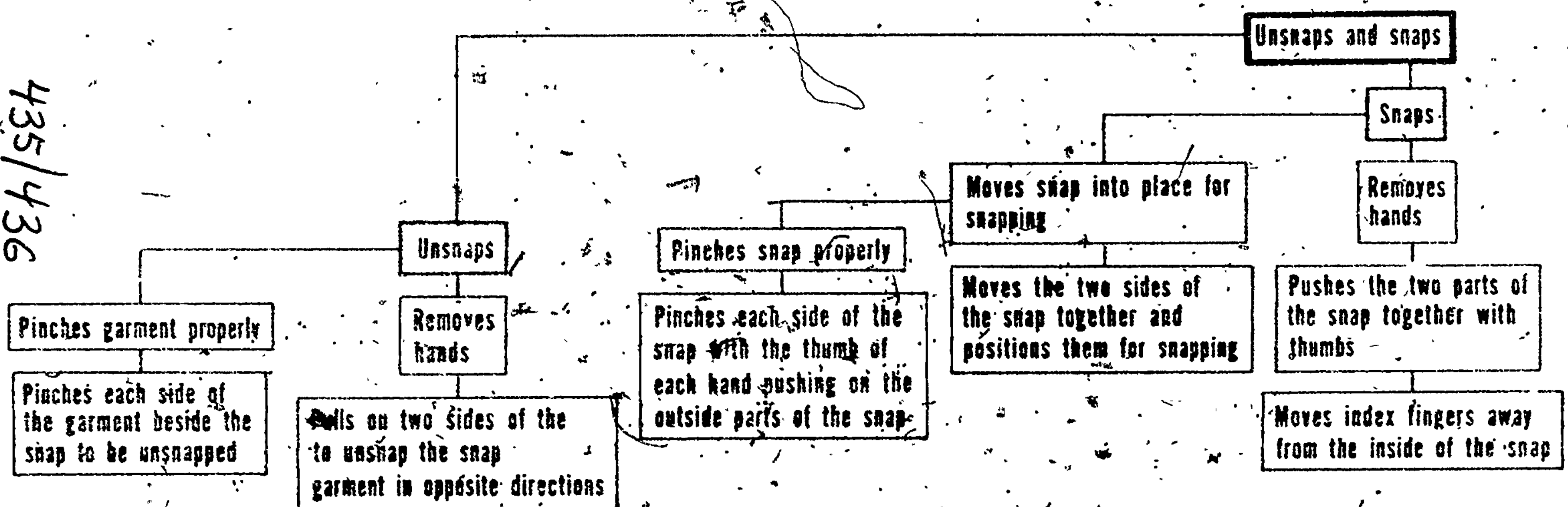
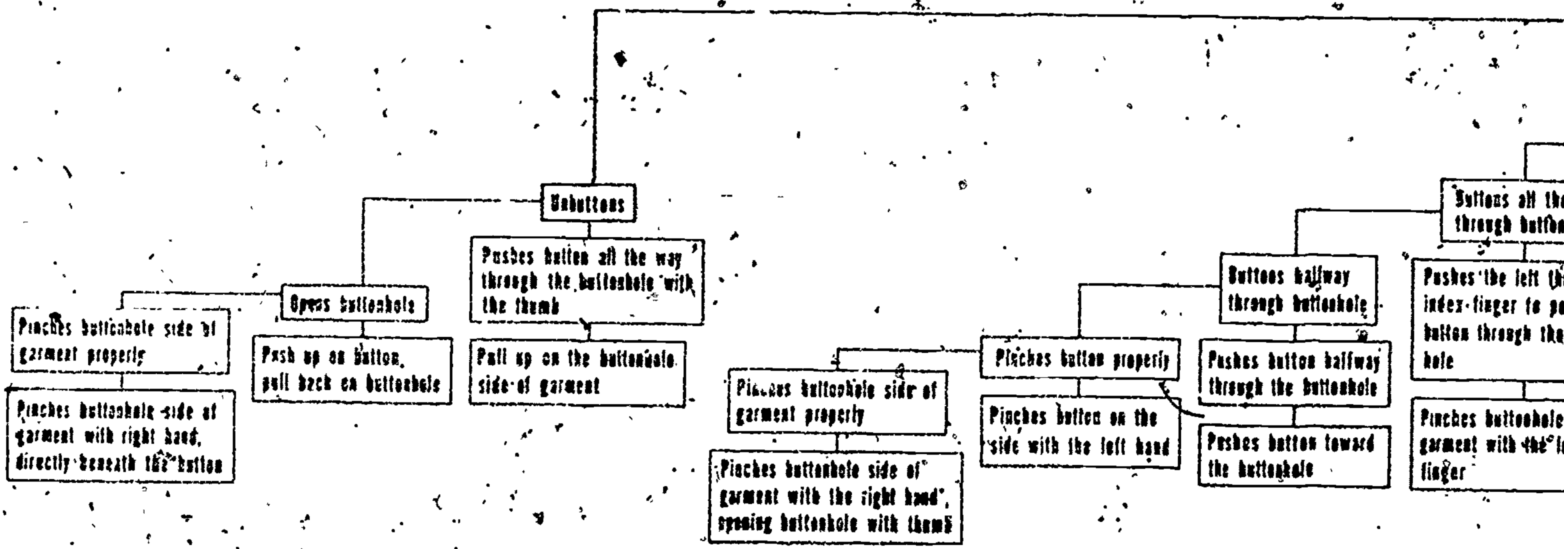

Unsnaps and snaps
Snaps
Removes hands
Pushes the two parts of the snap together with thumbs
Moves index fingers away from the inside of the snap
Moves snap into place for snapping
Moves the two sides of the snap together and positions them for snapping
Pinches snap properly
Pinches each side of the snap with the thumb of each hand pushing on the outside parts of the snap
Unsnaps
Removes hands
Pulls on two sides of the to unsnap the snap garment in opposite directions
Pinches garment properly
Pinches each side of the garment beside the snap to be unsnapped

Figure 29



Unbuttons
Opens buttonhole
Pushes button all the way through the buttonhole with the thumb
Pinches buttonhole side of garment properly
Push up on button, pull back on buttonhole
Pull up on the buttonhole side of garment
Pinches buttonhole side of garment with right hand, directly beneath the button
Pinches buttonhole side of garment properly
Pinches buttonhole side of garment with the right hand, opening buttonhole with thumb
Pinches button properly
Pinches button on the side with the left hand
Buttons halfway through buttonhole
Pushes button halfway through the buttonhole
Pushes button toward the buttonhole

Figure 30

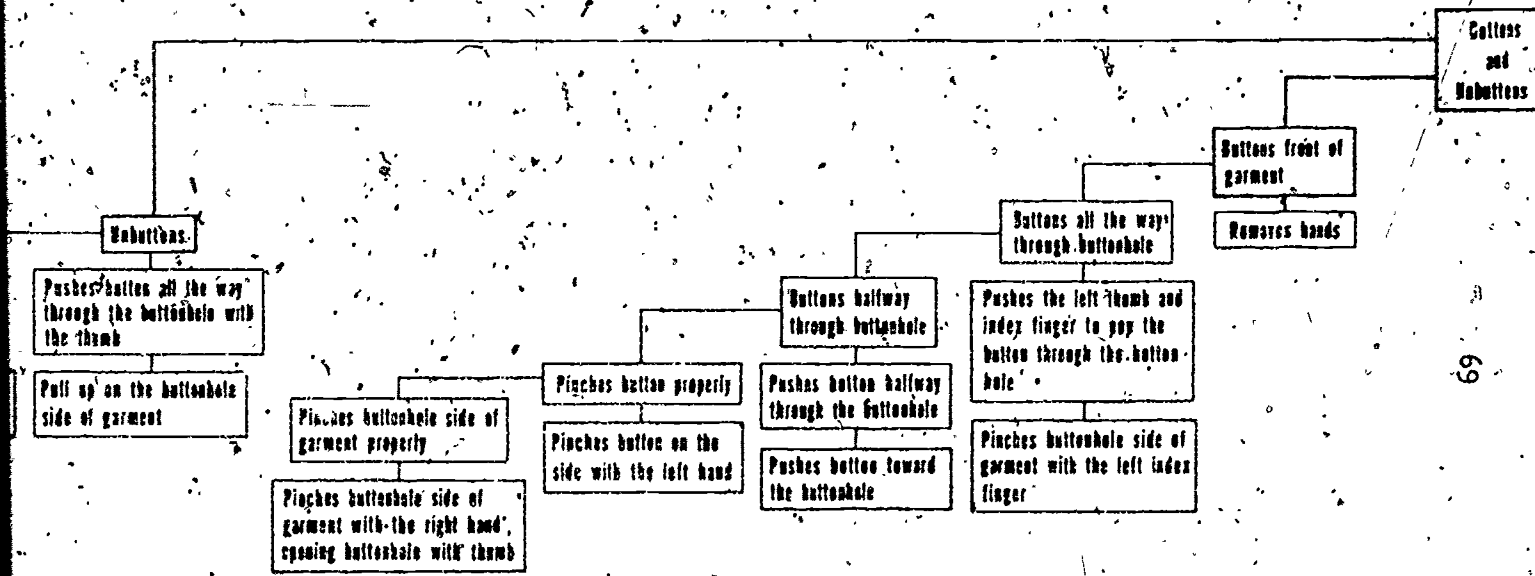

Buttons and Unbuttons
Unbuttons
Pushes button all the way through the buttonhole with the thumb
Pull up on the buttonhole side of garment
Buttons front of garment
Removes hands
Buttons all the way through buttonhole
Pushes the left thumb and index finger to pop the button through the button hole
Pinches buttonhole side of garment with the left index finger
Buttons halfway through buttonhole
Pushes button halfway through the buttonhole
Pushes button toward the buttonhole
Pinches button properly
Pinches button on the side with the left hand
Pinches buttonhole side of garment properly
Pinches buttonhole side of garment with the right hand, opening buttonhole with thumb

Figure 30

Pretest Procedures

The pretest for the Clothes Fastening Program enables the administrator to decide where to place a student in the program, or if a student already possesses all the fastening skills, not to place that student in the program at all. As presently written, the Clothes Fastening pretest consists of seven sections which can be administered in approximately 15 minutes. The specific questions answered by each of these sections are:

1) Can the student fasten and unfasten his own coat?
2) Can the student discriminate a coat from other items of clothing?
3) Can the student point to the parts of his body which are referred to in the verbal directions for this program (i.e., arm, elbow, hand, and head)?
4) Can the student imitate the teacher's gross motor movements using arms and head?
5) Can the student zip, snap, and button the appropriate fastening vests?
6) Can the student string three beads with either hand (i.e., does he possess the fine motor skills of pushing and pulling, as well as the eye-hand coordination necessary for clothes fastening)?
7) Can the student stand upright for the period of time required to complete the tasks for this pretest?

This program was conceptualized during the past year and is currently in the first stages of initial writing and fieldtesting; therefore, the pretest described here is tentative. It is uncertain whether the skill assessed in section P-7 (standing upright for an extended period of time) is needed for successful learning of fastening skills. The criteria for adequate proficiency in fine motor and eye-hand coordination, as assessed through a bead stringing task, have not yet been specified for this program.

Lesson Procedures and Materials

The Clothes Fastening Program consists of three mini-programs, all of which were conceptualized and written during the past year. Instructional materials for these programs were also designed and constructed this year. At present, the entire program consists of 17 lessons.

Zipping Program. The Zipping Program is comprised of five lessons. The first teaches the student how to push the slider down to the end of the zipper track. In the second lesson, the student engages the zipper by himself, and in the third he zips it up and sets the talon so it locks. In the fourth lesson, the student unlocks the talon, unzips the zipper and disengages it. As presently written, these first four lessons call for the student to perform the tasks on a zipper board, an instructional aid found in many preschool and kindergarten classrooms. The fifth lesson calls for the student to apply the skills taught in the first four lessons to zipping and unzipping the front closure on a specially designed vest with a large, jacket-type zipper.

Snapping Program. The Snapping Program was also written as a five-lesson sequence. The first four lessons call for the use of a snapping board. On this board, the student first learns to press the snap closed after it has been correctly positioned by the administrator. In the second lesson, the student learns the correct method of grasping the two sides of a snap closure and completes the snapping process. In the third lesson the student must correctly position the two sides of the snap closure and complete the entire chain. In the fourth lesson, the student learns to unsnap the board. Finally, in the fifth lesson, the student wears a specially designed vest and applies these skills to the snapping and unsnapping of the vest.

Buttoning Program. This mini-program consists of six lessons and one criterion test. The first three lessons involve the use of a button board and teach the following skills: 1) completing the buttoning process by pulling through each of three buttons (inserted in the button holes by the instructor); 2) holding the two sides of the button closure correctly and completing the buttoning process (after the instructor has positioned the two sides); and 3) independent buttoning of all three buttons. In the next two lessons, this sequence is repeated as the student wears a specially designed button vest with a front closure consisting of three large buttons. The sixth lesson teaches the student to unbutton the vest and requires him to demonstrate mastery of this skill by correctly unbuttoning three consecutive times.

Several major questions about this instructional program remain unanswered. First, the relative efficacy of forwards chaining (used in the lesson sequence for zipping) and backwards chaining (used in the lesson sequences for snapping and buttoning) needs to be determined. Additionally, there is a need to investigate the efficiency of teaching these skills on fastening boards before teaching the student to fasten a garment while it is being worn. The original mini-programs incorporated these boards because of their common availability in many classrooms. Since the visual and kinesthetic perspective involved in fastening on a board is quite different from that gained when fastening on the front of one's own body, problems encountered in transferring these skills from board to vest may outweigh the advantages of first learning to perform these skills on a fastening board. Finally, due to the learning characteristics of the target population for this program, it may be impractical to assume generalization from a vest to the child's own clothing. Therefore, these mini-programs may need to be expanded to include specific instruction on different types and weights of clothing, sizes of fasteners, and construction of fasteners (e.g., nylon vs. metal zippers).

Initial Fieldtest Results

Subjects. Eight students served as subjects in the first phase of initial fieldtesting for the Clothes Fastening Program. These students, all 5 years old, were selected from the EEU's Preschool for developmentally delayed children and the Down's Syndrome Kindergarten. All demonstrated the necessary entry behaviors but did not have the fastening skills taught by this program.

Procedures. Lessons for each miniprogram were written to correspond to the sequence of steps identified through task analysis and displayed in the lattice for Clothes Fastening. As this was the first phase of initial fieldtesting, the lessons were revised and rewritten on a daily basis in accordance with student performance data.

Results. In initial fieldtesting, student performance was highly erratic and error pile-up was often encountered. This is not uncommon for the first version of any instructional sequence and, in fact, is the raison d'etre for Team III's highly structured approach to instructional program development. On the basis of the data collected, the lessons in this program have been substant [illegible] frequently rewritten. As yet, no student has satisfactorily com [illegible]s program sequence; therefore, no data will be presented here.

Discussion. Initial fieldtest results have raised many questions about the sequence and materials employed in these mini-programs. A modified version of the program, substituting the use of fastening vests for the fastening boards called for in many lessons, will be included in the next fieldtesting. Additionally, the merits of forwards and backwards chaining of these skills will be carefully analyzed through further fieldtesting.

Current Status

The Clothes Fastening Program is in the first phase of initial fieldtesting. Because of the relative brevity of the three mini-program which make up this program, it is anticipated that the first phase can be completed by the end of Summer Quarter. Therefore, the program should be ready for the second phase of initial fieldtesting when school reopens in the fall. Thus, it is reasonable to expect the Clothes Fastening Program to enter the secondary fieldtest stage next winter.

The Ruler Measurement Program

Terminal Goal and Target Population

The terminal goal of the Ruler Measurement Program is to teach the correct use of a 12 inch ruler. The threefold goal is to teach the student to use the ruler in three ways: 1) measure line segments; 2) rule paper; and 3) divide line segments into equal parts. The program is intended for use with any student who lacks these ruler measurement skills but who possesses the necessary entry behaviors.

The prerequisite skills for the first six sections of the program are: grasp motion; turn motion; count and identify numbers from 1 to 12; precise use of pencil; identify ruler; concept of top and bottom; concept of fractions; write fractions, 1/8, 1/4, 1/2. A supplemental lesson sequence was written this year to teach these fraction skills to students possessing the other entry behaviors. With these skills, a student may enter the sections which teach measuring line segments and ruling paper; however, these skills are not sufficient to meet the goals of the final two sections. The student must show proficiency in simple division by two and four to enter the final sections on dividing line segments. The program is written so that even those students who lack the skills necessary to complete the last two sections may enter and complete the first six sections.

Skill Sequence

The eight sections of the Ruler Measurement Program (indicated by the criterion tests) correspond to the major subgoals along the ridgeline of the lattice for Uses Ruler, presented in Figure 31. Similarly, the content and arrangement of the individual lessons follow the sequence of skills or enroute objectives identified in the initial task analysis. The first three sections teach the student to measure line segments to the nearest 1/2, 1/4, and 1/8 inch, using a 12 inch ruler. The next three sections teach the student to rule lines on a blank sheet of paper in the same place as the lines already drawn on a model. The final two sections teach the student to divide line segments into halves and fourths. The student may not enter any of these sections until he masters the skills taught in the preceding sections.

Pretest Procedures

The information collected through the pretest for the Ruler Measurement Program answers the following questions:

1) Does the student possess the fine motor control to grasp and turn a ruler?
2) Is the student able to count from one to twelve?
3) Is the student able to identify the numbers from one to twelve both sequentially and out of order?
4) Does the student possess the fine motor control to manipulate a pencil through precision tasks?
5) Does the student understand the concepts of top and bottom?
6) Does the student understand the concept of fractions?
7) Can the student write fractions?
8) Does the student have simple divison skills?
9) Does the student understand the concept of the starting and ending points of a line segment?
10) Is the student able to mark off 1 inch, 1/2 inch, 1/4 inch, and 1/8 inch increments of a line using a ruler?
11) Is the student able to measure line segments to the nearest inch, 1/2 inch, 1/4 inch, and 1/8 inch?
12) Is the student able to rule paper?
13) Is the student able to divide line segments?

An affirmative response to each of the first seven questions is prerequisite to the student's entry into the program. Question 8 refers to the additional entry behavior needed for placement in the last two sections of the program. The last five questions correspond to the major skills taught in the program.

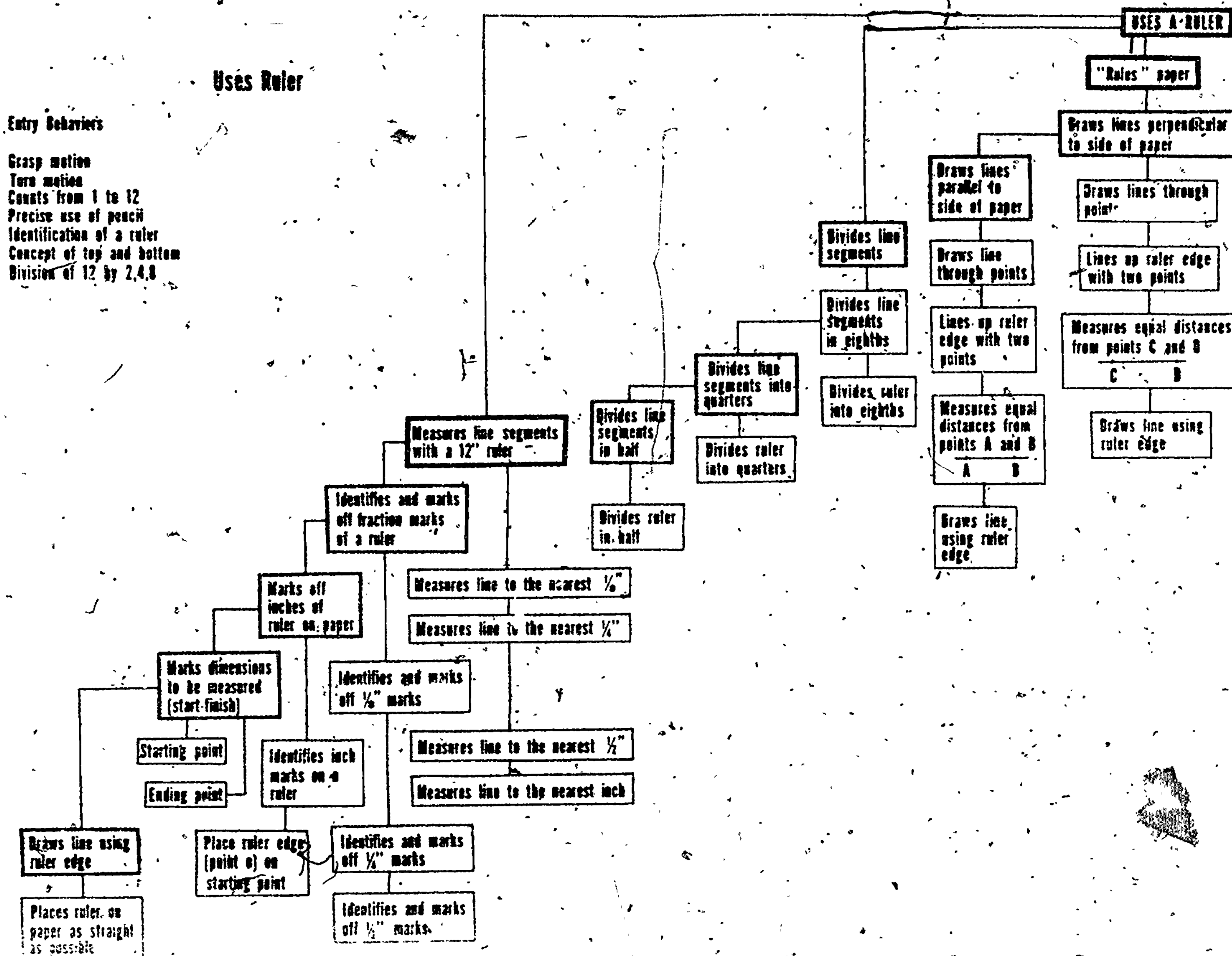
Lesson Procedures and Materials

The Ruler Measurement Program, written during the 1972-1973 academic

Uses Ruler

Entry Behaviors

Grasp motion
Turn motion
Counts from 1 to 12
Precise use of pencil
Identification of a ruler
Concept of top and bottom
Division of 12 by 2,4,8



year, consists of 36 lessons and 8 criterion tests. The criterion tests, spaced throughout the sequence, assess a student's mastery of specific skills taught in preceding lessons. Successful completion (at least 90% correct) of each criterion test is required before a student may progress to succeeding lessons.

The lessons are written in the three column format described earlier and are intended for administration on a one-to-one basis. The program includes the use of two different types of instructional materials: non-consumable aids (plasticized models and a sequenced set of plastic rulers), and approximately 150 consumable worksheets.

On the basis of the second phase initial fieldtest data, several aspects of the Ruler Measurement Program were revised this year. However, neither the number nor the format of the lessons was altered significantly.

To increase clarity, the teacher's directions were revised. Many remediations were added for lessons in which specific student errors were repeatedly encountered. Additionally, division skills were no longer considered prerequisite to entry into the program. A student not having these skills, but meeting the other prerequisites, is given instruction in the first six sections which cover measuring line segments and ruling paper. Thus students can enter and complete the program without having contact with the final sections. Finally, the student responses were revised in many instances. The researchers found that breaking multiple responses down into their component parts facilitated the administration of the program.

Several new materials were developed this year. These materials included a few replacements for dot-to-dots, and more importantly, the revision of three aids: L-13a, L-16a, and L-19a. The originals consisted of divided aids: one with 1/2 inch increments, one with 1/4 inch increments, and one with 1/8 inch increments. Each new inch was initiated with a colored space. The lines separating the spaces were as long as the width of the aid.

The researchers found that the lines (all the same length, equating the width of the ruler) separating the spaces were confusing to the student. The student was unable to distinguish between the 1, 1/2, 1/4, and 1/8 inch increments. The researchers also found that the colors were unnecessary in recognizing spaces.

The new aids show lines of differing lengths separating the spaces. The lengths correspond to the size of the increment, e.g., the longest line designates 1 inch, and the shortest line designates 1/8 inch. This format is the same as that found on a regular 12 inch ruler. The length increment of interest is set apart by darkening its boundary lines. Thus this ruler aid establishes increment size and is easily faded out to be eventually replaced by a regular ruler.

The systems for data collection and display employed in the Ruler Measurement Program were also refined this year. In the interest of greater manageability, the data sheets were reduced to fit on 5 x 8 inch cards which can be scored in the teacher's lap. Additionally, a cumulative data form was developed to provide a concise record of a student's progress through the entire program. This form eliminates the necessity of going through all the individual data cards when only a general overview of the student's performance is desired (e.g., for parent conferences) and also provides a concise record for the student's permanent file. A copy of this form was presented in Figure 10.

Initial Fieldtest Results

Subjects. Throughout the academic year, four students participated in the second phase of initial fieldtesing of the Ruler Measurement Program. All were students at the EEU. One was an eleven year old boy with Down's syndrome from one of the elementary classrooms. One was an eleven year old boy, considered learning disabled and emotionally disturbed from an intermediate classroom. One was a twelve year old learning disabled boy in an intermediate class. The fourth subject was a thirteen year old boy with learning and language disabilities.

Procedures. The Ruler Measurement Program was under the immediate supervision of Mike Roe, one of the Team III interns, who administered the program to three subjects. Walter Berlin, the other Team III intern, served as instructor for the fourth subject in the program.

The lessons provided the instructions used during this phase of initial fieldtesting. Any additional instructions, clarifications or materials provided by the instructors were either incorporated into the revised lessons or were added as suggested remediation techniques.

Results. One of the subjects was withdrawn from school and did not complete the program. He had progressed through Lesson number 10, scoring 100% correct on every lesson. The last subject to whom the program was administered did not successfully complete the program for two reasons: 1) he lacked the fraction skills which were later made prerequisite to entry into the program, and 2) lack of time due to the closing of school for summer recess, which made it impossible to provide the needed remediation in these skills.

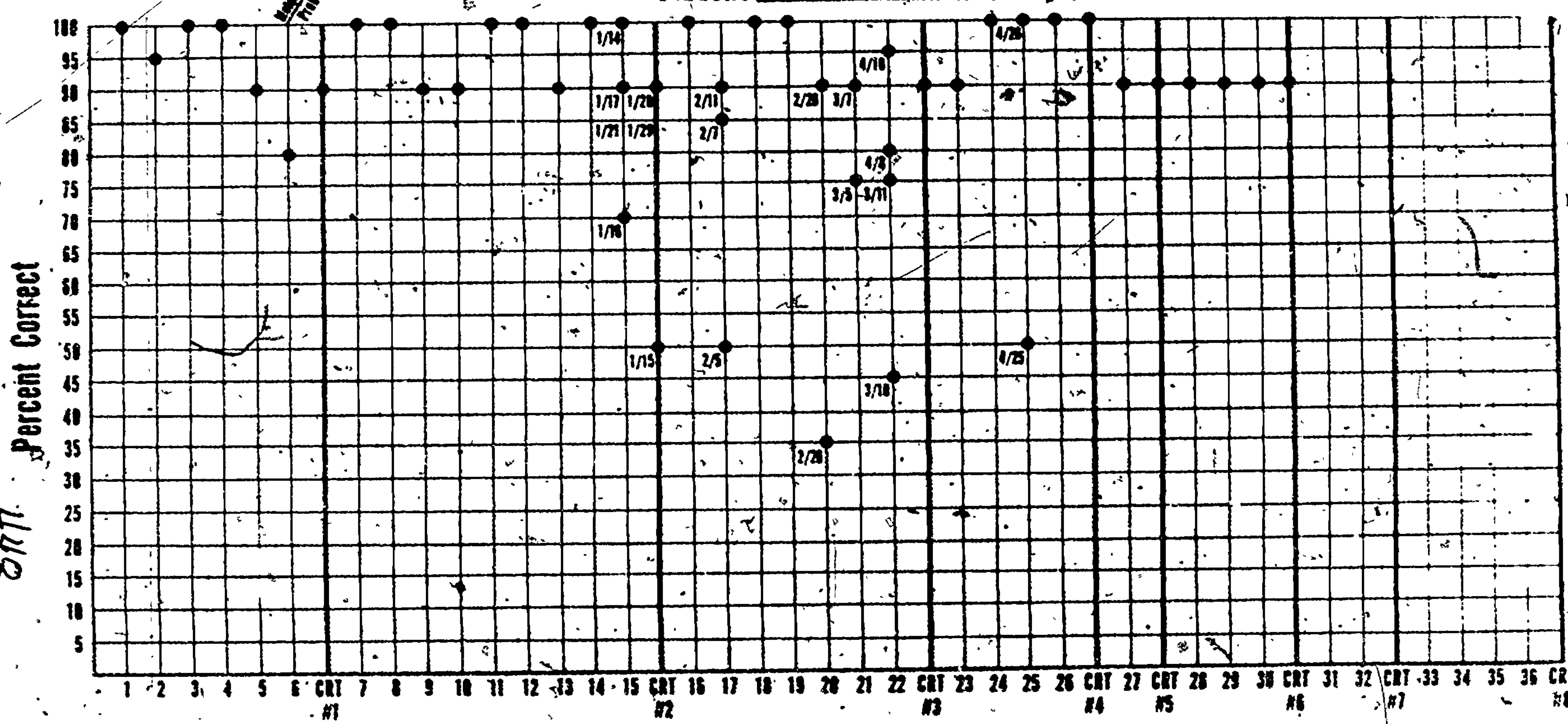
Thus, only two subjects, T. and B., successfully completed the program this year. As neither of these students possessed division skills, the last six lessons and two criterion tests were not administered. On entering the program, T. did not possess any fraction skills and this lack is reflected in his initial performance on Lessons number 15 through 22. A supplemental lesson sequence to teach these skills was concurrently written and administered to this subject, enabling him to complete the measurement lessons. T.'s data are presented in Figure 32.

B., the second subject to complete the program this year, demonstrated that he was proficient in the prerequisite fraction skills on the Ruler Measurement Pretest. This student was able to complete the lessons at or above the 90% criterion level on all but two days. The administrator reported that behavior problems accounted for the low number of correct responses on these two days. B.'s data are presented in Figure 33.

RULER MEASUREMENT PROGRAM
COMPREHENSIVE DATA SHEET

Teacher ROE Date Begun 11/9/73

Student T Date Finished 5/21/74



Lessons and Criterion Reference Tests

Figure 32

RULER MEASUREMENT PROGRAM
COMPREHENSIVE DATA SHEET

Teacher ROE **Date Begun** 1/7/74

Student B **Date Finished** 3/7/74

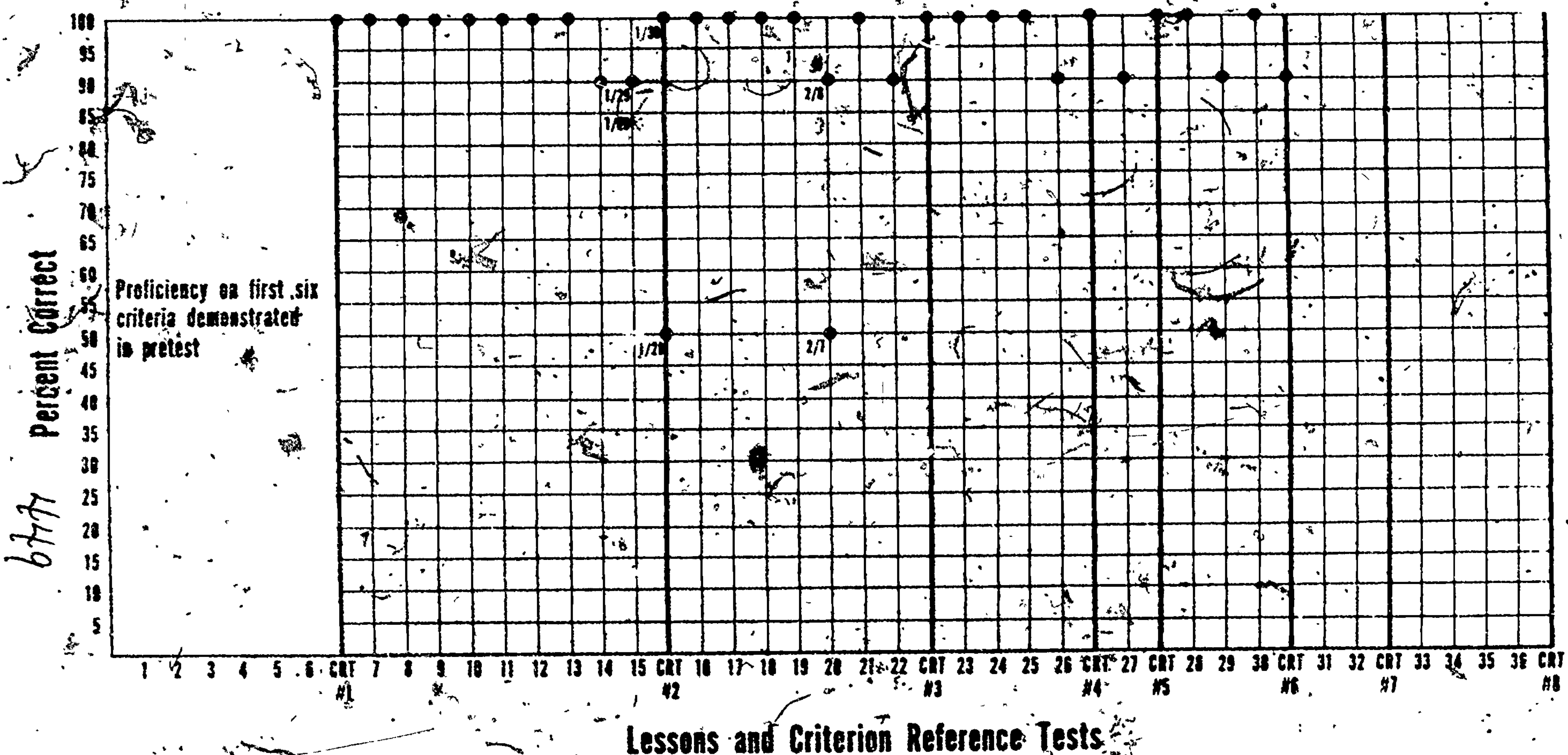


Figure 33

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Discussion. The data from the second phase of initial fieldtesting indicate that the Ruler Measurement Program is effective in teaching the skills of measuring line segments and ruling paper. Because no student was found at the EEU who possessed the necessary division skills, but was deficient in ruler measurement skills, the lessons which teach division of line segments were not administered this year. However, the program is now being prepared for secondary fieldtesting and it is hoped that students who can benefit from the line division lessons will be available in this larger population.

Current Status

The Ruler Measurement Program, written by Team III during the 1972-1973 academic year, has now been developed through the second phase of initial fieldtesting. It is being edited for publication in an experimental edition. Non-consumable materials and consumable student workbooks are being produced in multiple packages. It is anticipated that this work will be completed by the 1974 Fall Quarter. The program will then be submitted to secondary fieldtesting in the public schools with a sample of approximately 50 subjects. A supplemental lesson sequence to teach the prerequisite fraction skills for this program was written this year. Second phase initial fieldtesting will be conducted for these lessons at the EEU during Fall Quarter. The fraction lessons will then be submitted to secondary fieldtest in public schools, as supplements to the Ruler Measurement Program.

The Metric Measurement Program

Terminal Goal and Target Population

The terminal goal of the Metric Measurement Program is to teach the correct use of a thirty centimeter metric ruler. Specifically, the student in this program is taught to use the metric ruler in three ways: 1) to measure line segments, 2) to rule paper, and 3) to divide line segments.

This program is intended for use with any student who lacks the metric measurement skills and possesses the entry behaviors identified in this lattice. These prerequisite abilities are: grasp motion; turn motion; counts and identifies numbers from 1 to 100; precise use of pencil; identify ruler; concepts of top and bottom; concept of fractions; writes fractions 1/2 and 1/10. These skills are necessary for the completion of the first six sections--measuring line segments and ruling paper. They are not sufficient, however, to meet the goals of the final two sections--dividing line segments. The individual must show proficiency in simple division by two and ten to enter the final sections. This program is written so that those students who lack the skills necessary to complete the final sections may enter and complete the first six sections.

Skill Sequence

The eight sections of the Metric Measurement Program (indicated by the criterion tests) correspond to the major subgoals along the ridgeline of the lattice for Uses Metric Ruler, presented in Figure 34. Similarly, the

USES METRIC RULER

Entry Behaviors:

Grasp motion

Counts and identifies numbers from 1 to 100

Precise use of pencil

Concept of top and bottom

Concept of fractions: ½, ⅒

Writes fractions: ½, ⅒

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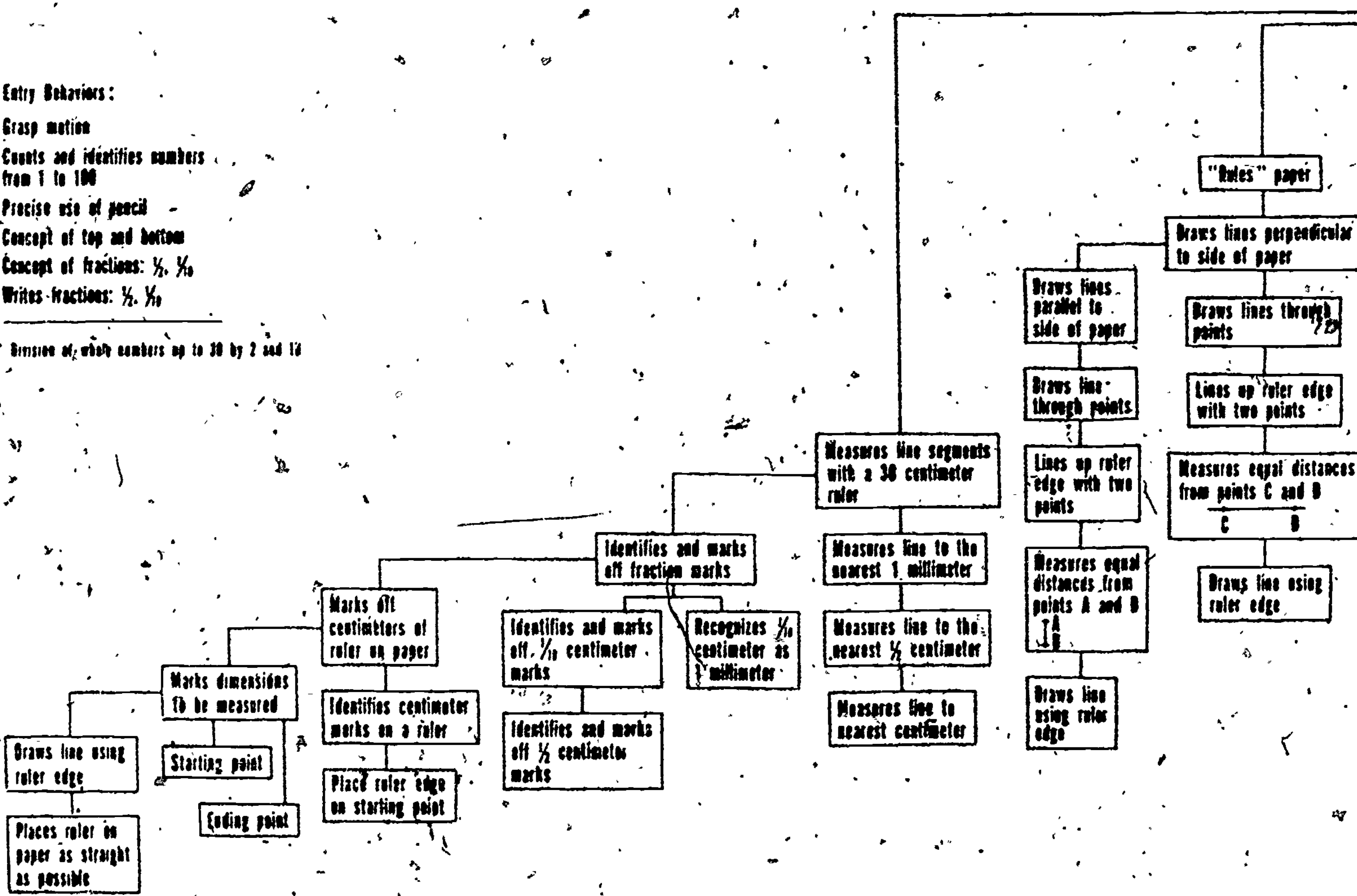
*Division of whole numbers up to 30 by 2 and 10



*Needed for "Divides line segments" only

Figure 34

USES METRIC RULER

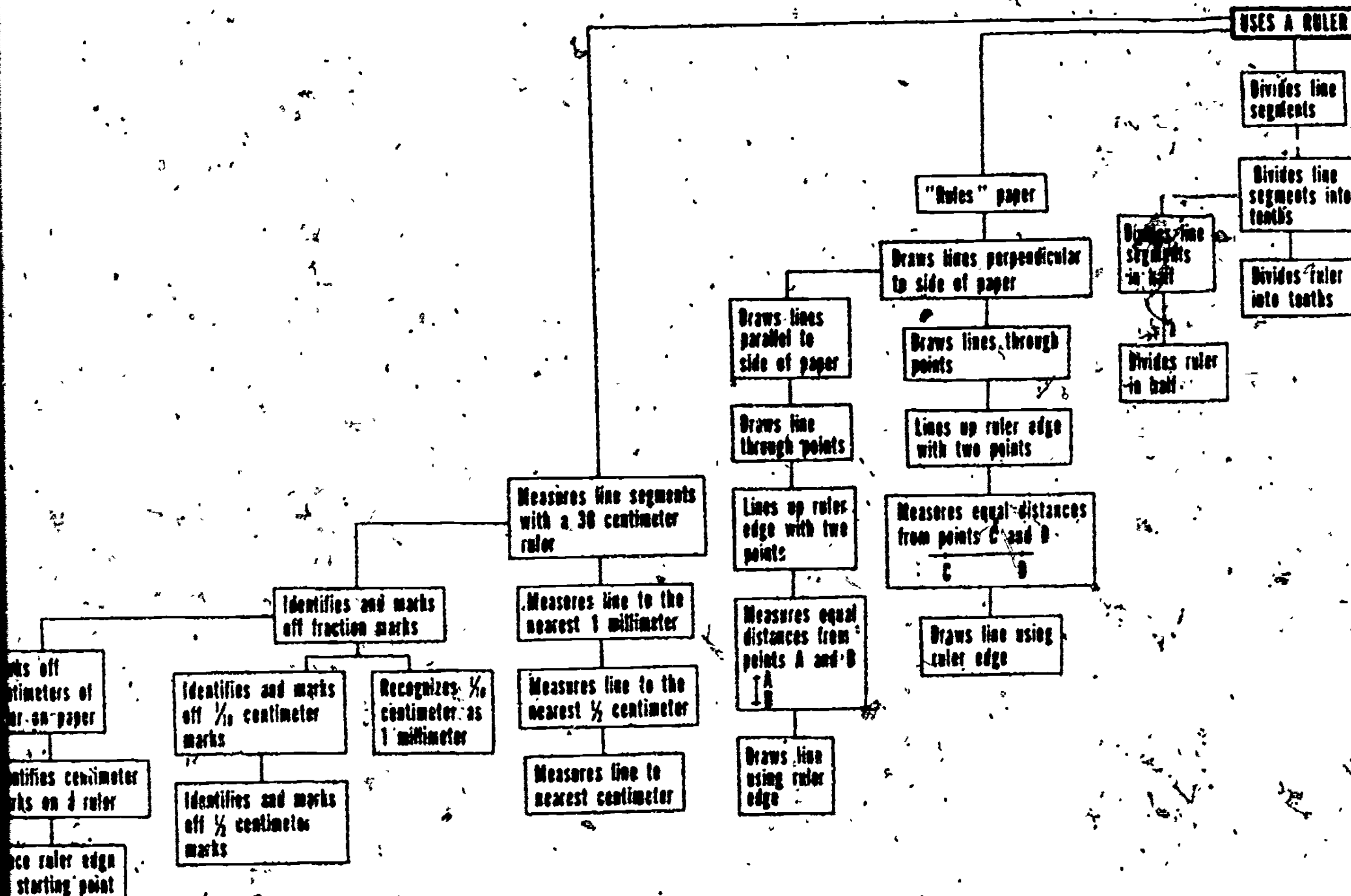


Figure 34

content and arrangement of the individual lessons follow the sequence of skills or enroute objectives identified in the initial task analysis.

The first three sections teach the student to measure line segments using a 30 centimeter ruler to the nearest 1/2 and 1/10 centimeter. In the process the student learns the equivalency of 1/10 centimeter to 1 millimeter. The next three sections teach the student to rule vertical and horizontal lines on a blank sheet of paper in the same place as the lines already drawn on a permanent model. The final two sections teach the student to divide line segments into halves and tenths. The student may not enter any of these sections until he masters the skills taught in the preceeding lessons.

Pretest Procedures

The information collected through the pretest for the Metric Measurement Program answers the following questions:

1) Does the student possess the fine motor control to grasp and turn a ruler?
2) Is the student able to count from 1 to 100?
3) Is the student able to identify the numbers from 1 to 100 both sequentially and out of order?
4) Does the student possess the fine motor control to manipulate a pencil through precision tasks?
5) Does the student understand the concept of top and bottom?
6) Does the student understand the concept of fractions?
7) Can the student write fractions?
8) Does the student have simple divison skills?
9) Does the student understand the concept of the starting and an ending point of a line segment?
10) Is the student able to mark off 1 centimeter, 1/2 centimeter, and 1/10 centimeter increments of a line using a metric ruler?
11) Is the student able to measure line segments to the nearest 1 centimeter, 1/2 centimeter, and 1/10 centimeter?
12) Is the student able to rule paper?
13) Is the student able to divide line segments?

An affirmative response to each of the first seven questions is prerequisite to the student's entry into the program. Question 8 refers to the additional entry behaviors needed for placement in the last two sections of this program. Finally, the last five questions correspond to the major skills taught in this program.

Lesson Procedures and Materials

The Metric Measurement Program was conceptualized, latticed and written this year in response to a growing need for this type of program. Many educators, feeling the impact of the Senate's Metric Conversion Act of 1972, now recognize this as an important skill for today's students. Very few materials or programs are available for teaching this skill, especially to students with learning handicaps.

When work began on the Metric Measurement Program last fall, Team III's Ruler Measurement Program was already in the second phase of initial fieldtesting. Since the skill sequence for these two programs is very similar, the program writer was able to profit from the experience gained in the development of the lesson sequence for ruler measurement. The Metric Measurement Program was developed through the first phase of initial fieldtesting in just three academic quarters. Additionally, a supplemental lesson sequence, similar to that developed for the Ruler Measurement Program, was written to teach the prerequisite fraction skills for this program.

The Metric Measurement Program consists of 32 lessons and 4 criterion tests. The criterion tests, occurring throughout the sequence, assess a student's mastery of the specific skills taught in preceding lessons. Successful completion (at least 90% correct) of each criterion test is required before a student may progress to succeeding lessons. The lessons are written in the three-column format and are intended for one-to-one administration. The lessons in this sequence call for the use of many specially designed instructional materials. These include approximately 115 consumable worksheets, 16 non-consumable measurement aids, and a series of 6 plastic metric rulers which provide gradually reduced cues and increasing detail.

Only a few minor revisions in this program were required on the basis of initial fieldtest data collected this year. Some sections of the teacher directions were condensed or re-worded to increase clarity. Originally, several lessons called for multiple student responses; these were broken down into component parts to facilitate administration. Finally, suggested remediations were added to a few lessons in which errors occurred frequently.

<u>Initial Fieldtest Results</u>

<u>Subjects</u>. Five boys, all students at the EEU, served as subjects for the initial fieldtesting of the Metric Measurement Program. Three of these students were eleven years old and one was ten years old. These four boys were diagnosed as learning disabled and were enrolled in an intermediate class. The fifth subject, a thirteen year old boy with learning and language disabilities, was enrolled in the EEU's demonstration classroom.

<u>Procedures</u>. The Metric Measurement Program was under the immediate supervision of Mike Roe, one of the Team III interns. Mike was the program writer and he administered the sequence to the first three students. Walter Berlin, the other Team III intern, served as instructor for the last two students.

The lessons provided the instructions used during this phase of initial fieldtesting and were continually revised to reflect data input. Thus all instructions, clarifications and materials used in this fieldtesting are included in the revised version of the Metric Measurement Program.

<u>Results</u>. The student response data for this program remained consistently above the criterion level. There was no lesson on which more than one student performed below 90% correct on the first administration. Because of the very limited variability in the data for the initial field-

test subjects, their mean scores, expressed in terms of percent correct, are presented in Figure 35. The means were computed as the percent correct divided by the number of administrations of that lesson. Thus, if a student scored below 90% on a particular lesson, that lesson would be readministered and both scores would be figured in computing the group mean for that lesson.

Discussion. The data indicate that this instructional program is effective in teaching metric ruler measurement skills. Because of the high level entry behaviors required by this program, and the limited population available at the EEU, it may not be possible to include as large and varied a sample in the second phase of initial fieldtesting as would be desirable. However, if feedback from one or two more administrators at the EEU supports the data gathered in the first phase of initial fieldtesting, this program will be prepared for secondary fieldtesting.

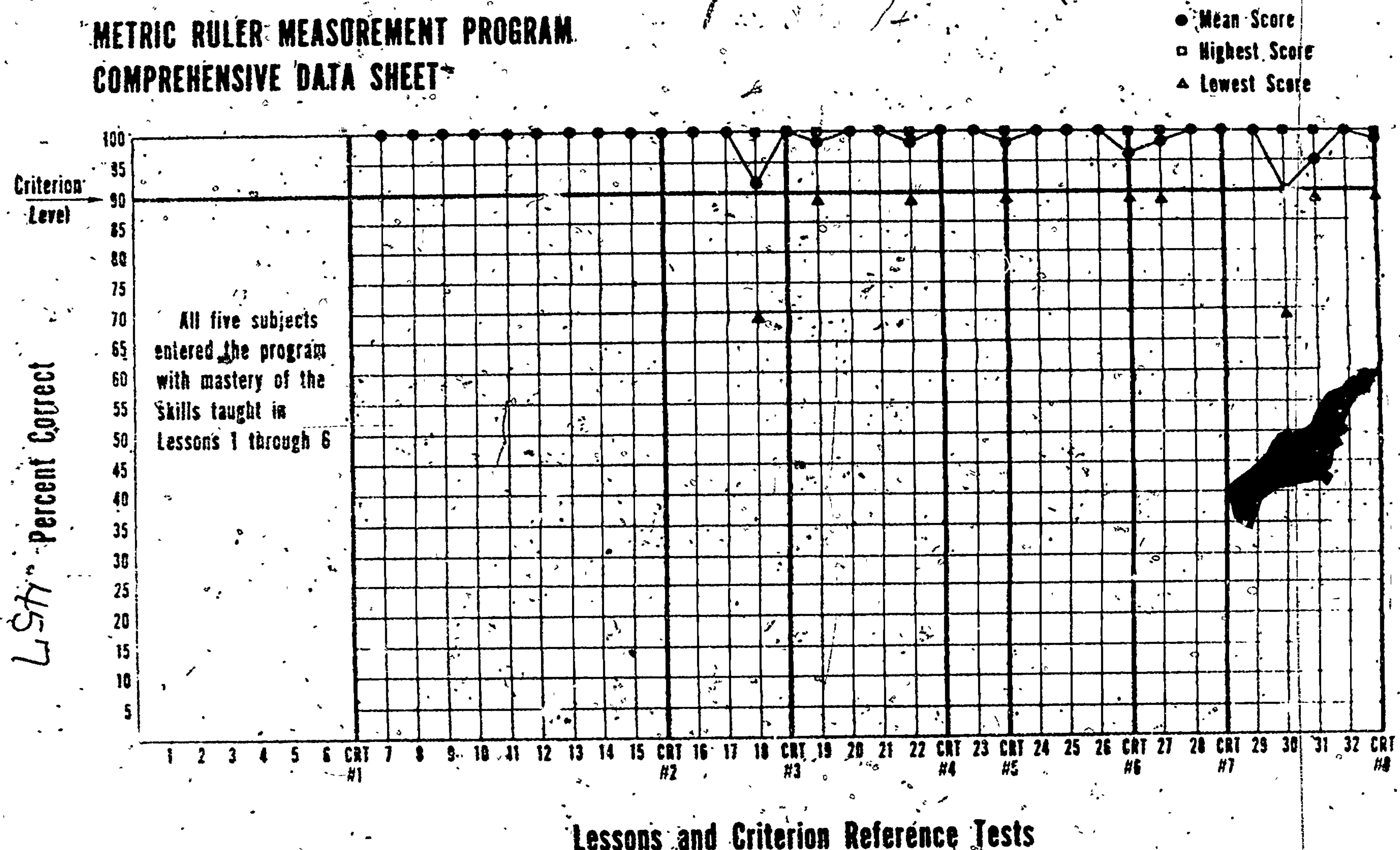
Current Status

The Metric Measurement Program was latticed and written during the past year. A supplemental lesson sequence to teach prerequisite fraction skills was also written. The first phase of initial fieldtesting, involving five subjects, demonstrated the efficacy of this program. Thus it is now ready for the second phase of initial fieldtesting--administration at the EEU by one or two additional administrators. This phase should be completed in the 1974 Fall Quarter. The program will then be edited and materials prepared for secondary fieldtesting next winter.

Summary

During the past two years, Team III conducted research on a prototypic model for the development of efficient and effective instructional programs. The model stipulates many steps in this developmental process. According to this model, there are ten stages through which the programmer should progress in the creation, refinement, and validation of an instructional sequence. These stages are:

1) Possess prerequisite knowledge about basic learning principles and the particular subject area to be programmed.
2) Make primary decisions regarding specific program goals and target population.
3) Develop lattice for program to display task analysis of the skill sequence.
4) Develop pretest package to assess entry behaviors and target skills.
5) Decide on program's format.
6) Determine initial fieldtest population.
7) Initial fieldtest (concurrent with lesson writing).
8) Secondary fieldtest.
9) Final fieldtest of entire program.
10) Produce and disseminate instructional program.



Summary of Initial Fieldtest Data for Five Subjects

Figure 35

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During the 1973-1974 academic year, the efficacy of this model was evaluated through the development of several instructional programs. Fieldtest data gathered in this research generally validated the major components of the prototypic model. Several procedural modifications were made as student data and administrator feedback indicated the need for such revisions.

The importance of brevity and clarity in teacher directions became evident when several program pretests and lessons required rewriting this year. Similarly, convenient procedures needed to be developed for recording raw data (i.e., specific student responses) as lessons were administered. It was also necessary to design appropriate charts to display cumulative data for each program. Data presented on these forms provide an overview of a student's progress through a particular instructional sequence.

The modified lattice system for task analysis proved to be especially applicable to the needs of classroom teachers at the EEU. Many of these teachers mastered the latticing technique through independent reading of a working paper written by Dr. Deborah Smith which describes the procedures involved in lattice construction. These teachers reported that lattices served as useful guides for daily lesson planning.

The most significant refinement of the prototypic model made this year was the expansion of the initial fieldtest stage to include two distinct phases. This modification was made for two reasons: 1) to allow for essential feedback from one or two administrators in addition to the program writer; and 2) to provide lesson data from students of varying ages and diagnostic categories. This second phase enables the programmer to evaluate both the accuracy of the entry behaviors criteria and the efficacy of the developed lesson sequence.

During the past year, Team III's research involved the continued development of five instructional programs in accordance with the procedures specified in the prototypic model. A sixth program (metric ruler measurement) was conceptualized, latticed and written. Additionally, four auxiliary programs were initiated during the past year.

The Shoe Tie Program was administered at the EEU this year to six students ranging in age from 5 to 18 years old. On the basis of data collected in this second phase of initial fieldtesting, several revisions were made in the lesson sequence, and new remediation sections were added. After final editing, the teacher's manuals for this program were produced and distributed to public school special education teachers for secondary fieldtesting. This secondary fieldtest population includes approximately 50 students, ranging in age from 3 to 13 years. Student performance data and teacher feedback from this fieldtesting will be collected in the 1974 Fall Quarter.

The Make Change Program underwent substantial [illegible] this year. Three mini-programs developed during the 1972-1973 academic year -- Coin Discrimination, Bill Discrimination and Money Values -- required rewriting. A fourth mini-program -- Coin Combinations -- was written to teach the skill of counting up sums of money through 25 cents. The entire revised sequence was administered to several students at the EEU. The subjects for this first phase of initial fieldtesting ranged in age from 10 to 13 years. The second phase of initial fieldtesting will be conducted for the Make Change Program in the 1974 Fall Quarter.

Initial fieldtesting of the Time Telling Program was completed during the 1972-1973 year. However, two additional in-house administrations were conducted by the program writer this fall to assess the efficacy of the mass produced instructional aids. As this data indicated that the new aids did not reduce the program's effectiveness, the teacher's manual was prepared for multiple production. Because of delays in the printing of data sheets and teacher's manuals, it was not possible to distribute this program to secondary fieldtest sites this year. Therefore, the Time Telling Program will be submitted to secondary fieldtesting when the public schools open in September.

The Clothes Fastening Program, although previously latticed, was written during the past year. The three mini-programs comprising this sequence -- zipping, snapping and buttoning -- are presently undergoing the first phase of initial fieldtesting. It is anticipated that all initial fieldtesting for this program will be completed by the end of the 1974 Fall Quarter.

Team III's Ruler Measurement Program underwent the second phase of initial fieldtesting at the EEU this year with a sample of students ranging in age from 11 to 13 years. This data supported the efficacy of the program and materials. Therefore, multiple program packages are now being prepared for secondary fieldtesting in the public schools this fall.

One new program, designed to teach the skill of using a metric ruler, was conceptualized, latticed and written through the first phase of initial fieldtesting this year. The Metric Ruler Measurement Program was administered to four students, 10 and 11 years old, at the EEU. This student data demonstrated the efficacy of the program in teaching metric measurement skills. Therefore, the second phase of initial fieldtesting will be conducted for the Metric Ruler Measurement Program during the 1974 Fall Quarter.

Four short programs were written this year as auxiliaries to existing programs. These are: Shoe Lacing; Shoe Lace Tightening; Simple Fractions 1/8, 1/4, and 1/2; and Simple Fractions 1/10 and 1/2. When initial fieldtesting is completed on these programs, they will be secondarily fieldtested in the public schools as supplements to the Shoe Tie Program, the Ruler Measurement Program, and the Metric Ruler Measurement Program.

During the coming year, Team III will complete its research on the prototypic model for creation of instructional programs. This model has been refined in the past two years in order to make it more efficient and broadly applicable. It is hoped that this prototypic model, as well as the instructional programs developed by Team III, will be disseminated to a large number of special educators when this project is concluded next year. Through this dissemination should come improved educational programming for handicapped students of all ages and levels of ability.

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Appendix

The Shoe Tie Program

Teacher's General Directions for Shoe Tying Program

This instructional program was designed for individualized administration. Do not use the program with groups.

Each lesson was designed to be given on a separate day. Since the program is relatively short and the student needs to absorb each section before moving on, it is not recommended that more than one lesson be taught each day. Should it be needed, the Remediation Lesson may be used at any time during the sequence of the lessons.

Pre-reading the lessons

Before teaching a lesson, be certain to pre-read the instructions carefully. Practice each of the steps until they seem natural to you. Be familiar with all of the steps and demonstrations required, and with the instructions you say to the student. All directions should be followed exactly; all instructions should be stated word for word.

Materials

Be sure to have the necessary materials readily available for the administration of this program. These materials are listed at the top of the pretest, and each lesson. The demonstration shoe may be any shoe with tie laces (i.e. an adult's tennis shoe or a hiking boot) which is large enough to be easily tied.

Criteria

The criteria or goals for each lesson --the skills the student is expected to possess before moving on to the next lesson --are described at the top of each lesson. Typically, in this program the student must perform the step or sequence correctly three consecutive times. This means that the student must perform the lesson's goals which are listed as the criteria, three times correctly without errors in between. If the student first performs the task correctly but misses on the second trial, the count of correct trials starts over again.

A precise verbal response should not be demanded of students with limited verbal ability. Accept any approximation of the requested word or phrase, or if the student has no speech allow him to indicate manually (i.e., point, gesture, imitate) the correct response.

If the student meets the criterion for a lesson, but you do not feel that the learner is truly proficient at the task, it is left to your discretion whether or not to proceed with the next lesson.

Lesson format

The following format was developed for ease in administering the lessons. On each page, the second column to the right contains your instructions. The directions are written in small letters. Phrases you say to the student are written in capital letters.

The third column specifies the correct student response. The final column, labeled "Remediation," indicates what procedures to implement if the student is unable to correctly execute the response.

Illustrations have been provided for your convenience. Please refer to the drawings anytime you are directed to do so. If directions seem unclear, the illustrations may help clarify correct procedures. The drawings are for your use only.

Data sheets

Each student response is coded on an individual data sheet. Please refer to the instructions and example on pages 15-16 for directions.

Reinforcement

NEVER tell the student that tying his shoes is easy. It isn't. If it were, the student would be doing it.

Always praise the student if he correctly performs a step required in the program. To reinforce correct performance of any one step in the program, tell the student the specific step he did appropriately. For example, if the student pulled the laces tight in the proper manner, say: "Good, you have just pulled both laces tight." In this way, you establish completion of a task and also indicate approval for good performance.

Constantly check during the instruction period to be certain that the student is paying attention to your instructions and demonstrations. Should the student not focus on the task, give the student a prompt or cue to redirect his attention. Directions such as, "(student's name), look down here," or "(name), pay attention to this," usually bring the student's attention towards the instructions.

"Strong" vs. "Weak" Hand

In this program, the "strong" hand refers to the student's dominant hand - the hand that the child naturally uses for most other tasks and skills (such as eating, drawing or writing, etc.). If you are not certain which is the student's dominant or strong hand, either hand may be used, since the program teaches skills for both the dominant and non-dominant hand.

Laces

It is recommended that the teacher use long (extending at least 12 inches from top hole), stiff laces for the majority of the program. Laces commonly used on skates or hiking boots work very well for this purpose; however, before the student begins to tie his own shoes he should have the opportunity to work with soft laces on the shoe. Therefore, around Lesson 8 or 9, replace the stiff lace with a soft shoelace similar to the laces found on the student's own shoes. These laces should have reinforced tips and should be firm enough to maintain a distinct bow. When the shoe is laced, each of the two free ends should extend not less than nine inches, and not more than thirteen inches, beyond the top lacing eyelets.

Lattice

The Lattice for Shoes Tied is included for the teacher's interest only. It provides an analysis of the components of the task - shoe tying. Please refer to page 13 for further explanation.

Letter to the parents

A letter should be sent home to the parents the day the student enters the program. The purpose of this letter is to see that the student has tie shoes and good laces with which to work. It is advisable for you to have extra laces on hand in case the parents send the student to school with laces that are too short.

The letter below is provided for your convenience. If you choose to write your own letter, please stress the step-by-step nature of the instructional program. Ask the parents not to attempt to teach their child to tie his shoes at home while you are teaching him at school. This request is made because of the number of variations available to tie shoes, not because parents cannot instruct their children.

Dear Mr. and Mrs. (parent's name)

(student's name) will be starting a shoe tying program at school and will need to wear laced shoes daily. Please be sure he comes to school with laces which are in good condition, and are long enough to be easily tied. The instructional program is sequenced. Please do not attempt to teach your child to tie his (or her) shoes at home. Everyone has his own way of tying shoes. The program used at school follows a step-by-step procedure which might be different from your own.

Thank you for your cooperation.

Sincerely yours,

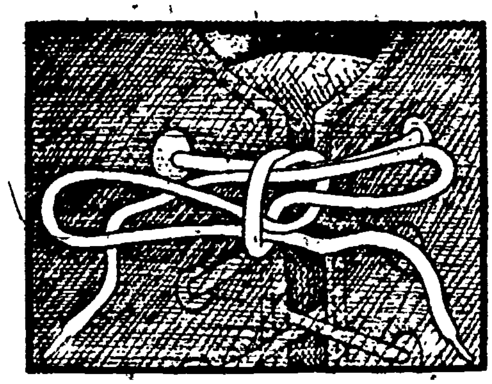
ESSENTIAL TERMS

The following terms must be understood by you before the pretest or lessons are begun:

BOW

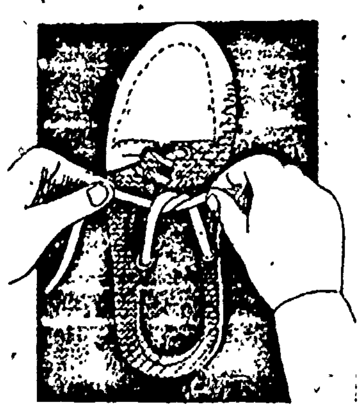
The "bow" is the final product in shoe-tying. It consists of two loops tied together with an overhand knot.

BOW-KNOT



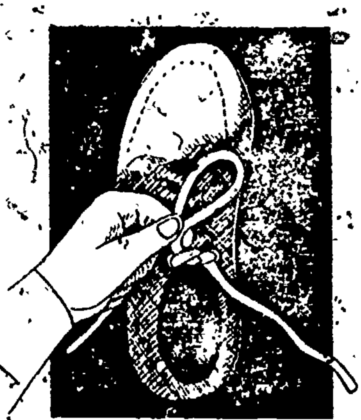
The "bow-knot" is the overhand knot that holds the two loops together to form the bow.

HALF-KNOT



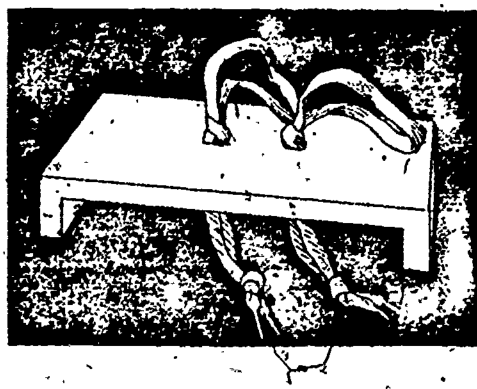
The "half-knot" is the overhand knot which is normally made before the bow is tied.

LOOP



The first step (following the half-knot) is the "loop." The lace is bent and pinched to form the loop.

REMEDO-BOARD



The "Remedo-Board" is a simple device used to familiarize students with the pinching and pulling motions used to tie shoelaces. It consists of a piece of wood drilled with two holes in which knotted shoelaces are secured for practicing the motions.

SHOE FLAP

Two portions of the shoe contain eyelets (holes on the shoe that the lace goes through). These portions of the shoe are referred to as the "shoe flaps."

TONGUE

The "tongue" is the central piece of material which lies under the shoe flaps.

General Pretest Directions

The pretest is to be administered with one child at a time.

There are ten Shoe Tying Data Sheets for the pretest included at the end of this booklet; a sample sheet follows the Pretest items. One Pretest Data Sheet should be used for each student. If more are needed, they are easily reproduced.

Place the data sheet in a convenient place for scoring, but be certain to keep the sheet out of the view of the child.

The materials needed for each section are listed directly under each pretest title. Before you begin a pretest, be certain to have all of the materials needed readily available. Check the following list for items you will need.

1. Pretest Sections and Directions
3. Boot or shoe with tie laces
4. Either a stopwatch or wall clock with a second hand
5. Three beads (These should be approximately one inch in diameter. The hole in the center of the bead should be just large enough for the shoe lace to pass through freely.)
6. Separate shoelace
7. Pencil

The directions in each pretest section tell the teacher exactly what to do and say. The exact words the teacher should say to the child are in capital letters.

Interpreting the Pretest:

In order for a student to qualify for this program, he must score 100% on Sections 2, 4 and Number 1b of Section 5.

Section 1

If the student does not score 100% correct on Number 1, then continue the pretest. If the student scores 100% correct on Number 1, then continue the pretest; however, omit Sections 2, 3, and 4.

If the student scores 100% correct on Number 1, but does not score 100% on Number 2, then place him at Lesson 11 in the Shoe Tie Program.

Section 2

In order for the student to score 100% correct, he must do the task within 30 seconds with each hand. A score of 100% correct on this section is a prerequisite to entrance in the Shoe Tie Program.

Section 3

If the student is unable to score 100% correct on Number 1, then place him at Lesson 1 in the Shoe Tie Program. If the student scores 100% correct on Number 1, but does not score 100% correct on Number 2, then place him at Lesson 2 in the Shoe Tie Program. If the student scores 100% correct on both Number 1 and 2, then place him at Lesson 3 in the Shoe Tie Program.

Section 4

A score of 100% correct on this section is a prerequisite to entrance in the Shoe Tie Program.

Section 5 - Auxiliary Skills

A score of 100% correct on 1b is a prerequisite to entrance in the Shoe Tie Program.

NOTE: Numbers 1, 2 and 3 of Section 5 are included in this Pretest to provide the teacher with an assessment of the student's lacing, dressing, and lace tightening skills.

At this time no program has been written to facilitate the teaching of these auxiliary skills.

Pretest Sections and Directions

If the student is wearing a shoe which has laces, use the student's shoe for those pretest sections which require the student to work with a shoe. If not, place the demonstration shoe directly in front of the student on a student-size desk with the heel facing the student. Say: TODAY WE ARE GOING TO SEE IF YOU ARE READY TO LEARN TO TIE YOUR SHOES. IF YOU HAVE ANY PROBLEMS, DON'T WORRY. I WILL HELP YOU WITH THE PARTS YOU CAN'T DO LATER.

WE ARE READY TO START. BE SURE TO DO YOUR BEST.

Pretest - Section 1: Ties and Unties Shoe P-1

Materials: Shoe with tie laces, data sheet

Place data sheet in front of you and out of the view of the student.

1. Untie the student's shoe and say: I WOULD LIKE TO SEE IF YOU CAN TIE YOUR SHOE. TRY TO TIE YOUR SHOE FOR ME.

2. If the student did not tie his shoe, retie it for him and say: I WANT TO SEE IF YOU CAN UNTIE YOUR SHOE. PLEASE UNTIE YOUR SHOE FOR ME.

If the half-knot is tied and the bow-knot is untied, say: PLEASE UNTIE THE LAST KNOT.

Remove the shoe from the table or place the student's foot on the floor.

Pretest - Section 2: Strings Beads with Both Hands P-2

Materials: Three beads, lace, data sheet and stopwatch

THIS SECTION IS TO BE TIMED. Place the beads and the lace in front of the child.

1. Say: PLEASE PICK UP THE SHOELACE. Note which hand the student used to pick up the lace.

2. Have the student hold the shoelace in his right hand and say: PLEASE PUT THESE BEADS ON THE LACE. PLEASE WORK AS QUICKLY AS YOU CAN.

3. Remove the beads from the lace. Place the lace in the student's left hand and say: STRING THE BEADS WITH YOUR OTHER HAND.

Pretest - Section 3: Pinches Loop with Both Hands and Pulls a Bow Tight P-3

Materials: Shoe with tie laces, bead-lace, data sheet

Remove beads.

1. Hold the lace in a loop which is about 3 inches long. Point to the student's right hand and say: PLEASE PINCH THIS LOOP.

If the student pinches the lace, say: PLEASE LET GO. Make another loop. PINCH THE LOOP AGAIN, BUT THIS TIME WITH THE OTHER HAND.

After the student pinches, say: LET GO.

2. The shoe should be untied. If it is not, please untie it. Now retie the shoe, but do not complete the last step (do not pull the bow tight).

Point to the student's right hand and to the right loop as you say: NOW PINCH THIS LOOP WITH THIS HAND.

Point to the student's left hand and to the left loop as you say: NOW PINCH THIS LOOP WITH YOUR OTHER HAND. MAKE SURE YOU PINCH BOTH PARTS OF THE LOOP AT ONCE.

Say: PULL THE LOOPS AWAY FROM EACH OTHER.

Pretest - Section 4: Pulls Lace out of Eyelets with Both Hands P-4

Materials: Shoe with tie laces, a separate shoelace

Unlace the shoe to the bottom two eyelets. These are the two eyelets across from each other that the lace goes through first when lacing up the shoe. Or unlace the top hole on each side and string a separate shoelace through the two holes.

1. Point to the student's right hand and say: PLEASE PULL THE LACE OUT OF THE HOLES WITH THIS HAND.

2. Restring the shoelace, point to the student's left hand and say: PLEASE PULL THE LACE OUT OF THE HOLES WITH THIS HAND.

Pretest - Section 5: Laces a Shoe and Tightens the Laces P-5

Materials: Shoe with tie laces

1. Remove the shoe from the student's foot. Place the shoe in front of the student on a student-size table. The heel should face the student and the lace should be separate from the shoe.

Hand the lace to the student and say: LACE UP THE SHOE. BE CAREFUL, BUT DO IT AS QUICKLY AS YOU CAN.

If the student did not lace up the shoe, point to the bottom eyelet and say:

PUT THE LACE THROUGH THIS HOLE.

1b. Point to the corresponding hole across from the hole which was just threaded and say: NOW PUT THE LACE THROUGH THIS HOLE.

2. If the student is unable to lace up the shoe, finish lacing the shoe but do not tighten the laces.

Say: TIGHTEN UP THE LACES.

3. Say: PLEASE PUT YOUR SHOE BACK ON YOUR FOOT. (If the demonstration shoe was used for the above sections, remove the student's shoe and use the above direction).

SHOE TYING DATA FOR PRETEST

-1

	Correct	Incorrect	Prompt
Ties Shoe			
Unties Shoe			

-2

. Picks up Lace ________ (Yes or No)

________ (Right or Left)

Strings Beads

	Right Hand	Left Hand	Time
2.			
3.			

-3

. Pinches Loop

Right Hand	Left Hand

. Pinches Bow Loop

	Yes	No
Right Hand		
Left Hand		
Pulls Bow T--ht		

P-4

Pulls Laces out of eyelets

	Yes
Right Hand	
Left Hand	

P-5

	Yes
1. Laces Shoes	
1a. Puts Laces in eyelets	
2. Tightens Laces	
3. Puts on Shoe	

SHOE TYING DATA FOR PRETEST

Incorrect	Prompt

(Yes or No)

(Right or Left)

nd	Left Hand	Time

nd	Left Hand

	No

P-4

Pulls Laces out of eyelets

	Yes	No
Right Hand		
Left Hand		

P-5

	Yes	No
1. Laces Shoes		
1a. Puts Laces in eyelets		
2. Tightens Laces		
3. Puts on Shoe		

Interpreting the Lattice

Before the Shoe Tying Program was developed, the task-- shoe tying-- was submitted to an analytical procedure which was then displayed in a lattice format. A lattice is a graphic display of a single educational skill which has been systematically analyzed. Its purpose is to provide a pattern for a sequential list of the major parts of a specific skill. A lattice is a masterplan, not an outline for teaching because it does not include the exact steps or teaching strategies used in the educational sequences.

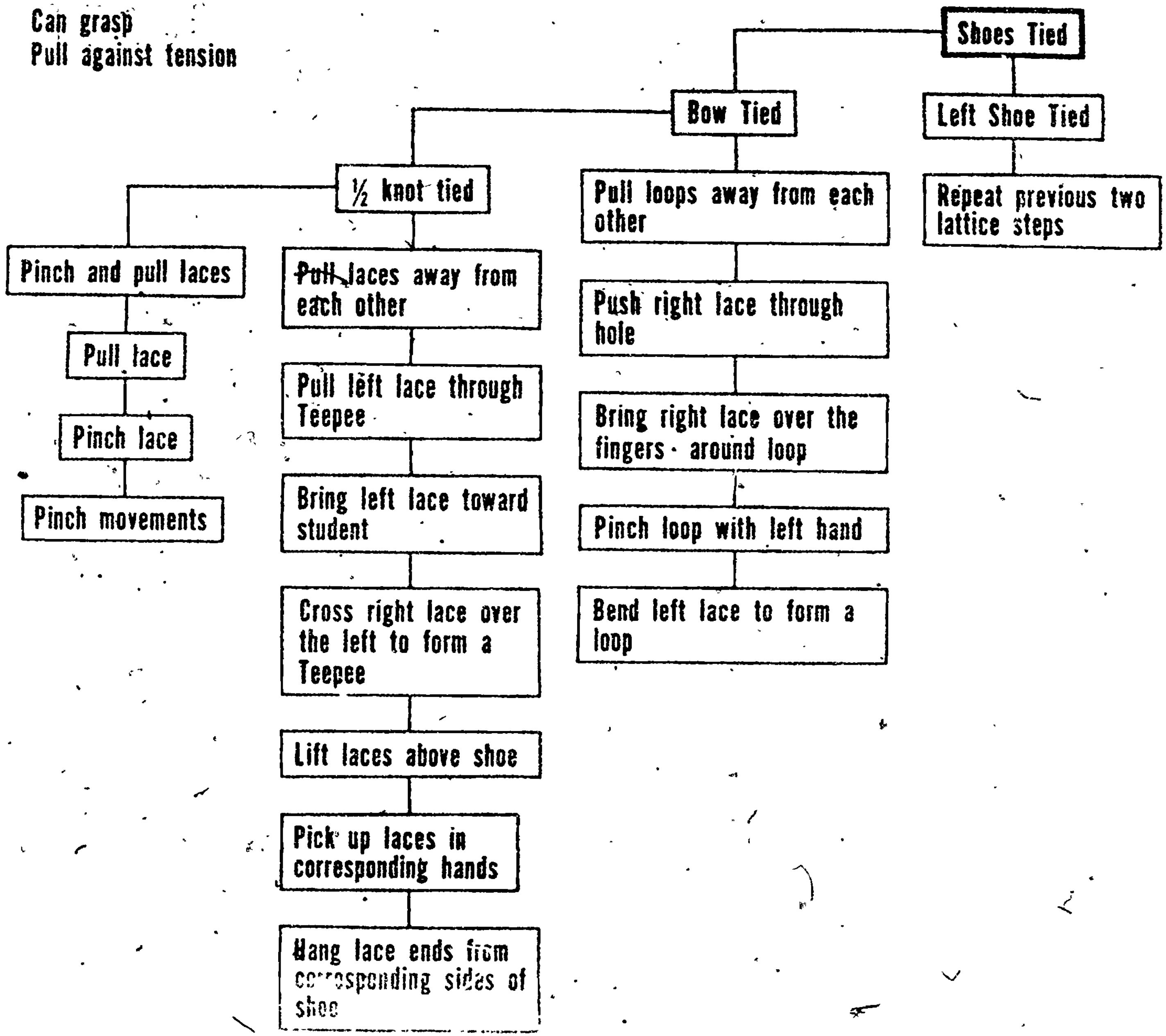
Major elements of the task analysis process are as follows: (1) Identification of the skill —In this case, "Shoes Tied" is the final objective. A student may be deficient in putting his shoes on his feet, but that is a different task and thus would not be included in the Shoe Tying Program. (2) Determination of "Entry Behaviors" - The programmer decides what skills will be required of students beginning a lesson sequence in order to insure more efficient instruction. (3) Analysis of the skill - Each major step involved in acquiring a skill is identified and the sequence of the steps is established. (4) Sequencing of the steps used to complete the task - A hierarchy of skills is determined concurrently with sequencing the steps.

In the Lattice for Shoes Tied, the "1/2 Knot Tied" and "Bow Tied" are two major component parts - subgoals of the final goal. Those behaviors which lead to the realization of subgoals are placed under the subgoals to represent the hierarchy of steps used to complete the task. When reading the lattice, begin at the bottom left-hand column and read to the top of that column; beginning at the bottom of the 2nd column, continue in the same way until you reach the last box in the upper right hand corner - the terminal behavior.

Lattice for SHOES TIED

Entry Behaviors

Imitate or model others
Can grasp
Pull against tension



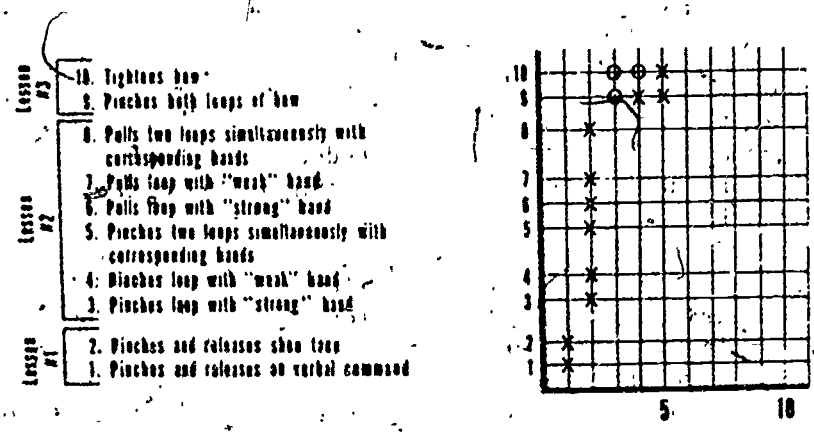
Instructions for the Data Sheet

The format of the Data Sheet is designed to provide an overview of the student's progress throughout the program. There are ten Data Sheets included at the end of this booklet; one sheet, which encompasses all the lessons, should be used for each student. If more are needed, they are easily reproduced. An Example Data Sheet and a sample Data Sheet are provided for further explanation.

The data chart's vertical axis is labeled "Criteria Correctly Completed.". These criteria, on the left side of the chart, correspond to the major criteria of each lesson in which proficiency is required before advancement. The horizontal axis labeled "Consecutive School Days in Program," represents the days in sequence on which a lesson was administered to the student.

To properly use the data chart, locate the lesson criteria which correspond to the lesson just administered and the proper day in sequence. Mark those criteria which the student correctly completed with an "X" at the position on the chart corresponding to the proper day. If the student did not meet specific criteria then those criteria should be marked with an "O" at the position on the chart corresponding to the proper day.

Example Data Sheet



This sample illustrates data charted for the first three lessons of the Shoe Tie Program. On the first day of instruction, the student mastered the two criteria of Lesson #1. Lesson #2 was also successfully completed in one day. The criteria of Lesson #3 required three days to master.

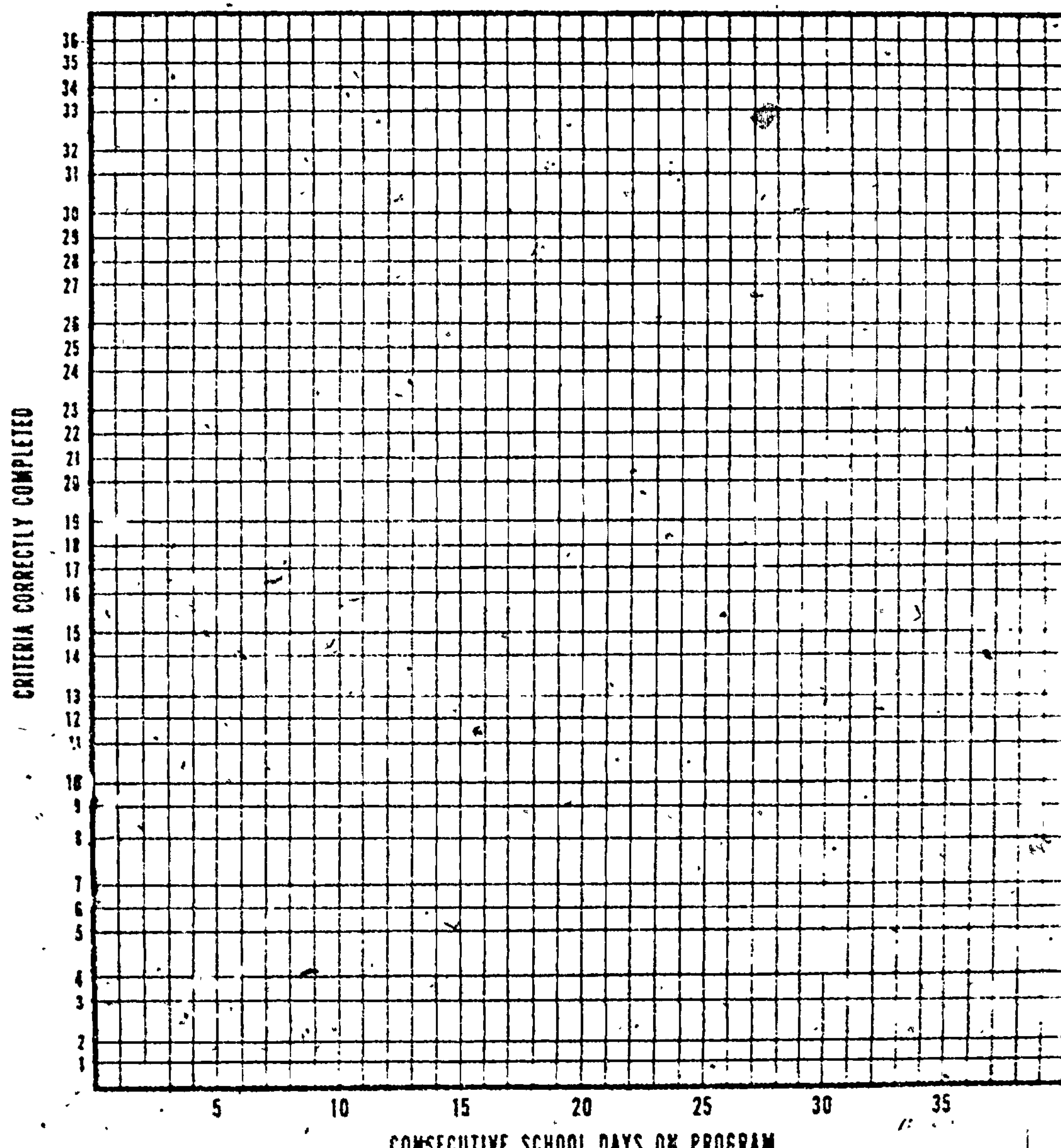
A student never advances to the next lesson until he has become proficient in each of the criteria listed for the lesson in progress.

SHOE TIE PROGRAM DATA SHEET

Teacher ____________ Date begun ____________

Student ____________ Date completed ____________

Lesson #11	36	Unties own shoe
	35	Unties half knot on own shoe
	34	Knots half knot on own shoe
	33	Unties bow knot on own shoe
Lesson #10	32	Ties bow knot on own shoe
	31	Ties half knot on own shoe
Lesson #9	30	Ties bow knot
	29	Tightens half knot
	28	Brings lace through loopee
	27	Makes loopee
Lesson #8	26	Ties the bow knot
	25	Tightens half knot
	24	Brings lace through loopee
Lesson #7	23	Tightens bow
	22	Pushes lace through hole
	21	Brings lace over fingers
	20	Makes loop
Lesson #6	19	Tightens bow
	18	Pushes lace through hole
	17	Brings lace over fingers
	16	Independently holds first loop in place
Lesson #5	15	Tightens bow
	14	Pushes lace through hole
Lesson #4	13	Tightens bow
	12	Pulls loop away from hole
	11	Holds first loop in place with assistance
Lesson #3	10	Tightens bow
	9	Pinches both loops of bow
Lesson #2	8	Pulls two loops simultaneously with corresponding hands
	7	Pulls loop with "weak" hand
	6	Pulls loop with "strong" hand
	5	Pinches two loops simultaneously with corresponding hands
	4	Pinches loop with "weak" hand
	3	Pinches loop with "strong" hand
Lesson #1	2	Pinches and releases shoe lace
	1	Pinches and releases on verbal command



SHOE TYING PROGRAM - LESSON 1

Materials: Shoelace

Criteria: Student pinches and releases a shoelace, three consecutive times correctly.

	Instructor	Student
	Sit beside student.	
	Section 1: Pinch on Verbal Command Teacher Demonstration	
	Demonstrate clearly and slowly the pinching movements with the thumb and first finger of the hand which corresponds to the "strong" hand of the student as you say: NOW WE ARE GOING TO LEARN HOW TO PINCH AND PULL A SHOELACE. FIRST I WILL SHOW YOU HOW TO PINCH AND THEN YOU CAN DO IT.	
	As you demonstrate the movement, say: PINCH. Demonstrate and give command three times.	
	Section 2: Student Response	
	Demonstrate how to hold thumb and first finger in open position.	
	Say: NOW WE WILL DO IT TOGETHER. PUT YOUR HAND LIKE THIS.	
	As you demonstrate the movement, say: NOW PINCH. (R-1)	R-1. Pinches thumb and first finger together with teacher.
	Wait for response and prompt if necessary.	

hes and releases a shoelace, three consecutive times correctly.

Instructor	Student	Remediation
Sit beside student.		
Section 1: Pinch on Verbal Command **Teacher Demonstration**		
Demonstrate clearly and slowly the pinching movements with the thumb and first finger of the hand which corresponds to the "strong" hand of the student as you say: NOW WE ARE GOING TO LEARN HOW TO PINCH AND PULL A SHOELACE. FIRST I WILL SHOW YOU HOW TO PINCH AND THEN YOU CAN DO IT.		
As you demonstrate the movement, say: PINCH. Demonstrate and give command three times.		
Section 2: Student Response		
Demonstrate how to hold thumb and first finger in open position.		
Say: NOW WE WILL DO IT TOGETHER. PUT YOUR HAND LIKE THIS.		
As you demonstrate the movement, say: NOW PINCH. (R-1)	R-1. Pinches thumb and first finger together with teacher.	
Wait for response and prompt if nec- y.		

Instructor	Student
Say: NOW WE WILL SAY PINCH AS WE DO IT TOGETHER.	
Model the pinching movements as yc say: PINCH. (R-2)	R-2. "Pinch." Makes pinching movements with teacher.
Section 3: Release on Verbal Command Teacher Demonstration	
Say: NOW WE ARE GOING TO LET GO. FIRST I WILL SHOW YOU HOW TO LET GO AND THEN YOU CAN DO IT.	
Demonstrate clearly and slowly the pinching movements as you say: FIRST I PINCH.	
Demonstrate clearly and slowly the releasing movement as you say: AND NOW I LET GO.	
Section 4: Student Response	
Demonstrate how to hc'd thumb and first finger in open position.	
Say: NOW WE WILL PINCH AND LET GO TOGETHER. HOLD YOUR HAND LIKE THIS.	
Demonstrate and wait for student response. (Prompt student if necessary.)	
Say: NOW PINCH. (R-3)	R-3. Pinches with teacher.

Instructor	Student	Remediation
Say: NOW WE WILL SAY PINCH AS WE DO IT TOGETHER.		
Model the pinching movements as you say: PINCH. (R-2)	R-2. "Pinch." Makes pinching movements with teacher.	
<u>Section 3: Release on Verbal Command</u> <u>Teacher Demonstration</u>		
Say: NOW WE ARE GOING TO LET GO. FIRST I WILL SHOW YOU HOW TO LET GO AND THEN YOU CAN DO IT.		
Demonstrate clearly and slowly the pinching movements as you say: FIRST I PINCH.		
Demonstrate clearly and slowly the releasing movement as you say: AND NOW I LET GO.		
<u>Section 4: Student Response</u>		
Demonstrate how to hold thumb and first finger in open position.		
Say: NOW WE WILL PINCH AND LET GO TOGETHER. HOLD YOUR HAND LIKE THIS.		
Demonstrate and wait for student response. (Prompt student if necessary.)		
Say: NOW PINCH. (R-3)	R-3. Pinches with teacher.	

Instructor	Student
Demonstrate and wait for student response. (Prompt student if necessary.)	
Say: AND NOW LET GO. (R-4)	R-4. Lets go with teacher.
Repeat Section 4 until the student correctly completes the task three consecutive times.	Repeats Section 4 three times correctly.
<u>Section 5: Repeated Practice</u>	
Say: NOW YOU WILL PINCH AND LET GO YOURSELF. FIRST PINCH. (R-5)	R-5. Pinches.
Wait for student response. (Prompt student if necessary.)	
Say: NOW LET GO. (R-6)	R-6. Lets go.
Wait for student response. (Prompt if necessary.)	
<u>Section 6: Pinching Shoelace Teacher Demonstration</u>	
Hold the lace in left hand by one end of the lace. The lace should be held at student's shoulder level.	
Say: NOW WE ARE GOING TO LEARN TO PINCH A SHOELACE. FIRST I WILL SHOW YOU AND THEN YOU CAN DO IT.	

Instructor	Student	Remediation
Demonstrate and wait for student response. (Prompt student if necessary.)		
Say: AND NOW LET GO. (R-4)	R-4. Lets go with teacher.	
Repeat Section 4 until the student correctly completes the task three consecutive times.	Repeats Section 4 three times correctly.	
<u>Section 5: Repeated Practice</u>		
Say: NOW YOU WILL PINCH AND LET GO YOURSELF. FIRST PINCH. (R-5)	R-5. Pinches.	
Wait for student response. (Prompt student if necessary.)		
Say: NOW LET GO. (R-6)	R-6. Lets go.	
Wait for student response. (Prompt if necessary.)		
<u>Section 6: Pinching Shoelace Teacher Demonstration</u>		
Hold the lace in left hand by one end of the lace. The lace should be held at student's shoulder level.		
Say: NOW WE ARE GOING TO LEARN TO PINCH A SHOELACE. FIRST I WILL SHOW YOU AND THEN YOU CAN DO IT.		

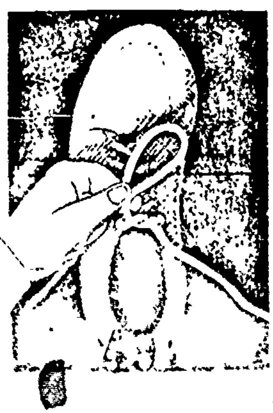
	Instructor	Student
	Pinch lace with right hand as you say: WATCH CAREFULLY. I PINCH THE LACE.	
	Let go of the lace with right hand as you say: NOW I LET GO OF THE LACE.	
	<u>Section 7: Student Pinches Lace</u>	
	Still holding the lace, extend it toward the child. Point to "strong" hand of the child as you say:	
	YOU PINCH THE LACE WITH THAT HAND. (R-7)	R-7. Pinches lace with "strong" hand.
	Say: AND NOW LET GO OF THE LACE. (R-8)	R-8. Lets go of lace.
	Repeat Section 7 until the student correctly completes the task three consecutive times.	Repeats Section 7 three times correctly.

Instructor	Student	Remediation
Pinch lace with right hand as you say: WATCH CAREFULLY. I PINCH THE LACE.		
Let go of the lace with right hand as you say: NOW I LET GO OF THE LACE.		
<u>Section 7: Student Pinches Lace</u>		
Still holding the lace, extend it toward the child. Point to "strong" hand of the child as you say:		
YOU PINCH THE LACE WITH THAT HAND. (R-7)	R-7. Pinches lace with "strong" hand.	
Say: AND NOW LET GO OF THE LACE. (R-8)	R-8. Lets go of lace.	
Repeat Section 7 until the student correctly completes the task three consecutive times.	Repeats Section 7 three times correctly.	

SHOE TYING PROGRAM - LESSON 4

Materials: Shoe with tie laces
Criteria: Student pinches lace just as it comes through the hole, pulls loop through and tighte
three consecutive times correctly.

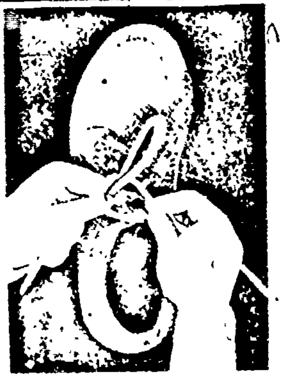
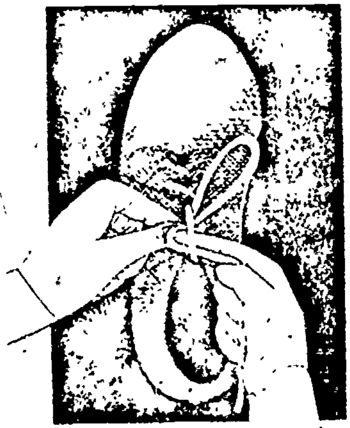
Instructor	Student
Place shoe in front of student, within his reach on a student-size table. The heel should face the student and the laces should be tied to the point of tightening the loops.	
Sit beside student.	
<u>Section 1: Review Lesson 3 Criteria</u>	
Say: YOU PINCH THE LOOPS AND PULL THEM AWAY FROM EACH OTHER. (R-1)	R-1. Pinches loops and pulls away from each other.
Loosen the loops and repeat Section 1 until the student correctly completes the task three consecutive times.	Repeats Section 1 three time correctly.
<u>Section 2: Loop-Making Teacher Demonstration</u>	
Untie the bow-knot, but leave the half-knot tied.	
Say: WATCH CAREFULLY. NOW I AM GOING TO SHOW YOU HOW TO MAKE A LOOP.	
Pinch the lace with your left hand so it forms a loop and say: I PINCH IT LIKE THIS (illustration a).	



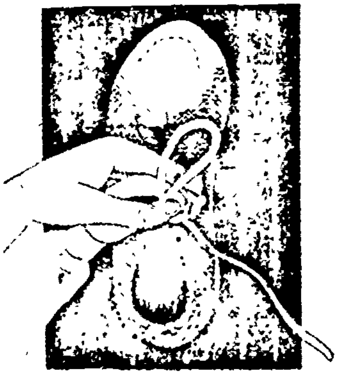
tie laces

inches lace just as it comes through the hole, pulls loop through and tightens bow - secutive times correctly.

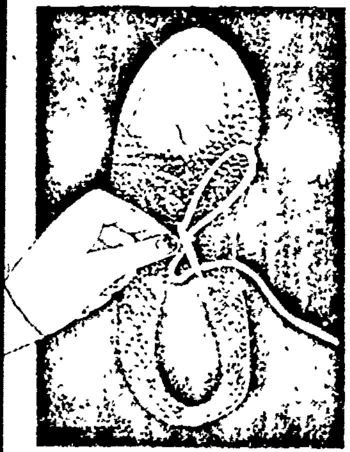
Instructor	Student	Remediation
Place shoe in front of student, within his reach on a student-size table. The heel should face the student and the laces should be tied to the point of tightening the loops.		
Sit beside student.		
Section 1: Review Lesson 3 Criteria		
Say: YOU PINCH THE LOOPS AND PULL THEM AWAY FROM EACH OTHER. (R-1)	R-1. Pinches loops and pulls away from each other.	
Loosen the loops and repeat Section 1 until the student correctly completes the task three consecutive times.	Repeats Section 1 three times correctly.	
Section 2: Loop-Making Teacher Demonstration		
Untie the bow-knot, but leave the half-knot tied.		
Say: WATCH CAREFULLY. NOW I AM GOING TO SHOW YOU HOW TO MAKE A LOOP.		
Pinch the lace with your left hand so it forms a loop and say: I PINCH IT LIKE THIS (illustration a)		

	Instructor	Student
 b.	Make certain you hold the lace loosely as you wrap it around the loop in your left hand and say: NOW I BRING THE OTHER LACE OVER MY FINGERS LIKE THIS (illustration b).	
 c.	Push the lace through the hole so it extends through the hole by no more than $1\frac{1}{2}$" as you say: NEXT I PUT THE LACE THROUGH THE HOLE (illustration c).	
	Drop the laces so the student can pull the bow tight and say: NOW YOU PULL THE LOOPS AWAY FROM EACH OTHER. (R-2)	R-2. Pulls loops away from each other.
	Repeat Section 2 until the student correctly completes the task three consecutive times.	Repeats Section 2 three times correctly.

Instructor	Student	Remediation
Make certain you hold the lace loosely as you wrap it around the loop in your left hand and say: NOW I BRING THE OTHER LACE OVER MY FINGERS LIKE THIS (illustration b).		
Push the lace through the hole so it extends through the hole by no more than $1\frac{1}{2}$" as you say: NEXT I PUT THE LACE THROUGH THE HOLE (illustration c).		
Drop the laces so the student can pull the bow tight and say: NOW YOU PULL THE LOOPS AWAY FROM EACH OTHER. (R-2)	R-2. Pulls loops away from each other.	
Repeat Section 2 until the student correctly completes the task three consecutive times.	Repeats Section 2 three times correctly.	

Illustration	Instructor	Student
	Section 3: Repeated Demonstration and Practice	
	Untie the bow-knot. Say: I WILL HELP YOU MAKE THE LOOP AND BOW. WE WILL DO IT TOGETHER. PLEASE GIVE ME YOUR HAND.	
 d.	Make the loop as you hold the student's left hand in position to pinch the loop (illustration d).	
	Say: PINCH THE LOOP. (R-3)	R-3. Pinches loop with teacher.
	Bring the other lace around your fingers as you say: NOW WATCH CAREFULLY WHILE I MAKE THE OTHER LACE GO OVER YOUR FINGERS.	
	Put the lace through the hole as you say: NEXT THE LACE GOES THROUGH THE HOLE LIKE THIS.	
	Release the student's left hand and say: NOW YOU PULL THE LOOPS AWAY FROM EACH OTHER. (R-4)	R-4. Pulls loops away from each other.
	Repeat Section 3 once or until the student correctly completes the task two consecutive times.	Repeats Section 2 twice correctly.

Instructor	Student	Remediation
<u>Section 3: Repeated Demonstration and Practice</u>		
Untie the bow-knot. Say: I WILL HELP YOU MAKE THE LOOP AND BOW. WE WILL DO IT TOGETHER. PLEASE GIVE ME YOUR HAND.		
Make the loop as you hold the student's left hand in position to pinch the loop (illustration d).		
Say: PINCH THE LOOP. (R-3)	R-3. Pinches loop with teacher.	
Bring the other lace around your fingers as you say: NOW WATCH CAREFULLY WHILE I MAKE THE OTHER LACE GO OVER YOUR FINGERS.		
Put the lace through the hole as you say: NEXT THE LACE GOES THROUGH THE HOLE LIKE THIS.		
Release the student's left hand and say: NOW YOU PULL THE LOOPS AWAY FROM EACH OTHER. (R-4)	R-4. Pulls loops away from each other.	
Repeat Section 3 once or until the student correctly completes the task two consecutive times.	Repeats Section 2 twice correctly.	



e.

Instructor	Student
Section 4: Student Pinches Lace as It Comes through the Hole, Pulls Loop through and Tightens Bow	
Untie the bow-knot. Say: I WILL HELP YOU MAKE THE LOOP AND BOW AGAIN. WE WILL DO IT TOGETHER. PLEASE GIVE ME YOUR HAND.	
Make the loop as you hold the student's left hand in position to pinch the loop. Say: PINCH THE LOOP. (R-5)	R-5. Pinches loop with teacher.
Continue tying the bow up to and including the point at which the loop protrudes approximately 1/2" through the hole (illustration e).	
Point to the student's right hand as you say: PINCH THE BIG LOOP WITH THAT HAND. (R-6)	R-6. Pinches big loop with right hand.
Point to the student's left hand as you say: NOW LET GO WITH THAT HAND. (R-7)	R-7. Lets go with left hand.
Point to the student's left hand again and say: NOW PINCH THE LITTLE LOOP COMING THROUGH THE HOLE WITH THIS HAND. (R-8)	R-8. Pinches little loop with left hand.

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Instructor	Student	Remediation
ection 4: Student Pinches Lace as It Comes through the Hole, Pulls Loop through and Tightens Bow		
ntie the bow-knot. Say: I WILL ELP YOU MAKE THE LOOP AND BOW AGAIN. E WILL DO IT TOGETHER. PLEASE GIVE E YOUR HAND.		
ake the loop as you hold the stu- ent's left hand in position to inch the loop. Say: PINCH THE OOP. (R-5)	R-5. Pinches loop with teacher.	
ontinue tying the bow up to and ncluding the point at which the oop protrudes approximately 1/2" hrough the hole (illustration e).		
oint to the student's right hand s you say: PINCH THE BIG LOOP WITH HAT HAND. (R-6)	R-6. Pinches big loop with right hand.	
oint to the student's left hand as ou say: NOW LET GO WITH THAT HAND. R-7)	R-7. Lets go with left hand.	If student is not pulling loops so as to produce fairly even bows, reach around his shoulders and model the correct behavior once. Follow this modeling by taking the student' hands and assisting him through the movements.
oint to the student's left hand gain and say: NOW PINCH THE LITTLE OOP COMING THROUGH THE HOLE WITH HIS HAND. (R-8)	R-8. Pinches little loop with left hand.	

	Instructor	Student
	Say: AND NOW PULL THE LOOPS AWAY FROM EACH OTHER. (R-9)	R-9. Pulls loops away from each other to tighten bow.
	Repeat Section 4 until the student correctly completes the task three consecutive times.	Repeats Section 4 three times correctly.

Instructor	Student	Remediation
Say: AND NOW PULL THE LOOPS AWAY FROM EACH OTHER. (R-9) Repeat Section 4 until the student correctly completes the task three consecuti e times.	R-9. Pulls loops away from each other to tighten bow. Repeats Section 4 three times correctly.	

SHOE TYING PROGRAM - LESSON 11

Materials: Student's laced shoes
Criteria: Student ties and unties his shoes.

	Instructor	Student
	Place one foot on which the shoe is tied on edge of chair. Sit beside student.	
	<u>Section 1: Untying the Bow-knot Teacher Demonstration</u>	
	Say: NOW YOU WILL LEARN TO UNTIE YOUR OWN SHOE. FIRST WATCH ME CAREFULLY.	
	Pinch the end of one lace in one hand and the end of the other lace in the other hand as you say: I PINCH THE END OF ONE LACE TIGHTLY. DO NOT PINCH A LOOP. I <u>PINCH</u> THE END OF THE <u>OTHER</u> LACE IN MY OTHER HAND. Pull the laces and untie the bow as you say: NOW I PULL THE LACES AWAY FROM EACH OTHER UNTIL THE LOOPS ARE GONE.	
	Retie the student's shoe and repeat Section 1 once.	
	<u>Section 2: Student Unties Bow and Reties his Shoe</u>	
	Leave the student's laces untied. Have him exchange feet on the chair.	

's laced shoes
-ties and unties his shoes.

Instructor	Student	Remediation
Place one foot on which the shoe is tied on edge of chair. Sit beside student.		
Section 1: Untying the Bow-knot Teacher Demonstration		
Say: NOW YOU WILL LEARN TO UNTIE YOUR OWN SHOE. FIRST WATCH ME CAREFULLY.		
Pinch the end of one lace in one hand and the end of the other lace in the other hand as you say: I PINCH THE END OF ONE LACE TIGHTLY. DO NOT PINCH A LOOP. I PINCH THE END OF THE OTHER LACE IN MY OTHER HAND. Pull the laces and untie the bow as you say: NOW I PULL THE LACES AWAY FROM EACH OTHER UNTIL THE LOOPS ARE GONE.		
Retie the student's shoe and repeat Section 1 once.		
Section 2: Student Unties Bow and Reties his Shoe		
Leave the student's laces untied. Have him exchange feet on the chair.		

	Instructor	Student
	Say: NOW YOU WILL UNTIE THE BOW ON YOUR OTHER SHOE.	
	PINCH THE <u>END</u> OF A LACE IN YOUR HAND. BE CARE.UL NOT TO PINCH A LOOP. (R-1)	R-1. Pinches one lace.
	NOW PINCH THE END OF THE OTHER LACE WITH YOUR OTHER HAN: (R-2)	R-2. Pinches other lace.
	NOW PULL THE LACES AWAY FROM EACH OTHER UNTIL THE LOOPS ARE GONE. (R-3)	R-3. Unties bow.
	Untie the ha.f-knot on the student's shoe.	
	Say: TIE YOUR S OE. (R-4)	R-4. Ties shoe.
	Repeat Section 2 until the student performs all of the responses correctly.	
	Section 3: Untying the Half-Knot Teacher Demonstration	
	Say: PULL THE LACES AWAY FROM EACH OTHER SO THAT THE LOOPS ARE GONE. (R-5)	R-5. Unties bow.
	Say: THE BOW IS UNTIED, BUT THERE IS STILL MORE TO DO.	

Instructor	Student	Remediation
Say: NOW YOU WILL UNTIE THE BOW ON YOUR OTHER SHOE.		
PINCH THE END OF A LACE IN YOUR HAND. BE CAREFUL NOT TO PINCH A LOOP. (R-1)	R-1. Pinches one lace.	
NOW PINCH THE END OF THE OTHER LACE WITH YOUR OTHER HAND. (R-2)	R-2. Pinches other lace.	
NOW PULL THE LACES AWAY FROM EACH OTHER UNTIL THE LOOPS ARE GONE. (R-3)	R-3. Unties bow.	
Untie the half-knot on the student's shoe.		
Say: TIE YOUR SHOE. (R-4)	R-4. Ties shoe.	
Repeat Section 2 until the student performs all of the responses correctly.		
Section 3: Untying the Half-Knot Teacher Demonstration		
Say: PULL THE LACES AWAY FROM EACH OTHER SO THAT THE LOOPS ARE GONE. (R-5)	R-5. Unties bow.	
Say: THE BOW IS UNTIED, BUT THERE IS STILL MORE TO DO.		

Instructor	Student
Display your index finger on the hand which corresponds to the "strong" hand of the child.	
Say: THIS IS MY FIRST FINGER. WHAT IS THIS? (R-6)	R-6. "Your first finger."
Curve your finger so it is in a "hooking" position. Insert your curved index finger under knot. Always perform the task with the palm of your hand facing down. (See illustration.) Demonstrate how to untie half-knot as you say: WATCH MY FINGER UNTIE THE HALF-KNOT. I PUT MY FIRST FINGER UNDERNEATH THE HALF-KNOT LIKE THIS.	
THEN I PULL MY HAND UP IN THE AIR LIKE THIS.	
Retie the half-knot and repeat the above step once.	
<u>Section 4: Untying the Half-knot</u> <u>Guided Practice</u>	
Retie the half-knot on the student's shoe.	
Demonstrate how to curve index finger and say: HOLD YOUR FIRST FINGER LIKE MINE. (R-7)	R-7. Curves finger.

Instructor	Student	Remediation
Display your index finger on the hand which corresponds to the "strong" hand of the child.		
Say: THIS IS MY FIRST FINGER. WHAT IS THIS? (R-6)	R-6. "Your first finger."	
Curve your finger so it is in a "hooking" position. Insert your curved index finger under knot. Always perform the task with the palm of your hand facing down. (See illustration.) Demonstrate how to untie half-knot as you say: WATCH MY FINGER UNTIE THE HALF-KNOT. I PUT MY FIRST FINGER UNDERNEATH THE HALF-KNOT LIKE THIS.		
THEN I PULL MY HAND UP IN THE AIR LIKE THIS.		
Retie the half-knot and repeat the above step once.		
<u>Section 4: Untying the Half-knot Guided Practice</u>		
Retie the half-knot on the student's shoe.		
Demonstrate how to curve index finger and say: HOLD YOUR FIRST FINGER LIKE MINE. (R-7)	R-7. Curves finger.	

Instructor	Student
Say: NOW YOU PUT YOUR FIRST FINGER UNDER THE LACE. (R-8)	R-8. Puts finger under knot.
Say: NOW PULL YOUR HAND UP IN THE AIR. (R-9)	R-9. Unties half-knot.
Say: GOOD - YOU HAVE FINISHED UNTYING YOUR SHOE.	
<u>Section 5: Student Ties and Unties His Shoes</u>	
Say: NOW TIE YOUR SHOE. (R-10)	R-10. Ties shoe.
Say: UNTIE YOUR SHOE. (R-11)	R-11. Unties shoe completely.
Have student put other foot on chair.	
Say: NOW TIE THIS SHOE. (R-12)	R-12. Ties shoe.
Say: NOW UNTIE THIS SHOE. (R-13)	R-13. Unties other shoe completely.
Say: GOOD! NOW YOU KNOW HOW TO TIE AND UNTIE BOTH OF YOUR SHOES.	
Say: TIE BOTH YOUR SHOES AND WE ARE DONE FOR TODAY.	
Check on shoe tying skills one day after the completion of the last lesson. Again 3 days after the last lesson...one week...two weeks.	
Contact the student's parents and request that the student be permitted to consistently tie his shoes [illegible]	

Instructor	Student	Remediation
Say: NOW YOU PUT YOUR FIRST FINGER UNDER THE LACE. (R-8)	R-8. Puts finger under knot.	
Say: NOW PULL YOUR HAND UP IN THE AIR. (R-9)	R-9. Unties half-knot.	
Say: GOOD. - YOU HAVE FINISHED UNTYING YOUR SHOE.		
<u>Section 5: Student Ties and Unties His Shoes</u>		
Say: NOW TIE YOUR SHOE. (R-10)	R-10. Ties shoe.	
Say: UNTIE YOUR SHOE. (R-11)	R-11. Unties shoe completely.	
Have student put other foot on chair.		
Say: NOW TIE THIS SHOE. (R-12)	R-12. Ties shoe.	
Say: NOW UNTIE THIS SHOE. (R-13)	R-13. Unties other shoe completely.	
Say: GOOD! NOW YOU KNOW HOW TO TIE AND UNTIE BOTH OF YOUR SHOES.		
Say: TIE BOTH YOUR SHOES AND WE ARE DONE FOR TODAY.		
Check on shoe tying skills one day after the completion of the last lesson. Again 3 days after the last lesson...one week...two weeks.		
Contact the student's parents and request that the student be permitted to consistently tie his shoes [illegible]		

SHOE TYING PROGRAM - REMEDIATION LESSON

Materials: Shoe with Tie Laces
Criteria: Remediating specific skills throughout the lesson sequence.

Instructor	Student's Response
This lesson should be used if during the course of the lessons the student develops deficiencies in learning to tie his shoes. For example, a student may forget a specific skill due to a lay-off period between lessons. In this lesson, the number in parenthesis preceding each section heading is the number of the original lesson to which that section corresponds. For example, (3) "Section 2" means that Section 2 corresponds to Lesson 3's criteria. If the student has lost a specific skill, locate the original lesson in which the skill was taught, find the corresponding section in this lesson, and teach that section. As in all cases, the student must perform the section criteria correctly three consecutive times before moving on. Following the successful completion of the remediating section, it is advised to continue through this lesson, section by section in ascending order, until the student has reached the section corresponding to the lesson in which his deficit was discovered. Rather than working through this section, he should be returned to the normal lesson sequence.	

REMEDIATION LESSON

Tie Laces
ng specific skills throughout the lesson sequence.

ctor	Student's Response	Remediation
used if during the the student dev- learning to tie e, a student may l due to a lay- sons. mber in paren- section heading riginal lesson corresponds. For 2" means that to Lesson 3's t a specific inal lesson in ught, find the in this lesson, . As in all t perform the ctly three con- moving on. ul completion of n, it is advised is lesson, section g order, until d the section cor- on in which his . Rather than ection, he the normal lesson		

REMEDIATION LESSON

Instructor	Student's Response
(1,2) <u>Section 1: Pinching and Pulling</u>	
If the student has difficulty pinching and/or pulling, model the movements in the air and have the student imitate.	
If the above method does not help, teach Lessons 1 and 2 in their entirety.	
(3) <u>Section 2: Student Pulls Bow Tight</u>	
Tie the shoe, stopping at the step where one pulls the loops to finish the bow. Say: YOU <u>PINCH</u> THE LOOPS AND PULL THE BOW TIGHT. MAKE SURE YOU PINCH BOTH PARTS AT ONCE. PULL THE LOOPS AWAY FROM EACH OTHER. (R-1)	R-1. Pinches loops and pulls bow tight.
(4) <u>Section 3: Student Pinches Lace Just as it Comes through the Holes, Pulls Loop through and Tightens Bow</u>	
Tie bow up to and including the point at which the loop protrudes approximately 1/2" through the hole.	
As you hold the student's left hand in position to pinch the loop, say: I WANT YOU TO FINISH TYING THE SHOE.	
Point to the student's right hand and say: PINCH THE BIG LOOP WITH THAT HAND. (R-2)	R-2. Pinches big loop with right hand.

ctor	Student's Response	Remediation
and Pulling		
ficulty pinching the movements e student imi-		
es not help, in their		
lls Bow Tight		
at the step ops to finish NCH THE LOOPS . MAKE SURE T ONCE. PULL CH OTHER. (R-1)	R-1. Pinches loops and pulls bow tight.	
nches Lace Just e Holes, Pulls ens Bow		
uding the point rudes approxi- e hole.		
t's left hand in loop, say: I NG THE SHOE.		
right hand and OP WITH THAT	R-2. Pinches big loop with right hand.	

Instructor	Student's Response
Point to the student's left hand and say: NOW LET GO WITH THAT HAND AND PINCH THE LITTLE LOOP COMING THROUGH THE HOLE. (R-3)	R-3. Pinches little loop with left hand.
NOW PULL THE LOOPS AWAY FROM EACH OTHER. (R-4)	R-4. Pulls loops away from each other.
(5) <u>Section 4: Student Pushes Lace through Hole and Finishes Tying the Shoe</u>	
Make the loop and hold the student's left hand in position to pinch it.	
Say: I BRING THE LACE OVER YOUR FINGERS.	
Point to index finger of student's right hand. Say: NOW YOU PUSH THE LOOP THROUGH THE HOLE WITH THAT FINGER. (R-5)	R-5. Pushes loop through the hole.
AND NOW FINISH TYING THE SHOE. (R-6)	R-6. Finishes tying shoe.
(6) <u>Section 5: Student Brings Lace over his Fingers and Finishes Tying the Shoe</u>	
Say: I WILL MAKE THE LOOP. Point to student's left hand and say: NOW YOU PINCH IT WITH THAT HAND. (R-7)	R-7. Pinches loop with left hand.
HOLD THE OTHER LACE IN YOUR OTHER HAND, AND BRING THE LACE OVER YOUR FINGERS. (R-8)	R-8. Brings lace over his fingers.
NOW FINISH TYING THE SHOE. (R-9)	R-9. Finishes tying shoe.

tructor	Student's Response	Remediation
t's left hand and TH THAT HAND AND OP COMING THROUGH	R-3. Pinches little loop with left hand.	
AWAY FROM EACH	R-4. Pulls loops away from each other.	
Pushes Lace through ying the Shoe		
old the student's on to pinch it.		
ACE OVER YOUR		
er of student's right U PUSH THE LOOP TH THAT FINGER.	R-5. Pushes loop through the hole.	
G THE SHOE.	R-6. Finishes tying shoe.	
Brings Lace over ishes Tying the Shoe		
IE LOOP. Point and and say: TH THAT HAND. (R-7)	R-7. Pinches loop with left hand.	
IN YOUR OTHER LACE OVER YOUR	R-8. Brings lace over his fingers.	
SHOE. (R-9)	R-9. Finishes tying shoe.	

REMEDIATION LESSON

Instructor	Student's Response
7) <u>Section 6: Student Makes Loop and Finishes Tying the Shoe</u>	
Say: YOU WILL NOW MAKE THE LOOP. Point to the student's right hand and say: BEND THE LACE WITH THAT HAND. (R-10)	R-10. Bends lace with right hand.
NOW PINCH THE LACE TOGETHER TO FORM THE LOOP WITH YOUR OTHER HAND. (R-11)	R-11. Makes loop by pinching with left hand.
NOW FINISH TYING THE SHOE. (R-12)	R-12. Finishes tying shoe.
8) <u>Section 7: Student Brings Lace through "Tepee" and Finishes Tying the Shoe</u>	
Say: I WILL MAKE THE "TEPEE." Bring the laces up into the "tepee" position - right in front of left lace.	
Point at the left lace and say: NOW YOU BRING THIS LACE TOWARDS YOU AND THROUGH THE "TEPEE." (R-13)	R-13. Brings left lace through "tepee."
NOW PULL BOTH LACES AWAY FROM EACH OTHER. (R-14)	R-14. Pulls both laces away from each other.
NOW FINISH TYING THE SHOE. (R-15)	R-15. Finishes tying shoe.

tor	Student's Response	Remediation
es Loop and		
THE LOOP. Point hand and say: HAND. (R-10)	R-10. Bends lace with right hand.	
THER TO OTHER HAND.	R-11. Makes loop by pinching with left hand.	
OE. (R-12)	R-12. Finishes tying shoe.	
ngs Lace through ing the Shoe		
TEPEE." Bring tepee" pos- of left lace.		
and say: NOW ARDS YOU AND -13)	R-13. Brings left lace through "tepee."	
Y FROM	R-14. Pulls both laces away from each other.	
OE.	R-15. Finishes tying shoe.	

Instructor	Student's Response
(9) <u>Section 8: Student Ties Half-Knot and Bow</u>	
Say: YOU WILL NOW MAKE A "TEPEE." HOLD A LACE IN EACH HAND. (R-16)	R-16. Holds a lace in each hand.
Point to the student's right hand and say: THE LACE IN THAT HAND ALWAYS GOES IN FRONT OF THE OTHER LACE. PUT THAT LACE (right) IN FRONT OF THE OTHER. (R-17)	R-17. Places right lace in front of the left.
YOU HAVE NOW MADE THE "TE ." FINISH TYING THE SHOE. (R-18)	R-18. Ties shoe from "tepee" step.

ructor	Student's Response	Remediation
Ties Half-Knot and		
AKE A "TEPEE." HOLD (R-16)	R-16. Holds a lace in each hand.	
's right hand and AT·HAND ALWAYS -OTHER LACE. PUT FRONT OF THE OTHER.	R-17. Places right lace in front of the left.	
E "TEPEE." E. (R-18)	R-18. Ties shoe from "tepee" step.	

TEAM II:

ASSESSMENT, INSTRUCTION, AND

INTEGRATION OF HANDICAPPED CHILDREN

Team Members	Coordinator:	Dr. Marie Eaton
	Acting Principal:	Mr. Dale Gentry
	Researcher:	Ms. Kathleen Liberty (1/2 time)
	Researcher:	Ms. Frances Anderson (1/2 time)
	Researcher:	Ms. Corrine McGuigan

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