Evaluation of an Experimental Time-Telling Program for Normal and Mentally Impaired Children

James W. Partington

Follow this and additional works at: https://scholarworks.wmich.edu/masters_theses

Part of the Psychoanalysis and Psychotherapy Commons

Recommended Citation
https://scholarworks.wmich.edu/masters_theses/2380

This Masters Thesis-Open Access is brought to you for free and open access by the Graduate College at ScholarWorks at WMU. It has been accepted for inclusion in Master's Theses by an authorized administrator of ScholarWorks at WMU. For more information, please contact wmu-scholarworks@wmich.edu.
EVALUATION OF AN EXPERIMENTAL TIME-TELLING PROGRAM
FOR NORMAL AND MENTALLY IMPAIRED CHILDREN

by

James W. Partington

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment
of the
Degree of Master of Arts

Western Michigan University
Kalamazoo, Michigan
April 1976
ACKNOWLEDGEMENTS

The author wishes to acknowledge the Kalamazoo Valley Intermediate School District; Paul Wollam, Superintendent; and Annlee Decent, Director of Special Education, for their continued support and encouragement. I would also like to thank Gerald L. Shook, Coordinator of the Kalamazoo Valley Multihandicap Center, for his administrative assistance in running this study. I am indebted to the staff of the Multihandicap Center and Program for the Severely Mentally Impaired that participated in training; secretary, Lucretia Meeth; and the editorial comments of my thesis committee, Paul T. Mountjoy, Brian A. Iwata, and Galen J. Alessi. I would like to especially thank Mark L. Sundberg for his invaluable assistance in designing this study.

James W. Partington
INFORMATION TO USERS

This material was produced from a microfilm copy of the original document. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the original submitted.

The following explanation of techniques is provided to help you understand markings or patterns which may appear on this reproduction.

1. The sign or "target" for pages apparently lacking from the document photographed is "Missing Page(s)". If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting thru an image and duplicating adjacent pages to insure you complete continuity.

2. When an image on the film is obliterated with a large round black mark, it is an indication that the photographer suspected that the copy may have moved during exposure and thus cause a blurred image. You will find a good image of the page in the adjacent frame.

3. When a map, drawing or chart, etc., was part of the material being photographed the photographer followed a definite method in "sectioning" the material. It is customary to begin photoing at the upper left hand corner of a large sheet and to continue photoing from left to right in equal sections with a small overlap. If necessary, sectioning is continued again — beginning below the first row and continuing on until complete.

4. The majority of users indicate that the textual content is of greatest value, however, a somewhat higher quality reproduction could be made from "photographs" if essential to the understanding of the dissertation. Silver prints of "photographs" may be ordered at additional charge by writing the Order Department, giving the catalog number, title, author and specific pages you wish reproduced.

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

Xerox University Microfilms
300 North Zeeb Road
Ann Arbor, Michigan 48106

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
MASTERS THESIS M-8380

PARTINGTON, James William
EVALUATION OF AN EXPERIMENTAL
TIME-TELLING PROGRAM FOR NORMAL
AND MENTALLY IMPAIRED CHILDREN.

Western Michigan University, M.A., 1976
Psychology, clinical

Xerox University Microfilms, Ann Arbor, Michigan 48106
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>16</td>
</tr>
<tr>
<td>III</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>42</td>
</tr>
<tr>
<td>IV</td>
<td>45</td>
</tr>
<tr>
<td>V</td>
<td>49</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
INTRODUCTION

Responding appropriately to time schedules is a fairly complex sequence of behaviors; but since many of man's activities are influenced by time schedule, it is important that man be able to determine the exact time by observing the stimuli presented by a clock. Not only must a person be able to determine the exact time by observing a clock but then he must also be able to estimate the amount of time required to travel to his destination, determine a time to depart and, finally, he must get to his destination on time.

Since individuals living in the community are greatly affected by time schedules, it is clearly a benefit for as many individuals as possible to acquire the skill of time telling, the first step in responding to time schedules. The ability to tell time from a clock cannot be acquired by merely watching the hands on the clock move. Before a person can tell time, it is necessary for the person to receive instruction.

The materials readily available for educators to assist them in their attempts to teach the skill include commercially packaged programs, film strips, movies, books in a story form, and mathematics textbooks. A review of these materials indicates that they are either costly or undesirable for teaching all students and especially for those who are mentally or physically impaired.

Some of these materials are designed for teaching various skills related to the concept of time in addition to teaching the student to
identify the correct time from a clock. Because of this, the materials often require that the students have many prerequisite skills in their repertoire which are more than necessary to identify the time from a standard clock. An example is the program, "What Time Is It?" (Barcott, 1973), which requires that students write the numbers 1 to 60 in three minutes without error; write in groups of five the groups of numbers from 1 to 60 in two minutes without error; and read at or above a second grade level (determined by the Slosson Oral Reading Test). Another program, the TMI-Grolier Time Telling Program for the Mentally Retarded (Bradley & Hundziak, 1965), which utilizes a teaching machine, requires that the students be able to count from 1 to 12 and count by 5's to 55 and have the ability to read 46 simple words which were used in the program as instructions. In order to acquire the skill of time telling by programs similar to these, the student must have learned skills which are not essential to time telling.

An examination of mathematics textbook series indicates that there is no specific procedure to follow in teaching the students to tell time, but rather telling time is presented in small fragments over a period of years. In Mathematics for Individual Achievement Series (1974), the concept of hours and half hours is introduced at the first grade level; quarter hours at the second grade level; five-minute intervals at the third grade level; and finally, minutes at the fourth grade level. Other series such as Heath Elementary Mathematics (1972) and Modern School Mathematics (1974) follow a similar procedure of introducing time concepts over a period of
several years. The various divisions of the hour (i.e., half, quarter, etc.) seem to be presented after the concepts of half, quarter, etc., have been presented in the series. Needless to say, learning to tell time is quite a lengthy process if it is taught over a period of four years, even if many other time skills are presented in that approach. Materials to supplement the mathematic textbooks in the instruction of time telling include film strips, such as Modern Math: Telling Time (Urbancek & Urbancek, n.d.), which introduces the big and little hand of the clock, the face of the clock, hours, half hours, and quarter hours.

There are two problems with the approach of these mathematics textbooks and supplemental materials. The first is that there is no systematic process which the teacher can follow to teach time telling. The teacher must tie together the package of fragmented skills presented in the various materials such that the child can actually tell time to the nearest minute or else the child is left to fill in the gaps for himself. The second problem with this approach is that there is no mastery criterion to insure that, in fact, the child has actually learned to tell time with accuracy.

Since time telling is an important skill for individuals residing in the community, it would seem desirable to have a procedure to teach as wide a range as possible of students to acquire this skill. This would require that prerequisite skills for the procedure only include those skills which are essential to time telling. It would also be desirable to have the procedure systematically sequenced such that a nonprofessional educator could teach this skill. Two other desirable
features would include a mastery criterion to determine when the student has learned to accurately tell time and a procedure to maintain high levels of responding during instruction.

When one considers the behaviors of time telling, it is apparent that it is not necessary to write numbers, count by five's, nor read. The minimum prerequisite skills required before a person could learn to tell time to the nearest minute would seem to merely be the ability to identify the numbers 1 to 12, count from 1 to 30, and be able to discriminate between the big and little hands of the clock. Once a person has acquired these skills, it would be easy to teach him to identify the hours by discriminating the position of the little hand. The person could then be taught to identify whether it was before or after the hour, and then it would be possible to teach him to count the number of minutes before or after the hour as indicated by the position of the big hand. Finally, the person could be taught to identify the half hours. After receiving this instruction, the person would be able to tell time to the nearest minute.

A time-telling procedure was designed to provide those desirable characteristics which have been described. Initially, this procedure was developed for use with mentally impaired children. While teaching those children to tell time, a minor problem with the measure used to assess the children's acquisition of the skill was discovered. Since the procedure seemed to be effective with a wide range of impaired children, the problem in measurement was corrected and then the procedure was used to teach several normal children to tell time.
METHOD

Subjects and setting

Eight subjects were selected for the study (see Table 1). Four of the subjects were classified as multiply impaired, each being mentally impaired along with another impairment. One of the subjects was severely mentally impaired, and three subjects were of normal intelligence. Subjects of various levels of intelligence and handicaps were chosen to demonstrate the effectiveness of this program over a wide range of entry skills.

Subjects 1 through 4 attended school at the Kalamazoo Valley Multihandicap Center. Subject 1 was a 14-year-old deaf and educable retarded female who communicated via American Sign Language. Subject 2 was an 11-year-old educable retarded male who was speech and language impaired. Subject 3 was a 13-year-old female who was hearing impaired and trainable mentally impaired. Subject 4 was a 13-year-old male and was classified as trainable mentally retarded and emotionally disturbed. Subject 5 was a 22-year-old female attending the Kalamazoo County Severely Mentally Impaired Program. Subjects 6, 7, and 8 were females of normal intelligence. Subject 6 was a 5-year-old attending kindergarten half days during the first part of the study. Subject 7 was a 4-year-old who had previously attended a nursery school but was not attending any school while in the study. Subject 8 was a 5-year-old who had no schooling prior to the study but began attending kindergarten half days during the last half of the study.
Table 1

Summary of Subjects' Characteristics

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sex</th>
<th>Age</th>
<th>Intelligence</th>
<th>School Attended</th>
<th>Other Handicap</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>14</td>
<td>Educable mentally impaired</td>
<td>Multihandicap Center</td>
<td>Deaf</td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>11</td>
<td>Educable mentally impaired</td>
<td>Multihandicap Center</td>
<td>Speech &amp; language impaired</td>
</tr>
<tr>
<td>3</td>
<td>Female</td>
<td>13</td>
<td>Trainable mentally impaired</td>
<td>Multihandicap Center</td>
<td>Hearing impaired</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>13</td>
<td>Trainable mentally impaired</td>
<td>Multihandicap Center</td>
<td>Emotionally disturbed</td>
</tr>
<tr>
<td>5</td>
<td>Female</td>
<td>22</td>
<td>Severely mentally impaired</td>
<td>SMI Program</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>5</td>
<td>Normal</td>
<td>1/2 day kindergarten</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>Female</td>
<td>4</td>
<td>Normal</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>Female</td>
<td>5</td>
<td>Normal</td>
<td>1/2 day kindergarten</td>
<td>None</td>
</tr>
</tbody>
</table>
The prerequisite skills required of the subjects included the ability to name the numbers 1 to 12 and to count any quantity of objects from 1 to 30. Subjects were selected for this study only if they had these skills in their repertoire prior to starting the procedure.

The location of the training varied from subject to subject. Subjects 1, 3, and 4 received training in a classroom while Subject 2 received training in a visual and auditory attenuating booth at the Multihandicap Center. Subject 2 was trained in the booth because she was easily distracted by the presence of others in the classroom. Subject 5 received her training in a vision attenuating booth at the Severely Mentally Impaired Program. Subject 6 was trained in a classroom of the Multihandicap Center. Subject 7 was trained in her home, and Subject 8 was trained at both the Multihandicap Center and in her home.

All subjects were trained on an one-subject to one-teacher basis. For Subjects 6 and 7, a single paraprofessional teacher carried out the entire program. Subjects 1, 4, and 8 had two paraprofessional teachers during the program. Subjects 2 and 3 had three paraprofessional teachers, and Subject 5 had four paraprofessional teachers during the program. Teacher turnover was due to changes in instructional assignment schedules for staff at the Multihandicap Center and Severely Mentally Impaired Program.

The experimenter instructed Subjects 6, 7, and 8 while all the other subjects were instructed by psychology students who were working at either the Multihandicap Center or Severely Mentally Impaired Program.
Program. Some of the psychology students received pay for their work while the others received academic credit for their work.

Materials

The clock was a "Touch to Learn Clock" (Constructive Playthings, 1975). The face of the clock was 29 centimeters in diameter, and the numbers of the clock were 4.4 centimeters high. The face, numbers, and the hands of the clock were white and attached to a 34.7 x 34.7 centimeter piece of black cardboard. Each of the minutes on the face of the clock was clearly indicated by .5 centimeter white lines extending into the clock from the perimeter of the face.

For one phase, a circular piece of white paper 30.24 centimeters in diameter was placed over the face of the clock. This covering had a hole in the center to allow the hands of the clock to be over the covering. The paper covered only the face of the clock but not the hands. A line extending from top to bottom was drawn through the center of the covering. On the left side of the line, the word "before" was printed; and "after" was printed on the right side of the line.

Response measurement

During each phase of the procedure, except Phase II, a trial was begun by the instructor asking, "What time is it?" In Phase II, the trial was started when the instructor asked, "Is it before or after?"

---

1Constructive Playthings Catalog, 1040 East 8th Street, Kansas City, MO 64131, 1975.
Once the initial question was asked, the subject was allowed about 10 seconds to initiate a response (about 5 seconds for Phase II). If a response was initiated within that period of time, the instructor would allow the subject to continue with the answer and score the answer as being either correct or incorrect. If a response was not initiated within that period of time, the instructed told the answer to the subject and scored an incorrect response for that trial.

A session was defined as the completion of a specified number of trials for each phase or section of a phase. By this definition, it was possible to complete several sessions each day that an instructor worked with a subject. At the end of each session, the percent of correct responses was determined by dividing the number of correct responses by the total number of responses for that session and then multiplying the result by 100.

Reliability. Reliability was assessed by comparing the instructor's data with the data obtained by another observer who independently recorded the subject's responses as being correct or incorrect. Reliability observers were familiar with the procedure and were either psychology students working at the Multihandicap Center, Severely Mentally Impaired Program, or the parents of the children. Reliability measures were taken for most of the progress checks (probes) and occasionally during the training trials for all the subjects. Reliability was calculated by the following equation:

\[
\text{Percentage of agreement} = \frac{\text{agreements}}{\text{agreements and disagreements}} \times 100
\]
**Procedures**

The time-telling procedure consisted of nine phases with progress checks (probes) between most of these phases and a final generalization phase. The basic sequence of the procedure was as follows: (a) hours; (b) before and after the hour; (c) minutes before and after the hour in five-minute intervals; and (d) the half hours. After the students learned to tell time on the training clock, a real clock was used to generalize the acquired skills. The entire program is outlined in Table II.

**Training.** Subjects were praised after each correct response during the training trials. Some of the subjects were allowed access to other reinforcers intermittently during the sessions for attending behavior, and all subjects received additional reinforcement upon completion of a session. The reinforcers at the end of the sessions often included requested play activities, pop, or candy.

When a subject emitted an incorrect response during training, the instructor would tell the subject that the answer was wrong, explain why the answer was wrong, then present the trial again. This continued until the correct answer was given for that trial. Only the initial incorrect response was scored.

**Phase I.** Subjects were taught to identify the hours first in sequential order (Part A) and in random order (Part B). Both Part A and Part B of this phase consisted of 12 trials for each session. After the subjects mastered the hours in sequence (from one o'clock
<table>
<thead>
<tr>
<th>Program Sequence of the Teaching Program</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Sequence</strong></td>
</tr>
<tr>
<td>Probe</td>
</tr>
<tr>
<td>Phase I (Identification of Hours)</td>
</tr>
<tr>
<td>a. Sequenced</td>
</tr>
<tr>
<td>b. Random order</td>
</tr>
<tr>
<td>Phase II (Before/after Hours)</td>
</tr>
<tr>
<td>a. Before/after discrimination, hr. constant w/cover</td>
</tr>
<tr>
<td>b. Before/after discrimination, hr. constant w/o cover</td>
</tr>
<tr>
<td>c. Before/after discrimination, hr. random w/o cover</td>
</tr>
<tr>
<td>d. Before/after specific hours (one for each hour)</td>
</tr>
<tr>
<td>Probe</td>
</tr>
<tr>
<td>Phase III (1-5 Minutes before/after the Hour)</td>
</tr>
<tr>
<td>a. After in sequence</td>
</tr>
<tr>
<td>b. After in random order</td>
</tr>
<tr>
<td>c. Before in sequence</td>
</tr>
<tr>
<td>d. Before in random order</td>
</tr>
<tr>
<td>e. Before and after the hour in random order</td>
</tr>
<tr>
<td>Probe</td>
</tr>
<tr>
<td>Phase IV (6-10 Minutes before/after the Hour)</td>
</tr>
<tr>
<td>a. After in sequence</td>
</tr>
<tr>
<td>b. After in random order</td>
</tr>
<tr>
<td>c. Before in sequence</td>
</tr>
<tr>
<td>d. Before in random order</td>
</tr>
<tr>
<td>e. Before and after the hour in random order</td>
</tr>
<tr>
<td>Probe</td>
</tr>
<tr>
<td>Phase V (11-15 Minutes before/after the Hour)</td>
</tr>
<tr>
<td>a. After in sequence</td>
</tr>
<tr>
<td>b. After in random order</td>
</tr>
<tr>
<td>c. Before in sequence</td>
</tr>
<tr>
<td>d. Before in random order</td>
</tr>
<tr>
<td>e. Before and after the hour in random order</td>
</tr>
</tbody>
</table>
Table II (continued)

<table>
<thead>
<tr>
<th>Program Sequence</th>
<th>Trials per Session</th>
</tr>
</thead>
</table>

Probes

Phase VI (16-20 Minutes before/after the Hour)

- a. After in sequence 10 trials
- b. After in random order 10 trials
- c. Before in sequence 10 trials
- d. Before in random order 10 trials
- e. Before and after the hour in random order 40 trials

Phase VII (21-25 Minutes before/after the Hour)

- a. After in sequence 10 trials
- b. After in random order 10 trials
- c. Before in sequence 10 trials
- d. Before in random order 10 trials
- e. Before and after the hour in random order 50 trials

Phase VIII (26-29 Minutes before/after the Hour)

- a. After in sequence 8 trials
- b. After in random order 8 trials
- c. Before in sequence 8 trials
- d. Before in random order 8 trials
- e. Before and after the hour in random order 58 trials

Probes

Phase IX (Identification of Half Hours)

- a. Sequenced 12 trials
- b. Random order 12 trials

Probes

Generalization to a Real Clock 60 trials
to twelve o'clock) with 100% accuracy for two consecutive sessions, they then learned to identify the hours presented in a random order.

**Phase II.** The clock was covered with the "before/after paper." Parts A, B, and C of this phase consisted of 20 trials per session, and Part D consisted of 24 trials per session. During Part A, the hour hand was constantly pointing to the bottom of the clock, where the number six is located. The minute hand was randomly moved to the before and after portions of the "before/after paper" and was positioned between 1 to 29 minutes before or after the hour. That is, the minute hand never pointed to the exact hour nor the half past the hour positions. Part B of this phase was identical to Part A except that the "before/after paper" was removed. After the subjects mastered the before and after without the paper covering and with the hour hand held constant on the six, they began Part C which was identical to Part B except that now the hour hand was randomly positioned on the clock instead of being kept on the six. In Part D, 24 trials, one before and one after for each of the 12 hours, were conducted until criteria were met. The minute hand was always somewhere between 1 to 29 minutes before or after the hour. The placement of the hour hand was nonsequential. Examples of a response given during this phase would be, "After 3," or, "Before 7."

**Phase III.** This phase consisted of five parts. In Part A, the student was taught to identify one through five minutes after the hour in sequence while the hour hand was randomly placed at the various hours. For instance, a typical sequence would be: one minute after 6,
two minutes after 11, three minutes after 4, etc. The sessions for Parts A, B, C, and D were 10 trials in length. Part B was the same as Part A except that the minutes (1 to 5) were presented in a random order. Part C was identical to Part A except that it taught 1 to 5 minutes before the hour. Part D was similar to Part C except that the minutes were presented in a random order. Part E of this phase was 20 trials in length and consisted of two trials of each of the minutes both before and after the hour covered in Parts A through D.

**Phase IV.** Parts A through D of this phase were identical to the same parts in Phase III except that it taught the minutes 6 to 10 before and after the hour. Part E of this phase was 20 trials for each session and consisted of one trial for each of the possible combinations of 1 to 10 minutes both before and after the hour.

**Phase V.** This phase concentrated on 11 to 15 minutes before and after the hour. Parts A through D were identical to those in Phase III except that 11 to 15 minutes before and after the hour were taught. Part E was 30 trials in length per session with one trial for each of the minutes from 1 to 15 both before and after the hour.

**Phase VI.** For this phase, Parts A through D were identical to those in Phase III except that 16 to 20 minutes before and after the hour were taught. Part E of this phase was 40 trials in length and consisted of one trial of each of the minutes from 1 to 20 both before and after the hour.

**Phase VII.** Parts A through D were the same as those in Phase III
except the minutes from 21 to 25 both before and after the hour were taught. Part E was 50 trials in length, one trial for each of the minutes from 1 to 25, both before and after the hour.

**Phase VIII.** This phase only dealt with 26 to 29 minutes before and after the hour. Therefore, in Parts A, B, C, and D of this phase, there were only eight trials for each session. For Part E, the sessions were 58 trials in length. This allowed one trial for each of the 29 minutes learned both before and after the hour.

**Phase IX.** This phase taught the students to identify the half hours. There were 12-trial sessions for both Parts A and B of this phase, one trial for each of the hours. In Part A, the half hours were taught in sequence from one-thirty to twelve-thirty; in Part B, they were taught in a random order. Responses for this phase were considered correct only if the subjects emitted their response in the form, "**(hour) thirty.***"

**Generalization.** In this phase, a real clock was used in place of the cardboard training clock. Each session of the phase was 60 trials in length. In this phase, each of the 60 possible minute hand positions served as trials. This resulted in a single "**(hour) o'clock**" answer; a single "**(hour) thirty**" answer; 29 "**(minutes) before (hour)**" answers; 29 "**(minutes) after (hour)**" answers. Once the subject had responded with 100% accuracy for two consecutive trials during this phase, the study was terminated.

**Probe data.** Prior to the initiation of training and after each
phase, except Phase I, each subject was tested on a series of probe trials. Correct responses were not reinforced, nor were incorrect responses corrected. There were two reasons for administering the probe series. The first was so that the instructor could determine if the subject had mastered all material which had been presented; and secondly, to demonstrate experimental control. On the initial design of the procedure for the impaired subjects, the probes were 24 trials in length. The 24-trial probes included two trials from each of the five-minute intervals both before and after the hour with at least one of the trials requiring a "(hour) thirty" answer. Several sets of probe trials were constructed and rotated such that the subjects were not tested continually on the same set of trials.

While teaching the impaired students, a problem with the probe data was noticed. The problem was that there were no "(hour) o'clock" answers required. Because of this, the instructor was unable to determine whether or not the subject had retained this information. The probe procedure was then changed such that four additional trials were added to the probe sequence. All the impaired subjects had both a few 24-trial and a few 28-trial probes. Since the normal subjects began training after the impaired subjects, all probes given to the normal subjects were 28 trials in length.

Experimental design

The design used in this study to demonstrate experimental control was similar to the changing criterion design described by Kazdin (1975) and Hall (1971). This type of design is particularly well
suited for behaviors which require shaping to reach a terminal goal and has been used in studies which decreased cigarette smoking (Axelrod, Hall, Weis & Roher, 1974), increased the number of correct math problems (Hall, 1971), and taught a child to walk (Horner, 1971).

In both the Axelrod et al. (1974) and Hall (1971) studies, the terminal goal was to either decrease or increase the frequency of some behavior currently in the subject's behavioral repertoire. The Horner (1971) study, however, differed in that the experimenter was shaping a behavior which the subject had never previously emitted. All three of these studies were similar in that the criterion for response cost (Axelrod et al., 1974) or reinforcement (Hall, 1971 and Horner, 1971) was made contingent upon the occurrence of a response which met a specified criterion.

In the present study, the behavior to be shaped initially was not in the repertoire of the subjects. Reinforcement was contingent upon individual correct responses as opposed to a series of responses meeting a specified criterion. When the subjects responded at a specified criterion on the probe trials, they were then able to proceed to the next phase of the procedure. After each phase, the criterion for responding on the probe trials was raised since there were more trials which presented material which the subjects had supposedly learned. Failure to respond at or above the specified criterion resulted in remediation of the last training phase completed. As a result, experimental control is demonstrated if the subjects are able to reach or surpass the specified criterion which is raised as the number of phases increases at the end of the phases.
RESULTS

Date for each of the eight subjects are presented in Figures 1 through 4. Since there is a considerable amount of data for each of the eight subjects and because the procedure was altered for some of the subjects, data for each subject shall be described individually with emphasis being placed on design problems in the initial procedure and unusual data obtained from each of the subjects.

Subject 1

The acquisition and probe data for Subject 1 are presented in Figure 1. Since this subject was deaf, all stimuli presented by the trainers, including trials, reinforcers, and corrections, and all responses by this subject were in American Sign Language. The first six of the seven probes were each 24 trials in length and did not require any "(hour) o'clock" responses. During the initial probe, the subject was unable to emit any correct responses. After the demonstration of the "(hour) o'clock" responses, the subject was able to correctly identify each of the 12 hours correctly in sequence. When the hours were presented in a random order, she required seven training sessions in order to meet criterion.

Since the procedure was only in the developmental stages when this subject began training, only Parts A and D of Phase II (before/after the hour) were used during training. In spite of the fact that Parts B and C were omitted, this did not seem to hinder the acquisition
FIGURE 2

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
FIGURE 3
of the skills taught in Part D of this phase. During the second probe, she also was unable to respond correctly since the probe was not sensitive enough to measure any of the skills which she had been taught.

During Phase III (1-5 minutes), the subject committed a few errors during the initial sessions of both of the sequenced parts of the phase (Parts A and C) but was still able to acquire the desired skills in a relatively short period of time. She exhibited 17 percent accuracy on the third probe which indicated that she was able to respond correctly to those stimuli to which she had previously been exposed during training but not to those on which she had not been trained.

During Phase IV (6-10 minutes), she only made one error on Part A; but the remainder of the phase was completed without any errors. The fourth probe resulted in her responding with 25 percent accuracy. Again, she responded correctly to those stimuli which she had previously been trained but was unable to respond correctly to any of the stimuli to which she had not received training.

Phase V (11-15 minutes) was slightly modified such that Parts A and C of the phase were not taught to the subject; only the random presentation of these trials were presented during training. There were only a few errors in training of Part B, and no errors emitted during Parts D and E. Part E of this phase and the previous phase did not provide the subject with a cumulative review of the materials presented in Phases III and IV but was merely a random presentation of those before and after trials which were taught in Phase IV.

When given the fifth probe, she emitted correct responses to only 33 percent of the stimuli presented. Some of the incorrect answers
were to stimuli which measured skills which had been previously taught during Phases III and IV. She then began a remediation phase which was a random presentation of all trials (30) from 1 to 15 minutes before and after the hour. In the first remedial session, she responded with only 50 percent accuracy; but by the seventh session, she was responding with 100 percent accuracy. After several sessions of responding with 100 percent accuracy, she was given a sixth probe on which she responded correctly to only those stimuli to which she had been exposed during training. This resulted in 50 percent correct responding during the probe. After it was noted that she responded incorrectly to some of the stimuli on which she had been trained during previous phases, it was decided that Part E of each of the remaining phases for this subject and Phases IV through VIII for the other subjects (which had not begun training prior to this time) would be a cumulative review of all trials learned after Phase II (before/after the hour) as described in the program description.

Phase VI (16-20 minutes) of the procedure was completed with little difficulty and was followed by the seventh probe which was four trials longer than the previous six probes had been. This longer probe allowed the experimenter to determine whether or not the subject had retained the skills taught in Phase I (hours) of the program. During this probe, she responded correctly to each of the stimuli which she had previously been exposed to during training, including those stimuli which measured skills which had been taught in Phase I.

Phase VII (21-25 minutes) was also completed quickly with the subject emitting only a few incorrect responses. At the end of this
phase, this subject was no longer available for training since she was placed in a different educational setting for the deaf.

During the training and probe sessions, a total of eight reliability checks were obtained. The scores were calculated as specified earlier and resulted in a mean of 96.9 percent accuracy with a range of 75 to 100 percent accuracy. For all of the reliability scores except one, there was 100 percent interobserver agreement. On the one reliability score which was 75 percent, the independent observer was watching the session via closed circuit television and had difficulty in observing the subject's responses which were given in American Sign Language.

Subject 2

The acquisition, training, and generalization data for Subject 2 are also presented in Figure 1. The first seven of the probes for this subject were 24 trials in length. After the subject was unable to respond correctly to any of the stimuli presented during the first probe, the instructor demonstrated the correct responses for Phase I (hours). The subject then completed both parts of Phase I without any incorrect responses.

Parts A, B, and D of Phase II (before/after the hour) were mastered with very little difficulty; however, the subject did have some difficulty with Part C of this phase. His responses during Part C indicated that he was having difficulty in discriminating between the big and little hands of the clock. The probe which followed Phase II indicated that he was still unable to respond correctly to any of the stimuli
presented during the probe.

Phase III (1-5 minutes) was completed quickly and without many errors. During the probe which followed this phase, the subject responded with 54 percent accuracy. He was able to respond correctly to each of those stimuli to which he had previously been exposed during training, and he was also able to respond correctly to many stimuli to which he had not been exposed. The skills which he had learned in Phase III had generalized to stimuli which were similar but had not been presented during training.

Phase IV (6-10 minutes) was completed with the subject only emitting a single incorrect response during Part C. He responded with 67 percent accuracy to the stimuli presented during the fourth probe, which again indicated that he was responding correctly to some stimuli on which he had not received any training.

Phase V (11-15 minutes) was completed by the subject without any errors. During the probe which followed Phase V, he responded with 83 percent accuracy. Correct responses to each of the stimuli which had been presented during training should have resulted in 50 percent correct responding to this probe.

The training of Phase VI (16-20 minutes) was completed without any errors. The subject responded with 100 percent accuracy to all stimuli presented during the probe which followed this phase.

Phase VII (21-25 minutes) was completed with the subject making only one mistake in both Parts A and C. All but one of the responses emitted during the probe which followed this phase were correct. This resulted in 96 percent correct responding during the probe.
Phase VIII (26-29 minutes) was completed with the subject emitting only two incorrect responses, both of which were during Part C of the phase. The probe at the end of this phase was the first 28-trial probe which included the "(hour) o'clock" trials. During this probe, he responded with 89 percent accuracy. Two of the incorrect responses were emitted to stimuli which were presented in Phase I. Because of this, a remediation of Phase I, Part B, was completed prior to starting training on Phase IX.

Phase IX (half hours) was completed with only a few errors during Part B. Upon completion of this phase, the final probe was presented; and he was able to respond to each of the probe stimuli correctly.

A generalization of the skills learned on the training clock to a real clock was then begun. Generalization was completed in only three sessions.

During the training, probe, and generalization sessions, a total of 28 reliability checks were obtained. For each of these checks, there was 100 percent interobserver reliability.

Subject 3

The acquisition and probe data for Subject 3 are presented in Figure 2. This subject did not complete the time-telling program; however, an interesting problem arose during training. The first two probes were the type which did not assess the skills which were taught in Phase I. The initial probe indicated that the subject was unable to answer any of the probe trials correctly. After five sessions,
with one mistake during each of the sessions, this subject was able to meet criterion of identifying the hours in sequence. The other seven subjects had much less difficulty with Part A of Phase I. After Part B of the phase was completed, with less difficulty than Part A, Phase II (before/after the hour) was begun.

Parts A, B, and C of Phase II were completed without much difficulty. Part D of this phase, however, seemed to take an exceptionally long time for this subject to complete. On the second probe, she was still unable to answer any of the trials correctly. This was not surprising since the skills required for this probe had not been learned in the first two phases.

Although there were some errors during training of Phases III (1-5 minutes) and IV (6-10 minutes), training proceeded without many problems. The probe session which was to be conducted between these two phases was forgotten by the instructor.

When the 28-trial probe, which assessed skills learned in Phases I through IV was given, it was noticed that the subject was unable to respond correctly to any of the stimuli which were introduced in Phase I. All responses by the subject during the probe were in the form required for trials which tested "(#) minutes before/after (hour)." A remediation phase consisting of Parts A and B of Phase I was then completed by the subject without error.

Another probe session was conducted immediately following the completion of the remediation phase. During this probe, the percent of correct responses decreased from 43 percent accuracy on the previous probe to a 29 percent accuracy following the remediation proce-
During this fourth probe, the subject responded incorrectly to both the stimuli which required "(hour) o'clock" responses and the stimuli which required "(#) before/after (hour)" responses. She occasionally used the "o'clock" response form where the "before/after" response form was required and vice versa. Since both of these response forms had each been taught separately but not together, it was decided that it would be necessary to design a special phase to teach this subject to discriminate when to use the two different response forms.

Each session of the special phase was 12 trials in length. The hour hand was placed so it directly pointed to a particular number for a sequence of three trials. The first trial in the sequence required a "(1-5) minutes before (hour)" response. The second trial required a "(hour) o'clock" response, and the third trial required a "(1-5) minutes after (hour)" response. After this sequence of three responses was completed, the instructor then moved the hour hand to another hour and repeated the sequence of three responses. Each session of this special phase contained four of the three-trial series.

After 17 sessions of this special procedure had been completed, the subject had never attained greater than 90 percent accuracy on any of the sessions. It was then decided that it would be necessary to change some stimulus dimension such that the discrimination could be achieved by the subject. A piece of construction paper which was blue on the left side and red on the right side was made large enough to cover the 34.7 x 34.7 centimeter piece of black cardboard to which the clock face was attached. A hole 29 centimeters in diameter was
cut in the middle of this paper such that the face of the clock was clearly visible. On the left hand side of the clock was printed "before" and on the right was printed "after." The red and blue pieces of paper were joined together exactly at the top and bottom of the clock. At the top of the clock was a white piece of paper (3 centimeters x 5 centimeters) on which was written "o'clock," with an arrow pointing to the o'clock position of the clock. This cover was attached to the clock for the second part of the special procedure. The subject was initially unable to read the words "before" and "after," but she was able to identify and give the sound of the letters "a" and "b." When told what the words said, she was able to identify the words when asked by the instructor.

In a total of 10 sessions, the subject met criterion for this special phase with the cover on the clock. After she met criterion with the cover, the cover was then removed; and the special phase was repeated for a total of 23 sessions until she was able to meet criterion without the aid of the cover.

Upon completion of this special procedure without the cover, the fifth and final probe session was presented. During the probe trials, she responded correctly to only those stimuli which required a "_ (hour) o'clock" response form; however, she was able to use the appropriate form for the remainder of the stimuli even though she consistently miscounted the number of minutes before or after the hour.

Parts A, B, and C of Phase III (1-5 minutes) were repeated prior to the subject's prolonged absence from school necessitated by a need for major surgery, during which she received a kidney transplant.
There were a total of 29 reliability checks taken during training and probe sessions. The range of interobserver agreement scores was from 92 to 100 percent with a mean of 99.4 percent agreement.

Subject 4

The training and probe data for this subject are presented in Figure 2. The initial probe session (which was the only one for this subject, which was 24 trials in length) resulted in all incorrect responses from the subject. Both parts of Phase I (hours) and Parts A, B, and C of Phase II (before/after the hour) were completed with this subject emitting only a few incorrect responses. When Part D of Phase II was begun, the percent of correct responses drastically decreased to between 0 and 28 percent correct for five sessions. From the subject's responses to the trials, it was apparent that the subject was unable to discriminate between the large and small hands of the clock.

The time-telling program was temporarily terminated while the subject was taught to discriminate between the large and small hands of the clock. After the subject was able to make this discrimination, Part D of Phase II was resumed. Although he seemed to be able to make the discrimination prior to resuming the procedure, some errors still occurred. After 12 sessions, he had met the usual criterion for the procedure; however, the experimenter decided to increase the criterion to insure that the subject had no difficulty with this discrimination because the skill taught in Part D of this phase was a prerequisite for correct responding for a majority of the remainder of the program.
Criterion was then raised to five consecutive sessions with 100 percent correct responding. After learning the large and small hand discrimination, he met the more stringent criterion after 26 sessions. The second probe session (which was 28 trials in length) was conducted following the completion of this phase. All responses by the subject during this probe were incorrect, so a remediation of Phase I, Part B, was begun.

After six remedial sessions, he met criterion; and the third probe session was presented. Again, he was unable to respond correctly to any of the probe stimuli. A special procedure (described in the results for Subject 3) to teach the "o'clock" and "before/after" discrimination was begun. After five sessions in which the subject never achieved greater than 33 percent accuracy, a special cover (used with Subject 3) was added to the training clock on Session 65. This increased the percent of correct responding; and after 20 sessions with this cover, he was able to meet the desired criterion. This subject had a fairly large sight vocabulary and was able to read the words which were printed on the special cover.

Upon completion of this special phase, another procedure was initiated. It was identical to the one just completed except that instead of presenting the four groups of three trials in the order "before," "o'clock," and "after" the three trials for each group were presented in a nonsequenced manner. This subject completed this phase without any incorrect responding.

On the fourth probe which followed these special procedures, the subject responded correctly to those stimuli which required a "(hour) o'clock" response and used the correct form of response for
the remainder of the responses which he was unable to answer.

Since he was able to respond with the correct response forms to the stimuli of the fourth probe, the regular program was continued beginning with Phase III (1-5 minutes). Although there were many errors during each part of this phase, the subject was able to complete the phase. During the probe which followed this phase, he emitted incorrect responses to three of the stimuli on which he had just completed training in the last phase. Therefore, remediation of Part E of Phase III was begun. Upon completion of the remediation, a sixth probe session was administered. On this probe, he was able to respond correctly to each of the stimuli on which he had been trained.

Parts A and B of Phase IV (6-10 minutes) were completed, and Part C was begun prior to the experimenter discontinuing the collection of data on this subject due to time limitations imposed upon the completion of this study.

During the training and probe sessions for this subject, a total of 19 reliability checks were taken. The range of interobserver reliability scores was from 92 to 100 percent with a mean of 99.2 percent agreement.

Subject 5

The training and probe data for Subject 5 are presented in Figure 3. This subject did not complete training on this program, but the data presented some interesting findings. The first three of the probe sessions for this subject were 24 trials in length, while the remainder of probe sessions were each 28 trials in length. On the initial probe,
she failed to answer any of the trials correctly. Training of the "o'clock" responses during Phase I was completed quickly and without any difficulty. Although she made several errors in each part of the before/after discrimination, the number of training sessions required prior to meeting the specified criteria was not excessive.

The probe session which followed Phase II resulted in 0 percent correct responding.

Part A of Phase III (1-5 minutes) required 19 training sessions before the subject met criterion. This was considerably more training sessions than were required for any of the other subjects for this same part of this phase. Parts B, C, and D were completed without many incorrect responses during training; but during Part E of this phase (a random presentation of both 1-5 minutes and before/after the hour), the subject emitted many incorrect responses. During the first training session of Part E, she responded with 85 percent accuracy; however, on subsequent sessions, the percent of responding decreased rapidly to between 30 and 45 percent. After the fifth session of this phase, it was evident she answered only the before/after segment of the response incorrectly. Since the before/after discrimination was learned in Phase II, a remediation of Part D of Phase II was completed prior to the return to and completion of Phase III, Part E.

During the third probe (Session 96), which then followed, the subject responded with 13 percent accuracy, responding correctly to all but one of the stimuli on which she had been trained.

Another probe was given on Session 97 because there was a 16-day
break between the two sessions, during which there was a change in instructors. On this probe (the first of the 28-trial probes for this subject), she responded incorrectly to each of the probe stimuli. A remediation of Phase II, Part D, was then begun since the subject was again having difficulty with the before/after discrimination. She completed this remediation phase after 28 sessions and was then given another probe on Session 126.

Since she was unable to respond correctly to any of the stimuli presented during this probe, a remediation of the entire Phase I and Part D of Phase II was begun. She quickly completed these remediation phases and then was given another probe.

During this probe, she responded to those stimuli which measured the skills learned in Phase I probe (hours) correctly; however, she did have difficulty with those stimuli which required the other response form, i.e., "(#) minutes before/after the (hour)." Since there was this confusion regarding response forms, the special phase which was used for Subjects 3 and 4 was then started. The cover used for Subjects 3 and 4 was not used for this subject. On Session 167, she met criterion for this special phase which presented the series of trials in the sequence of "before," "o'clock," and "after."

Between Sessions 167 and 168, there was a 20-day break during which there was a change of instructors. The new instructor continued the special phase for another 13 sessions until this subject again met the criterion for this special phase. Since she was requiring many sessions of this special phase prior to meeting criterion, it was decided to randomly present the "before," "o'clock," and "after"
stimuli. Upon completion of the random presentation of the stimuli in the special procedure, another probe (Session 193) was given.

During this probe, the subject responded correctly only to three of the four stimuli which required an "(hour) o'clock" response. A remediation of the special phases was again started; and after only three sessions, criterion was met. During a probe which was given immediately afterwards, she responded correctly to each of the stimuli which required a "(hour) o'clock" response and gave the proper response form for the remainder of the trials.

Training was then begun for Phase III (1-5 minutes). Many errors were made during both Part A and C of this phase, although Part B and D were completed quickly and without errors during training. As with Subject 4, data collection for this subject was terminated after completion of Phase III, Part D, due to time limitations imposed upon the completion of the study.

During the training and probe sessions, a total of 43 reliability checks were made. The range of interobserver reliability was from 96 to 100 percent with a mean score of 99.9 percent agreement.

**Subject 6**

The probe, training, and generalization data for the normal subjects 6, 7, and 8 are presented in Figure 4. For each of these three subjects, all of the probe sessions were 28 trials in length.

The initial probe for Subject 6 resulted in all incorrect responses. Training on Phase I was completed without the subject emitting any incorrect responses. Phase II was also completed quickly.
with only a few errors during the training of Parts C and D.

The second probe, which followed training of the before/after discrimination, resulted in the subject correctly responding to each of the stimuli which required an "(hour) o'clock" response. During training of all parts of Phase III (1-5 minutes), the subject emitted only four incorrect responses. On the probe which followed this phase, she scored 32 percent correct, which meant that she responded correctly to each of the stimuli on which she had been trained, plus generalized correctly to one additional probe stimuli.

Only seven errors were made during the training of Phase IV (6-10 minutes). The subject responded correctly to 57 percent of the probe stimuli which followed the training of Phase IV. She generalized on four stimuli correctly in addition to responding correctly to the stimuli on which she had been trained.

Since she responded correctly to each of the stimuli that were to be included during training in the next phase, the sequenced parts of Phase V (A and C) were omitted from training. Only four errors were made during the training of Parts B, D, and E of this phase. Responding during the probe which followed resulted in 79 percent correct responses. Although six of the probe stimuli which were responded to correctly had not previously been trained, the subject did not respond correctly to all of the stimuli to be included during training of the next phase.

Because of this, all parts of Phase VI (16-20 minutes) were included during training. There were no incorrect responses during the training of Parts A, B, C, and D; and there was only one incorrect
response during the first session of Part E. All but four of the probe stimuli which followed the training of Phase VI were responded to correctly.

Since all stimuli which had previously been included during training and all stimuli which were to be included during the training of the next phase were responded to correctly, only Parts B, D, and E of Phase VI (21-25 minutes) were included during training. Four incorrect responses were emitted during Part B, but all responses during Parts D and E were correct. During the probe session which followed this phase, the subject responded correctly to each of the stimuli on which she had been trained and correctly generalized on one stimulus to be included in the next phase to be trained. This resulted in 89 percent correct responding during the probe sessions.

During the training of Phase VIII (26-29 minutes), only two incorrect responses were emitted during Part C. On the probe which followed this phase, the subject responded correctly to all stimuli which had been trained, resulting in a score of 96 percent correct responses.

All responses during the training of Part A of Phase IX (half hours) were correct, but the subject made several incorrect responses during Part B. Each of the stimuli presented during the probe which followed Phase IX were responded to correctly.

Since the subject had completed training, generalization of the time-telling skill to a real clock was begun. Generalization was completed in only four sessions with only a few errors during the first two sessions.
A total of 17 reliability checks were made during the training, probe, and generalization sessions. All of the interobserver reliability measures resulted in 100 percent agreement.

Subject 7

The training, probe, and generalization data for this subject are presented in Figure 4. The initial probe which was given prior to starting training indicated that the subject was unable to respond correctly to any of the stimuli presented. The training of both the "(hour) o'clock" response and the before/after discrimination was quickly completed without the subject emitting many incorrect responses. On the probe which followed the training of Phases I (hours) and II (before/after the hour), the subject responded to 14 percent of the probe stimuli correctly. The stimuli that she responded correctly to were those stimuli on which she had been trained.

Although the subject gave several incorrect responses during training of each part of Phase III (1-5 minutes), she quickly completed this phase without responding at less than 70 percent accuracy on any session. The probe which followed this phase indicated that she was only able to respond correctly to those stimuli on which she had been trained during the first three phases of the procedure.

Phase IV (6-10 minutes) was quickly completed with only three incorrect responses being given by the subject during Part E. On the probe which followed this phase, the subject responded to 82 percent of the stimuli correctly. She appeared to generalize the skills
trained in Phases III and IV to many of the probe stimuli which had not been specifically trained.

Since she responded with a greater accuracy than was expected, the sequenced parts of Phase V (Parts A and C) were not included during training. She correctly answered each of the stimuli presented in the training of Phase V (11-15 minutes). On the probe session following Phase V, she responded with 86 percent accuracy.

Since the subject again responded correctly to many stimuli on which she had not been trained and responded correctly to each of the stimuli which were to be trained in Phase VI (16-20 minutes), Parts A and C were omitted from the training. This phase was completed quickly with only a few incorrect responses being given during Parts B and E. Her responses to the probe stimuli which followed this phase resulted in 89 percent of the stimuli being responded to correctly. Once again, many stimuli on which she had not been trained in addition to the stimuli on which she had been trained were responded to correctly.

Parts A and C of Phase VII (21-25 minutes) were omitted during training. However, the subject began to respond incorrectly to some stimuli to which she had previously responded correctly. Along with this increase in incorrect responses were statements indicating that she was becoming disinterested in the training. It appeared to the experimenter that the training procedure may have been overly redundant in presenting stimuli to the subject which she had correctly responded to in the past. During the probe session which followed this phase, she incorrectly responded to many stimuli to which she
had correctly responded in the past. This resulted in 68 percent
correct responding to the probe stimuli. Verbal comments by the sub-
ject continued to indicate displeasure with continuing the program.

Remediation of 1-25 minutes before/after the hour began with
the subject responding at only 66 percent accuracy during the first
session, and the entire remediation phase only required a total of
five phases. During the probe which followed this remediation phase,
she responded with 93 percent accuracy.

Only Parts B, D, and E of Phase VIII were included during train-
ing. Parts B and D were each completed quickly without any errors.
During Part E of the phase, each session was 58 trials in length.
When the subject emitted an incorrect response to any of the stimuli,
she would verbally indicate that she did not desire to finish that
session. This is probably not an unreasonable reaction since she
would be required to at least finish that session plus an additional
118 consecutive correct responses prior to meeting the criterion for
that part of the phase. After nine sessions, she met the desired
criterion; and during the probe session which followed, she responded
with 93 percent accuracy, correctly responding to each of the stimuli
on which she had been trained.

Phase IX (half hours) was completed with only a few incorrect
responses being given during both parts of the phase. All of the
stimuli from the probe session which followed Phase IX were responded
to correctly.

Generalization of the time-telling skills taught on the training
clock were then generalized to a real clock. Generalization was com-
pleted in only four sessions with the lowest percent of correct responses being given during the first generalization session. In this first session, she responded correctly to 77 percent of the stimuli with most of the incorrect responses occurring during the first part of the session.

A total of 20 reliability checks were taken during the training and probe sessions. There was a range of 95 to 100 percent inter-observer agreement with a mean of 99.7 percent agreement.

Subject 8

The training and probe data for this subject are presented in Figure 4. The initial probe session indicated that the subject was unable to correctly answer any of the probe trials.

Both Phases I (hours) and II (before/after the hour) were quickly mastered without many errors; however, on the second probe session, which followed the completion of Phase II, the subject only responded to one of the stimuli trained in Phase I. After the remediation of both parts of Phase I, a third probe was given; and on this, she responded correctly to all of the stimuli which were used during training in Phase I.

Training during Phase III (1-5 minutes) progressed without any major difficulty although this subject did make some mistakes on the first few sessions of both Parts A and C. During the probe session which followed Phase III, she responded to 32 percent of the stimuli correctly, indicating mastery of all the trials on which she had been trained and generalization of the minutes before/after the hour.
response to one stimuli that had not been trained.

Phase IV (6-10 minutes) was completed quickly with some errors occurring in each part of the phase. During the probe which followed Phase IV, the subject responded to 82 percent of the stimuli correctly. Responding to this probe demonstrated that she was able to correctly respond to each of the stimuli that were to be included in training during the next phase.

Therefore, only Parts B, D, and E of Phase V (11-15 minutes) were trained. When given the probe following the completion of Phase V, the subject responded to 79 percent of the trials correctly. This meant that she responded correctly to one less stimuli than on the previous probe; however, this score meant that she was able to respond correctly to all stimuli which had been trained and, in addition, that she was able to correctly respond to some stimuli which had not been trained.

One of the stimuli she responded to incorrectly was to be taught in the next phase. Therefore, all five parts of Phase VI were included during training. This phase was quickly completed with only a few incorrect responses. On the probe which followed this phase, she responded to 93 percent of the stimuli correctly.

Since the subject responded correctly to all stimuli which were to be taught in the next phase, only Parts B, D, and E of Phase VII (21-25 minutes) were included for training. All but two stimuli were responded to correctly during training of this phase. Following this phase, she correctly responded to 96 percent of the stimuli from a probe session indicating that she was able to correctly respond to all
stimuli which had been presented during training.

Phase IX (half hours) was completed without any incorrect responding. All trials of the final probe were responded to correctly, completing the training portion of the program.

Due to time limitations imposed upon the completion of the study, generalization data were not available for this subject.
DISCUSSION

Of the eight subjects that began training on the time-telling procedure, only four of the subjects completed the training portion of the procedure (Subjects 2, 6, 7, and 8) with three of them also completing the generalization phase (Subjects 2, 6, and 7). Two of the remaining four subjects who did not complete the program were unavailable to finish the program—one because of illness (Subject 3) and the other because of a change in educational setting (Subject 1). Data for the two remaining subjects (4 and 8) were no longer collected after a certain date due to time limitations imposed upon the completion of this research.

After all of the impaired subjects (1 through 5) began the program but before any of the normal subjects began (Subjects 6 through 8), it was noticed that the original probe sessions were not sensitive enough to measure whether or not the subjects were able to correctly respond to the stimuli material presented from Phase I, which taught the "o'clock" response. By not measuring this response, the experimenter was unable to determine whether or not the subjects were able to discriminate when it was appropriate to use either the "(hour) o'clock" or the "(#) minutes before/after (hour)" response form. As a result, several of the impaired subjects (3, 4, and 5) experienced much difficulty later in the program when the experimenter introduced a more sensitive probe measure and observed that they were unable to make this discrimination. A special phase was then designed to teach them this discrimination.

45
A second problem which was noticed was that the initial design of the time-telling program neglected to include a review of the skills taught in the previous phases (with the exception of Phase II) as the training progressed. Whenever a subject responded incorrectly to probe trials which were taught in Phase I, a remediation of that phase seemed to suffice. The skills taught in Phase II (before/after the hour) were used consistently throughout Phases III through VIII. Problems did arise, however, with Subject 1 in that the initial design specified for Phases III through VIII that only the trials trained in each particular phase would be reviewed in Part E of those phases. Since this problem was noticed with the first subject, the remainder of the subjects received a review of all the minute trials trained beginning with Phase IV.

An interesting oversight by the experimenter in regards to prerequisite skill for this program became evident while training Subject 4. During the phase, which taught the before/after discrimination, it became apparent that this subject was unable to discriminate between the large and small hands of the clock. It is clearly the case that this should have been included as a prerequisite for the program.

With two of the normal subjects (7 and 8) in the last few phases of the procedure, another problem arose. Both of these subjects had acquired the time-telling skill rather quickly, but motivation to complete the program seemed to decrease around Phase VII (21-25 minutes). The original program was streamlined during the study such that if the subjects were able to correctly answer each of the probe trials
for a phase prior to the training of that phase, they would then only need to complete Parts B, D, and E of that phase. Even with this streamlining of the phases, it appeared that these subjects still found the program to be overly redundant in presenting trials on which they had responded correctly to many times in the past. A solution to this problem was attempted with Subject 8. For her, Part E of Phases VII and VIII was decreased such that there were only 10 trials during Phase VII, Part E, and 12 trials during Phase VIII, Part E. Responding during the subsequent probe session was not hindered by this change.

Several months after the completion of the program, the mothers of each of the normal children (Subjects 6, 7, and 8) were contacted. The verbal reports from the mothers were almost identical regarding the skills of their children. Each indicated that their child was still able to tell time to the nearest minute with very few errors when asked to do so at home. In all cases, the children rarely used their time-telling skill unless prompted.

The mother of Subject 7 indicated that her child would tell time if a short temporal contingency was specified by the parent. An example would be at 11:45 a.m. the mother might say, "At 12 o'clock, you can go outside." The child was able to then inform the mother when it was 12 o'clock.

Each of these subjects (6, 7, and 8) had difficulty in determining the time when the clock they observed to tell time did not include any marks to indicate exact minutes. Using this type of clock resulted in many incorrect responses from each of these subjects.
The reports also indicated that none of the three children seemed to indicate any behavioral changes in regard to related time concepts. They were able to tell what time it was but were unable to estimate neither the amount of time passed since they last observed the clock nor the length of a specific unit of time, e.g., a minute or hour.

These reports indicate that the time-telling procedure produced desirable effects in teaching some of the subjects to tell time to the nearest minute but that this skill did not result in the children using this skill in their everyday living.

Further research in the area of teaching skills related to time telling could include the generalization of the time-telling skill to clocks which do not have marks to indicate the minutes, teaching children to use this skill during their daily activities, and altering the program such that it would be used to teach groups of children to tell time.
REFERENCES


Constructive Playthings Catalog, 1040 East 8th Street, Kansas City, MO 64131, 1975.


