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ABSTRACT

To individualize instruction in reading, a teacher needs diagnoses of each child's strengths and weaknesses. However, obtaining this information using traditional diagnostic tools is particularly difficult and time consuming because of the variety and complexity of the skills involved. This paper proposes the use of PLATO, a computer-aided instruction system, for the rapid diagnosis of reading skills. A study was conducted to compare the performance of children taking a reading comprehension test on PLATO to that of children taking the same test with paper and pencil. Fourteen fifth graders and 22 sixth graders from a medium-sized parochial school in Madison, Wisconsin, participated in the study. The results showed that with proper response procedures children performed comparably in the two testing situations. This paper contains the details of the study and includes a brief outline of future plans to develop a total on-line diagnostic system. (Author/RB)

Technical Report No. 327

On-Line Diagnosis of Reading Difficulties

by

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Report from the Project on
Conditions of School Learning and Instructional Strategies

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WISCONSIN RESEARCH AND DEVELOPMENT CENTER FOR COGNITIVE LEARNING

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- developing improved instructional strategies, processes, and materials for school administrators, teachers, and children, and
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The activities of the Wisconsin R&D Center are organized around one unifying theme, Individually Guided Education.

FUNDING

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ABSTRACT

To individualize instruction in reading a teacher needs diagnoses of each child's strengths and weaknesses. Obtaining this information, however, using only traditional diagnostic tools, is particularly difficult and time-consuming because of the variety and complexity of the skills involved. This paper proposes the use of PLATO, a computer-aided instruction system, for rapid diagnosis of reading skills.

Determining the computer system's validity as a testing instrument was a necessary first step. Therefore a study was conducted to compare the performance of children taking a reading comprehension test on PLATO to that of children taking the same test with paper and pencil. The results showed that with proper response procedures children performed comparably in the two testing situations. This report describes the details of the study and includes a brief outline of future plans to develop a total on-line diagnostic system.

I

INTRODUCTION

Individualized instruction, which is included in almost all innovative approaches to primary-level education, requires extensive diagnosis of learner characteristics. As examples, both IGE (Klausmeier, in press) and IPI (Glaser, 1970) include assessment of the entry-level abilities of the learner and his learning styles prior to the assignment of a particular instructional program, in addition to pre- and posttesting of all skills taught within the program. Due to the extensive time and manpower required for test administration or observation, these requirements can seldom be realized in a practical program.

To individualize reading at the primary level, for example, data would be needed on each child's general reading ability (i.e., comprehension), plus his abilities on such skills as word recognition, blending, letter-sound generalizations, vocabulary, and recognition of punctuation. And while the comprehension test might be group-administered, the other tests, if they are to be used for instructional placement, would need to be selected separately for each child. In practice, few classrooms, if any, engage in such extensive initial assessment. A single teacher, even with an aide, is generally not equipped to spend the time required nor does a teacher generally have the instruments available for extensive and reliable assessment of reading subskills.

Instead, all children usually take the same tests and only the rate of progress through the program varies across students. Those who are not meeting minimal expectations are referred to the reading specialist or school psychologist, who then may administer a battery of diagnostic tests.

The hiring of more testing specialists, especially at the beginning of the school year, is one approach to bringing practice closer to what is theoretically desirable according to the models of individualized instruction. This approach has obvious limitations in that these specialists are relatively expensive, especially at a time when most school systems are finding an ever-increasing chasm between themselves and solvency. Another approach, which is the concern of this paper, is to automate the administration and scoring of diagnostic tests, in particular, by means of an interactive computer terminal.

II

POTENTIAL ADVANTAGES OF ON-LINE DIAGNOSIS

Although computers are usually viewed as highly impersonal devices with enormous potential for dehumanizing everyday life, there are a number of features to computerized systems which actually work in the opposite direction of this characteristic--especially when compared to what children are subjected to when tested by humans. A computer-administered testing program, if properly constructed, would continually monitor student responses so that tests that were too easy or too difficult would not be taken to completion. Instead, upper and lower bounds would be set for each test, based on desirable levels of reliability. Once either of these limits was crossed, a different test would be selected or the process terminated. Under human testing, a test is normally taken to completion before performance is evaluated.

A second potential feature of an automated diagnosis system is its ability to select from a variety of possible testing paradigms. A reading specialist usually learns to administer one or, at most two, tests for each reading skill. With mass storage costs dropping continually, a system can be envisioned in which dozens of tests for each reading skill could be available immediately and selected automatically on the basis of student responses. In fact, except for limits on utility (and copyright approval) all available tests that can be scored automatically could be computerized.

A third potential advantage is cost, although this is clearly a potential advantage and not an immediately realizable advantage. The type of terminal required for on-line diagnosis sells today for approximately six thousand dollars. This is less than half of the usual salary of a school psychologist. Assuming that such a terminal were taken from school to school and connected by phone line to a local computing center, the per-hour operating cost, including computer time, terminal amortization, and maintenance would be considerably less than two dollars per hour. This leaves software development--an admittedly large expense--to be accounted. But a good system, developed for use on a variety of computers, could be amortized over a large number--possibly millions--of students. Therefore, its development costs would not add substantially to the per-hour use charge. Furthermore, the use of federal research and development funds might eliminate the need to recover development costs from users, especially if the system were administered through a nonprofit organization.

These are not the only advantages--or potential advantages--to an on-line diagnosis system for reading, but they are sufficient to justify further exploration of the matter. (For a brief review of computer-assisted testing, see Ferguson and Hsu, 1971.)

III

THE WISCONSIN ON-LINE READING DIAGNOSIS SYSTEM

Through a cooperative agreement between the Wisconsin Research and Development Center for Cognitive Learning at the University of Wisconsin and the Computer-based Education Research Laboratory at the University of Illinois, a PLATO terminal was installed at the University of Wisconsin in December 1973. The Pre-Reading Skills Project which, despite its name, has been exploring both reading and prereading skills for the past eight years (see Calfee, Venezky, & Chapman, 1969; Venezky, in press), then began a feasibility study on the use of PLATO for an on-line reading diagnosis system.

The end result of this work is envisioned as a complete on-line diagnostic system that would ascertain a student's IQ, oral comprehension, reading comprehension, and strengths and weaknesses in specific reading skills (e.g., letter-sound generalizations, blending, word recognition) in a single 30 to 40 minute session. According to student responses, testing paradigms and the sequencing of subtests would be varied. Animation, humor, and other highly motivating devices would be used to maintain interest and to ensure a high subtest reliability. For each student tested, teachers would receive a printed report in conversational English, giving diagnosis results in a form that could be directly related to instruction. No instructional suggestions are planned for the system. This paper, covering software development and testing experiments, is an interim report on this project.

HARDWARE

The hardware configuration for implementing this system now includes:

1. The standard PLATO terminal, including an 8-1/2 inch square plasma panel for character and graphic display, keyboard, and a random-access slide projector for rear-projection on the display panel. (For a full description of these items, see Stifle, 1973.)

2. A touch panel that fits around the plasma panel and detects any object that is placed near the panel surface by means of an infrared system. A grid of lights and photocells, 16 across and 16 down, is used, giving the capability of detecting objects as small as the finger of a young child.

3. A random-access audio recording and playback unit. This system is still under development at the University of Illinois, but is adequate for experimental work. Recordings are made on a removable, thin mylar disk, approximately 13 inches in diameter, which allows about 21 minutes of recording. However, the longest single recording segment is only about 11 seconds. The unit interfaces to the terminal and for head movement uses the same pneumatic system as the slide projection unit. Average time for location of a selected segment is about 3/10 second.

4. A Centronix printer (Model 306) that is interfaced to the PLATO terminal through a buffer memory which was built at the University of Wisconsin.

   The entire system is intended for use in a small mobile van that would move, as required, from school to school during the academic year. Children could either be tested in the van--thus requiring power and phone connections--or the equipment could be moved into the school building. Testing in the van would probably be used for brief visits, while equipment stationed in the school building would probably be maintained for extensive use. A similar arrangement is being used successfully by the CARE project at the Pennsylvania State University for an on-line system (see Hall and Mitzel, 1973). In the CARE system, a small computer and 16 student stations are transported in a van, which is then expanded at its school site into a full Computer-Aided Instruction laboratory.

SOFTWARE DEVELOPMENT

Three major programs have been developed for experimental use. The first program (WORD) is a control program that will eventually monitor the entire diagnostic system. At present it contains sign-on protocols and a general same-different test driver. The test driver allows users to enter same-different test items (letter-strings) and to specify the display format (horizontal or vertical) for a presentation, the spacing between items, and the exposure duration. Selection of items is random for each presentation.

The second program contains an on-line version of the comprehension subtest of the Stanford Diagnostic Reading Test, Level II, Form W, and units for collecting and analyzing student responses. The format of this test is further discussed in the following sections.

The third program, developed by a student for a course in Computer-Aided Instruction, is a general test driver for multiple-choice tests.

IV

EXPERIMENTAL STUDIES

To aid in the development of data presentation and student response modes, student behavior in an on-line testing situation was compared with behavior in a traditional paper-and-pencil test situation. The goal of these tests was to find on-line presentation and response modes that would lead to results comparable to those obtained with paper-and-pencil testing. At this stage, there was no attempt to find on-line paradigms which would yield higher scores than would be found in a paper-and-pencil mode with comparable students.

STUDY I

Materials

The comprehension subtest of the Stanford Diagnostic Reading Test, Level II, Form W, was selected as the testing instrument because of its widespread use and its apparent adaptability to the PLATO system. (This adaptability factor proved to be more illusory than real, but by the time certain problems were encountered, permission to use the test had been received from the publisher, and a testing schedule established; hence no change in instruments was made. These problems are described in the following discussion.)

The published version of the test has 18 paragraphs. In each paragraph, two to eight words have been replaced with numbered blanks. Four alternatives are given for each blank and the subject is asked to mark one choice for each. (There are sixty blanks in the test.) The paragraphs, which vary in length from 23 to 157 words, appear once each, followed by their sets of alternatives. However. due to space limitations of the PLATO display panel, the on-line version was programmed to display only one set of alternatives at a time. As each item was answered, the screen was erased and the context and alternatives for the next item were displayed. For all paragraphs except the last, the context was the entire paragraph. The last paragraph was too long to be displayed concurrently with a set of alternatives, so it was divided into three sections of approximately equal length.

These changes led also to a change from the item-identification system used in the published version. Since in the on-line version a subject's previous responses were not available to him, he could not easily identify the next item that was to be answered. Therefore, the original numbers in the blanks were deleted and a question mark placed in the space which was to be filled next. This question mark blinked for approximately four seconds and then remained steady until a response was made and the display erased. Only one question mark was present in a reading passage at any time. To preserve comparability, the paper-and-pencil version was retyped in a format similar to the on-line version, using the same size type as appears normally on the display panel (see Appendix A).

To select a response in the on-line format, the subject indicated the word he had selected to fill the blank by using his finger to touch the box containing it. His selection was then recorded by the test program, the screen erased, and the next selection displayed--all in about three seconds. The alternatives were displayed in individual rectangular boxes to help direct the subject's touch directly onto the word he was selecting. Boxes were also used on the paper-and-pencil test to set apart answer choices. To indicate his choice in this format, the subject wrote an X in the box he had selected.

Because a response could not be changed once the plasma panel had been touched, answer changes were not allowed on the paper-and-pencil test. The subject could respond in one of five ways on the paper-and-pencil test; he could select one of the four answer choices or he could skip the item if he did not know the correct response. In the on-line format, the subject was told to respond in one of five ways: either touch one of the four answer choices or push the NEXT key on the keyboard to indicate that he did not know the answer. In practice there was a sixth alternative. If the subject touched any part of the keyboard that was not enclosed by a box, the response was registered as a special 'no' response, and the next selection was displayed. No feedback was given in either the paper-and-pencil test or in the on-line testing mode.

Procedure

The on-line test was administered at the PLATO terminal in the Wisconsin R&D Center on the University of Wisconsin campus. Subjects were brought to the building three or four at a time, and carried school work with them to occupy their waiting time. Each subject was individually tested on the terminal, beginning with four sample items that made the method of response familiar. Once the examiner entered the subject's name, age, and sex on the terminal, the directions and first two sample items were presented to him by the panel display and audio unit. For these examples, the subject was given positive or negative reinforcement depending upon the choices made. Then the audio unit instructed the subject to do the last two sample items by himself. The subject was also given instructions to push the NEXT key if he did not know an answer. During the entire testing period for Studies 1 and 2, only one subject was interrupted by a system failure.

The written test was given to the entire paper-and-pencil group at one time in the school lunchroom. The proctor read the directions and the first two sample items, gave feedback for the first two responses, and made sure the mechanics of answering were understood. The proctor also explained that answer changes would not be allowed. Both groups were asked to do their best work.

Subjects

Fourteen fifth graders and twenty-two sixth graders from a medium-sized parochial school in Madison, Wisconsin, participated in the study. The school is considered an inner-city school by the City of Madison because of the number of families on welfare and the percentage of enrolled minority children. Each subject was randomly placed in either the on-line group or the paper-and-pencil group. Each group contained seven fifth graders and eleven sixth graders. The mean age for both groups was 11.7 years. The reading teachers of the children who were involved in the testing procedures inspected the group lists and affirmed that the groups contained an even number of strong and weak readers. Since the school uses an individualized reading program and did not give standardized reading tests to the children involved in the experiment in 1974 or in 1973, no further check for randomization was possible.

Results

The mean number correct for the paper-and-pencil group was higher than the mean number correct for the on-line group at both grade levels (see Table 1).

TABLE 1

MEAN NUMBER OF CORRECT RESPONSES BY GRADE AND TEST MODE (MAXIMUM = 60)

Grade	Paper and Pencil		On-line	
	N	$\overline{X}$	N	$\overline{X}$
5	7	34.29	7	29.57
6	11	43.82	11	35.18
total	18	40.11	18	33.00

A two-way analysis of variance (grade x test mode) on the mean scores shown in Table 1 showed significant main effects for grade ($F [1/32] = 6.353$, $p < .05$) and for test mode ($F [1/32] = 4.938$, $p < .05$). The interaction between grade and test mode was not significant.

A t-test on test mode (collapsed across grades) showed that the paper-and-pencil group was significantly better than the on-line group ($p < .05$). As expected, a second t-test showed that the sixth graders were significantly better than the fifth graders ($p < .05$). (The Stanford Level II test is designed to be used from the middle of the fourth grade through the middle of the eighth grade.) Additional independent t-tests showed a significant difference ($p < .05$) between the two test modes in the sixth grade but showed no significant difference between the two test modes in the fifth grade.

Comparisons were also made of the number of times each group chose not to respond (no response) and the number of times the two on-line groups (fifth and sixth graders) touched parts of the screen outside of the response areas (illegal responses). These data are summarized in Table 2. The difference in illegal responses between fifth and sixth graders shows that the sixth graders were somewhat less careful, and probably less serious, than the fifth graders in the on-line task. However, since sixth graders averaged only two illegal responses each, this response category does not appear to explain the test-mode differences at that grade level. Although the differences in "no responses" between test modes are relatively large, the

TABLE 2

IRREGULAR RESPONSES

Grade	No response		Illegal response
	On-line	P&P	On-line
5	37	20	4
6	13	3	21

"no responses" represent 5 percent or less of the total responses and therefore cannot be considered important.

Testing times averaged across grades for the two modes were nearly identical, as were the testing times between grades for the on-line mode (17.71 min. for the fifth grade versus 17.27 min. for the sixth grade.)

The error patterns were also similar across grades and across test modes. A Spearman rank-order correlation for items ranked according to number of errors showed a correlation significantly higher than chance between the two test modes (collapsed across grades: $r=.76$, $p < .01$), and between the two grades (collapsed across test modes: $r=.76$, $p < .01$). In other words, if many paper-and-pencil subjects missed a particular item, it was highly likely that relatively many on-line subjects would miss the same item. Also, if many sixth graders missed an item it was quite likely that (relatively) many fifth graders missed that same item.

Discussion

The high rank-order correlation between test modes, based on items ranked by total errors, indicates that the on-line presentation preserved the relative item difficulties of the traditional presentation. That is, the on-line mode did not introduce effects that acted differentially according to test item. (This does not rule out the possibility, however, that the presentation mode interacted with student ability.)

The superiority of the paper-and-pencil mode at both grade levels might have been due to the student's familiarity with traditional testing and lack of familiarity with on-line testing. As far as we could determine, none of the students had ever worked at a computer terminal before this experiment. However, attention appeared to be better for the on-line students and all except one appeared to work diligently and seriously at the task. A more plausible hypothesis is that the response procedure programmed for the on-line format produced more extraneous or undesired responses than occurred in the paper-and-pencil format. Since the display changed as soon as a response was detected, the on-line subjects had no way to tell if the alternative they intended to select did in fact register. Furthermore, any interception of the touch panel's light detection system registered a response, even if it were caused by an accidental probe. Several subjects stated that the system occasionally registered a response before they felt they had actually indicated their choice. Therefore, changes were made in the response protocol to prevent accidental responses from registering, to allow alteration of responses made, and to show when an area outside of the response areas had been touched so that a legitimate response could be made. These changes are described in the next study.

STUDY II

Materials

The test questions from Study I were used in this study. However, at the time each display was presented, the alternatives were no longer enclosed in boxes. When a word was touched, a box then appeared around that word. If the subject was satisfied with that choice, he touched the same word again. This registered the response and displayed the next question. If the subject was not satisfied with the choice that registered, he could touch another word. This made the box disappear from around the subject's last choice and reappear around the new choice. In this way, the subject could change his mind and answer choice as many times as he wished. To register an answer and display the next item, the subject had to touch the same word twice in succession. If the subject touched a non-word area on the screen, a sign appeared at the bottom of the screen explaining that the area touched had not been a word. The option of pushing the NEXT key when the subject did not know the answer was still available. Thus for this study the subject was allowed five response possibilities--one of the four answer choices or the NEXT key, which was equivalent to making no response.

The same paper-and-pencil test was used as in the first experiment, but this time the subjects were allowed to change their answers as long as they were still working on a page. (Two items appeared on each page.) They were not allowed, however, to check back over their responses once they had gone on to the next page as this was not possible on the on-line test.

Procedure

The on-line test was administered at the Center in the same manner as in Study I. The audio device was used to explain the sample items and the method of response. Each subject practiced answering questions, changing answers, and pressing the NEXT key. Earphones were worn to improve the clarity of the recordings. If the subject did not touch a word during the sample items, an audio message explained that a word had not been touched and asked the subject to try again. The complete introduction is shown in Appendix B.

The written test was given in a room at the children's school. The same procedure was used with the sample items as in the first experiment, but with the previously mentioned change in instructions. Time needed to complete the test ranged from 13 to 30 minutes, with most subjects finishing in about 20 minutes.

Subjects

The subject sample consisted of the same 22 sixth graders who had participated in the first experiment. The group that had previously taken the paper-and-pencil test took the on-line test. The group that had previously taken the on-line test took the paper-and-pencil test. The mean age for the new on-line group was 12.1 years and the mean age for the new paper-and-pencil group was 12.2 years.

Results and Discussion

Table 3 shows the sixth-grade mean scores for the first experiment (Study I) and the second experiment (Study 2).

TABLE 3

SIXTH GRADE MEAN SCORES

STUDY	Paper and Pencil		On-Line	
	N	$\overline{X}$	N	$\overline{X}$
I	11	43.82	11	35.18
II	11	40.55	11	43.18

The difference in scores for the two test modes was not significant ($t = 0.7633$, $df = 20$, $p > .05$). This was interpreted to mean that the test modes were equivalent--a conclusion reinforced by the nearly identical scores for paper-and-pencil subjects in Study 1 ($\overline{X}$=43.82) and the same subjects in the on-line mode in Study 2 ($\overline{X}$=43.18).

V

FUTURE DEVELOPMENT

Work is now in progress on on-line diagnostic tests for letter-sound generalizations, drawing on earlier work reported by Venezky, Chapman, and Calfee (1972) and Johnson and Venezky (1970). Three testing formats are being considered. The first is similar to the one described in Johnson and Venezky (1970) in which real words are used as alternatives for letter-sound patterns which occur in non-word targets. The second, which was devised especially for on-line testing, provides oral alternatives for a visually displayed pseudo-word. For example, the subject might see <u>cipe</u> and then have to choose between [sip], [kaip], and [saip]. The third involves a display of a synthetic word (e.g., <u>nupe</u>) with the simultaneous playback of a possible pronunciation (e.g., /nʌp/). The subject indicates whether the pronunciation is "correct" or not. One or more of these formats will be programmed and tested on primary level children during the 1974-75 school year.

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APPENDIX A

Sample from Paper-and-Pencil Version
(Stanford Diagnostic Reading Test,
Level II, Form W*)

GPO 808-0/6-4

A MACHINE OF THIS SCOPE WAS REJECTED, HOWEVER, BECAUSE WHEN TEACHING CHILDREN, SO MANY UNEXPECTED THINGS HAPPEN ABOUT WHICH THE SPACE AGE TEACHER WOULD NOT BE ABLE TO MAKE __?__. ALSO, ITS MAJOR ADVANTAGE, THE ABILITY TO TEACH EACH STUDENT INDIVIDUALLY, IS ITS MAJOR DISADVANTAGE, IN THAT THE AMOUNT OF EQUIPMENT IS PROHIBITIVE IN TERMS OF _____.

?

QUESTIONS	DECISIONS
TABULATIONS	SCORES

A MACHINE OF THIS SCOPE WAS REJECTED, HOWEVER, BECAUSE WHEN TEACHING CHILDREN, SO MANY UNEXPECTED THINGS HAPPEN ABOUT WHICH THE SPACE AGE TEACHER WOULD NOT BE ABLE TO MAKE _____. ALSO, ITS MAJOR ADVANTAGE, THE ABILITY TO TEACH EACH STUDENT INDIVIDUALLY, IS ITS MAJOR DISADVANTAGE, IN THAT THE AMOUNT OF EQUIPMENT IS PROHIBITIVE IN TERMS OF __?__.

?

SPACE	SKILL
TIME	COST

[Test items 1 and 2]

SEVERAL TIMES A DAY JUDY WANTS TO PRACTICE HER PIANO LESSON. SHE MUST LIKE TO __?__ THE PIANO. MAYBE SHE WANTS TO BECOME A ______.

CLEAN	BREAK
MOVE	PLAY

SEVERAL TIMES A DAY JUDY WANTS TO PRACTICE HER PIANO LESSON. SHE MUST LIKE TO ______ THE PIANO. MAYBE SHE WANTS TO BECOME A __?__.

MUSICIAN	MECHANIC
PHYSICIAN	SINGER

[Test items 59 and 60]

APPENDIX B

Protocols for On-Line Version

Study 2

TOUCH ME

Display 1

Comment: Child has earphones on and is ready to begin.

Audio: No audio. Child touches screen to begin.

Directions: Find the one word that belongs in the space with the ? and touch that word with your finger.

Sample:

The mouse ran away when it saw the __?__.
The mouse was ____.

cat	hole
cheese	table

?

Display 2

Audio: "Let's read the directions at the top of the page together. Find the one word that belongs in the space with the question mark and touch that word with your finger. Now let's read the sentence with the question mark. The mouse ran away when it saw the ____. The answer words below are cat, hole, cheese, table. Touch the word that best completes the sentence.

Comment: The subject touches cat--a box is drawn around cat and subject hears the message: "You chose the word with the box around it. Check your answer. If you're happy, touch the word again. If you want to change your answer, touch another word." If subject touches cat again, the message: "Very good. Cat was the right answer," is played and Display 3 appears.

If the subject does not touch cat, a box is drawn around his choice and he hears the message: "You chose the word with the box around it. Check your answer. If you're happy, touch the word again. If you want to change your answer, touch another word." If the subject touches the same wrong word again, he receives the message: "You picked the wrong answer. Touch another answer." If he then touches cat, he will proceed as above. The box will continue to move until he has touched one word twice, whereupon display 3 will appear.

Directions: Find the one word that belongs in the space with the ? and touch that word with your finger.

Sample:

The mouse ran away when it saw the ____.
The mouse was _?_.

?

hungry   happy

afraid   glad

Display 3

Audio: "Now let's read the next sentence together. The mouse was ____. Touch the word below that best completes the sentence."

Comment: If the subject touches afraid, a box is drawn around it. If the subject touches it again, he hears the message: "Good for you. Afraid was the right answer," and Display 4 appears.

If the subject doesn't touch afraid, a box is drawn around his choice and the audio asks if he is happy with his choice. If the subject touches the same word again, he receives the message: "No. The correct answer was afraid," and Display 4 appears.

Directions: Find the one word that belongs in the space with the ? and touch that word with your finger.

Sample:

The cactus is _?_ that grows in the desert. It can survive with almost no ____.

a plant   a hill

?

an animal   an insect

Display 4

Audio: "Now read the last sentence by yourself and touch the word below that best completes the sentence."

Comment: When the subject touches any word, a box is drawn around his choice. When he touches the same word again, he receives the message: "Look at the keyboard. See the gray key at the right with -NEXT- written on it. When you don't know an answer touch the -NEXT- key to go on. Touch the -NEXT- key now." When the subject touches -NEXT- Display 5 appears.

GPO 808-046-3

Directions: Find the one word that belongs in the space with the ? and touch that word with your finger.

Sample:

The cactus is ____ that grows in the desert. It can survive with almost no __?__.

sun heat

?

[water] air

Display 5

Audio: "Now read the sentence to yourself and touch the word below that best completes the sentence."

Comment: When the subject touches any answer, a box is drawn around his choice and he hears the message: "Let's practice changing answers. Pretend the word in the box is not the word you want. Touch another word." After the subject changes his answer, he hears the message: "OK. If you are happy with this answer, touch the same word again. If you want to change your answer again, touch another word." As soon as the subject has touched a word twice, Display 6 appears.

TAKE OFF YOUR EARPHONES.

TOUCH HERE TO BEGIN THE TEST.

Display 6

Audio: "When you are ready to begin the test, take off your earphones and touch the screen."

Comment: The subject has now had practice in all of the test procedures. He removes his earphones, touches the screen, and is shown the first test question.

GPO 808-046-2