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ABSTRACT

This study of 22 individuals (ages 13-20) with cerebral palsy investigated the use of scanning, an interface technique that allows access to assistive devices such as communication boards, electronic augmentative communication devices, and computers by using a pointer, either a finger or a cursor. This packet of information includes the findings of a comparison of three basic modes of scanning use with electronic devices (automatic, inverse, and step), and information on the Scanning Assessment Tool. The study examined which scanning mode provides the greatest accuracy for individuals with cerebral palsy and the effects of cursor speed. A second analysis examined the difference between pre-hits, post-hits, no hits, and scanning mode. The study's results were not definitive; persons with different types of cerebral palsy may or may not be more successful when using a particular type of scanning. The results do indicate that when persons are potential candidates for using scanning, each mode should be evaluated separately. The study found that all subjects had higher accuracy scores when using a slower scanning speed and that there were significant differences between pre-hits, post-hits, and no hits and cerebral palsy type. An appendix includes the survey the clinicians used for the Scanning Assessment Tool and information on assessing selection control techniques. Instructions for installing and using the Scanning Assessment Tool are attached, along with a reprint of an article, "Scanning Assessment Tool: Assessing Selection Control Techniques" (Jennifer Angelo). (Contains 39 references.) (CR)

Final Report

Comparing Scanning Modes for Youths with Cerebral Palsy

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Comparing Scanning Modes for Youths with Cerebral Palsy
Report

The report is divided into four areas,

- findings of the study,
- discussions from the Advisory Board,
- development of the Scanning Assessment Tool, and
- where the information has been dissemination thus far.

Technology has opened doors for individuals with disabilities. It provides greater access to written and spoken communication and mobility. Greater access in turn provides greater educational and vocational potential[1]. This technology, called assistive devices, aids persons in speaking, writing, mobility, and independence to perform tasks that prior to assistive devices they could not execute[2].

Some areas of assistive device technology have received concentrated efforts of study to influence improvement. Areas are speech synthesis intelligibility[3],[4],[5],[6], and message encoding strategies[7],[8],[9]. Still, other areas essential in developing optimal access methods for assistive devices remain largely unstudied. Scanning falls into the latter group.

Scanning is an interface method, that is, a technique which allows access to assistive devices such has communication boards, electronic augmentative communication devices, and computers. It is recommended when persons have great difficulty controlling their movements. Scanning works by having a pointer, either a finger or a cursor, point to or "scan" items located on the communication board or screen of the augmentative communication device or computer. The items, alphabet, words, or pictures are presented one at a time to the user. Users indicate their choice by signally to the person who is pointing to stop when the desired item is presented. When using an electronic device users press the switch connected to the device when the cursor highlights the desired item[10],[11]. There are three modes or types of scanning use with electronic device. 1) Automatic Scanning: The switch is pressed and the cursor advances across the items automatically. When the cursor is over the desired item, the switch is pressed again to indicate the desired item. 2) Inverse Scanning: the cursor only advances while the switch is being pressed. The desired item is indicated by releasing the switch. The item that the cursor indicates when the switch is released is the item presented. 3) Step Scanning: the switch is pressed successively to advance the cursor item to item. When the cursor is over the desired item, the user releases the switch. The absence of a switch press is the signal that a selection has been made[12].

All three modes of scanning require a minimum of muscle control to activate the switch to make a selection. An inherent disadvantage of scanning is that it is slower than other interface methods, such as using a keyboard[13],[14] In scanning, each item is only available for selection one at a time instead of being available simultaneously such as with a computer keyboard.

Literature Review

Empirical investigations of the efficacy of various scanning strategies is minimal. Treviranus and Tannock[15] published a descriptive study illustrating the importance of a scanning

type display in facilitating computer access for persons with severe physical disabilities. LeBlanc and Barker[16] tested the ability of individuals with athetoid cerebral palsy to control a two-switch row-column scanning system. Comparison of four scanning systems was conducted: Row-column scanning, a user-driven two-switch system, a vertical scanning system, and a horizontal scanning system. The only significant finding was subjects performed significantly worse when using row-column auto-scan than when using the other three systems. Unfortunately, generalization of the findings is difficult due to 1) use of two switches instead of one switch and 2) the increased cognitive ability and visual perceptual skill needed for row-column scanning. Angelo[17] compared scanning modes and found that subjects with spastic cerebral palsy performed most poorly using automatic scanning and that persons with athetoid cerebral palsy performed most poorly using step scanning. Only six subject participated in this study and thus the results are difficult to generalize. These are the only studies found that examine scanning issues.

There are three areas of concern regarding scanning. First, users are not adequately assessed for the specific scanning mode most appropriate for them. Although automatic scanning is the mode most often seen in commercially available software[18],[19], preliminary findings show that youths with spastic cerebral palsy perform most poorly using this mode[18]. Thus, persons who use scanning may be using the method which is least effective. Second, the cursor speed must be slow enough for the user to control the scan mode adequately. Using an inappropriate mode necessitates decreasing cursor speed to allow for accuracy. When using the appropriate scanning mode, the speed can be increased. Users are more efficient and faster using the proper mode. Third, when users make an error they must wait for the cursor to continue on its path of scanning all the items and then return to the item the user originally wanted; a time consuming process. Error rate decreases when the user accesses the mode over which they have the most control. Thus, they scan more rapidly. This study addresses these areas of concern by providing 1) information on scanning mode(s) that provides the greatest accuracy for youths with cerebral palsy, 2) information and a way to assess how fast the cursor speed should be, and 3) control, if persons use the scanning mode that allows them the most control, they will make fewer errors. Fewer errors mean less time spent waiting for the cursor to continue on its path, deleting errors and making the correct selection.

The youth age range (13 through 20 years old) will be used for this study. Children develop in strength and speed and continue to exhibit changes in these areas until middle childhood[20],[21],[22],[23]. It can be inferred from Knobloch and Pasasmanick[24] and Gesell[25] that there are no major changes in motor development after middle childhood. After childhood, motor skills reach a homeostasis and refinement of ability begins. They have the base of control and they begin to refine their movements to the best of their abilities. Eliminating major growth spurts or significant changes in motor control will eliminate a confounding factor for this study. The subjects' ability to scan accurately will be due to their ability, and not due to a maturation factor. Therefore, the age range of 13 through 20 is a natural time to practice motor skills to obtain skilled performance.

The last reason this comparison of scanning modes project should be conducted is that

merely providing devices does not insure individuals the ability to speak, write, or improve their independence[26]. Assistive devices are abandoned when configured improperly[27],[28]. Often devices are provided for individuals but the devices are not the proper device or training is not properly carried out. The device is used for awhile but due to improper configuration the user quits using it. This causes frustration, dissatisfaction, and financial loss[29]. One aspect of insuring that assistive devices are used is to assure that the access method is the one the user has the most control over. This study will provide data that will assist in assessing scanning modes. This will provide improved recommendations for persons who use scanning to access assistive devices.

Purpose of present study

The purpose of the present study is to compare systematically the three basic modes of scanning; automatic, inverse, and step, using a single subject experimental design. The results will demonstrate which scanning mode provides greatest accuracy for youths with cerebral palsy. In addition a software assessment tool, Scanning Assessment Tool (SCAT) will be developed through this project. This assessment tool will help technology providers assess which scanning mode(s) their clients can best use.

The null hypothesis is: there will be no differences among scanning modes.

Sample

Data was collected on a on twenty-two subjects. Subject inclusion criteria are: 1) age range, 13 to 20 years old, 2) a minimum IQ of 50[30] as measured on the WISC-R. (Persons with a minimum of IQ of 50 can follow the directions and understand the requirements for this type of testing.), 3) no hearing impairment or corrected with hearing aids, 4) ability to perceive a figure from the background and have no visual neglect to the right or the left. (Portions of the Motor Free Visual Perception Test will be used for these two components.), 5) normal limits of visual acuity, 6) ability to press a switch on command with 80% accuracy, (For subjects who cannot press a switch on command with 80% accuracy, opportunities will be provided to learn this skill prior to the study.) The subjects mean age was 17 and the range was 12 to 20 years old.

Measurement Technique

The data collection tool, a software program written in Hypercard, runs on a Macintosh computer and was piloted in an earlier study[18]. The computer screen is eight inches by ten inches. The data collection tool has two components; a practice component and a test component. The practice component shows three boxes on the computer screen, with a smiling face in one of the boxes. Three boxes are the minimum necessary to allow practice without an undue amount of waiting while the cursor completes the scanning path. Subjects press their switch indicating they are ready to begin. The cursor, a shaded square, moves from one box to the next traveling across all three boxes. The subject presses the switch when the cursor moves to the box containing the smiling face. Cursor speed adjustment and learning how to use the scanning mode takes place during the practice component.

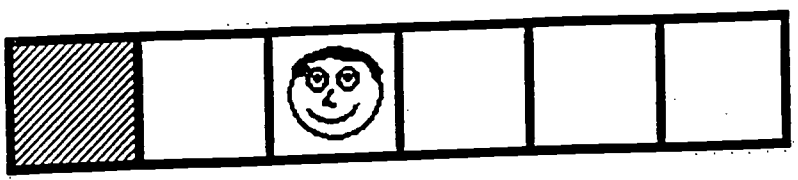
The speed at which the cursor moves from box to box can drastically change subject

performance in each scanning mode. Scanning is accurate using a slow speed but productivity decreases. A fast speed increases the scanning pace, however errors increase. Therefore, two speeds are used in automatic and inverse scanning modes. The first, slower cursor speed, will be set individually so subjects achieve ninety percent accuracy. The second, faster cursor speed, will be set so subjects achieve ten percent accuracy. Cursor speeds are distanced so that differences can be clearly identified.

For step mode, the cursor moves as fast at the user can press the switch. The acceptance time controls how fast scanning can proceed, that is; how long the cursor highlights an item before it is chosen as the desired one. If the acceptance time is set for a half-second, the user must press the switch within that time to move it to the next item, otherwise the item that the cursor is highlighting will be accepted as the item of choice. The acceptance time will be set so subjects achieve ninety percent accuracy and ten percent accuracy.

During the test component, the program displays six boxes. Six boxes are sufficient to test scanning ability and yet not fatigue the subject during testing. For each trial the cursor begins its path in the box furthest to the left and moves to the right. This is common in many scanning programs.

Figure 1 displays how the screen appears with six boxes presented for testing.
Figure 1



The software collects data on accuracy and error scores, mode being used, time when the cursor began moving and when subjects press their switch, and which box the error was made in. Also, a Macintosh mouse has been adapted to work with the data collection software. It accepts any switch with a 1/8 inch miniplug.

Instrumentation

Screening for subject criteria instruments

The IQ minimum, vision, and hearing acuity tests will be obtained from the school student records. Portions of the Motor Free Visual Perception (MVPT)[31] test will be conducted by the primary investigator. This test assesses visual perception without requiring a motor response. The test contains items in spatial relations, visual discrimination, figure-ground, visual closure and visual memory. The portions that will be used for this study are visual discrimination and figure ground. For the visual discrimination task the subject chooses the object from three objects that matches the reference figure. The figure-ground test assesses the ability to distinguish an object from its background. The correct items are equally distributed between the right and left side of the page. This is figured into the results. The ability to attend visually across the page is an important consideration to the present study. During testing for the study, the subjects must view

all boxes horizontally located on the screen. Subjects will have a minimum of 70% accuracy on visual discrimination, figure-ground and attending to the right and left side of the visual field for inclusion in this study. This test has been standardized on children 4 through 8 years old. The split-half reliability coefficients ranged from .81 to .84. Its only use here is as a screening tool to indicate if a major deficit exists in visually perceptual ability.

The Single-Input Control Assessment program was written for the explicit purpose of assisting in clinical judgements for switch recommendation and switch placement. That will be its use here prior to testing.

Procedures

Following Human Subjects Review Board Guidelines letters were sent to all parents or guardians of students with cerebral palsy within the appropriate age range from a local school. Parents of students interested in participating notified the primary investigator by returning a postcard that was in the initial mailing. After the parent or guardian subjects signed the consent form, the potential subjects were screened for the additional inclusion criteria and testing began.

Screening and data collection were conducted in the subjects' school during free periods or after school. First subjects were evaluated on their ability to press a switch in a non-timed basis. Switch placement was determined by using a site they have used in the past or through determining where they had the most control over switch pressing. When they are able to complete switch pressing accurately 90% testing using the scanning modes proceeded. Switch placement and accuracy were evaluated through Single-Input Control Assessment[32]. Subjects were tested in their wheelchairs or standard chair with arms.

Subjects were tested using one scanning mode in thirty minute sessions, three times a week for one month. This was a total 12 trials and six hours per month. At the beginning of the second and third months, the other scanning modes were introduced. The modes were systematically alternated between subjects to reduce the effect of order or carry over. The subjects were allowed to practice for fifteen minutes prior to each session. The session always started with the slow cursor speed and progress to the fast cursor speed. This gave the subjects the opportunity to perform their best using that mode.

Data analysis procedures

Two data points were collected in each session for fast and slow cursor speeds. An analysis of variance test for grouped data was conducted to compare groups of individuals within the study. These groups of person with cerebral palsy were, individuals with athetosis, mixed, or spasticity. There were two in the group with athetosis, four in the group with mixed, and eighteen in the group with spastic cerebral palsy.

Results

A two tailed analysis of variance test was used to test the hypothesis, there will be no difference in accuracy scores between the three modes. The probability for rejecting the null hypothesis was set at 0.05. The between subjects factor was the type of cerebral palsy and the within subjects factor was mode of scanning. Statistical analysis were performed using Systat,

version 5.0 [33](Wilkinson, 1992), a micro-computer based statistical package. For the main effect there was a significance difference between mode and cerebral palsy type (Table 1). The significant difference was between the slow and fast scanning speeds. All subjects had higher accuracy scores when using the slower speed. There was no significant difference between modes using the slow speed or modes using the fast speed. The slow speed scores were used for further analysis. The mean least square mean scores are reported in Table 2

The second analysis examined the differences between pre-hits, post hits, no hits, and mode. A pre-hit was defined as pressing the switch before the cursor highlighted the target. A post-hit was defined as pressing the switch when the cursor had passed the target. A no-hit was defined as the subject never pressing the switch for a particular trial. Each cerebral palsy type was examined separately. A two-way Friedman nonparametric statistic was used to evaluate the main effect. This statistic is appropriate to use when subjects are repeatedly measured and the data are not assumed to be normally distributed[34],[35]. Table 3 displays the results from the Friedman analysis.

If significance was found the post-hoc follow-up Wilcoxin statistic was used. An alpha level of $p < .01$ was used to be conservative. Significance depended on the alpha level. Both alpha levels are reported here to show where differences may be occurring. Subjects demonstrated a significant difference between the three variables (Table 4). For clarity the results are reported in Figures 1, 2, and 3. These figures are based on the Freidman results.

The results for subjects with spastic cerebral palsy showed that when they used auto mode they had significantly more post-hits in trials that had errors. When using the inverse or step mode there were significant differences between all three possibilities.

Those with mixed cerebral palsy had significantly more post-hits at the $p< 0.01$ alpha level for auto. The other two error rates were not significant at the $p< 0.01$ alpha level, but were significant at the $p <0.05$ alpha level. For the inverse mode the subjects in this group had significantly more pre-hits. For the step mode they had significantly more pre-hits.

The group with athetoid cerebral palsy demonstrated no significant differences when using the auto, inverse or step modes using the more conservative $p< 0.01$ alpha level. However, using the $p< 0.05$ alpha level there was significantly more pre-hits.

Discussion

The results from this study do not provide definitive results that persons with different types of cerebral palsy will do better or worse using a particular type of scanning. The results of this study support that when persons are potential candidates for scanning, each mode should be evaluated separately. Put in functional terms, with the current results, therapists cannot predict how a client may perform using the different modes. The client should be allowed to use each mode for a period of time. The scores reviewed by the client and therapist together deciding which mode will be best for the client to use.

The results for pre-hit, post-hit, and no-hit provide useful information to clinicians. This helps clinicians use their time with clients economically. During treatment time with clients the therapists can instruct the client to concentrate working on where the data demonstrates where errors will probably occur. Table 4 describes these results. An example is an individual with spastic cerebral may demonstrate the greatest difficult with the post-hit type of error. Therefore the therapist needs to instruct the client in how to anticipate the cursor movement and press the switch at the appropriate time. Once way the therapist might do this is to watch the client practice using the auto scanning mode and record the number of selection items from the desired selection item when the client presses the switch. Such as if the desired item is in Item 2 and the client presses the switch when the cursor highlights Item 4. The therapist notices that the client is fairly consistent at pressing the switch when the cursor highlights two items past the desired item. The therapist would then need to work on anticipation skill of the client.

Using the alpha level of $p<0.01$, inverse and step, Pre-hits were more problematic for persons with spasticity. For subjects with mixed cerebral palsy, there were more errors with post-hits using the auto mode, more pre-hits when using the inverse and step modes. In the athetoid group there were not enough subjects to draw any conclusions regarding what their abilities may be.

Conclusion

The results did not support the hypothesis that persons with cerebral palsy would show a significant difference of accuracy and speed when using the three scanning modes. Each mode needs to be tested individual and the therapist and client need to decide together which mode will be most appropriate for use. The other finding was that there were significant differences between pre-hits, post-hits, and no-hits. These findings can be useful to clinicians who are involved in teaching scanning skills to their clients.

More study is needed in this area to more clearly define where differences lie. A larger subject pool in each of the categories, spastic, mixed, and athetoid is needed.

Tables and Figures

Table 1 Analysis of Variance for Main Effect

Source	Sum of Squares	DF	Mean Square	F-Ratio	p
Modes	7191.65	5	1438.33	123.76	0.00
CP Types	49.26	2	24.63	2.11	0.12
Modes by CP Types	316.02	10	31.60	2.71	0.00
Error	6205.87	534	11.62		

Table 2 Mean Scores for Accuracy

Mean Scores

CP Type	Auto	Inverse	Step
Athetoid	22.50	19.87	19.75
Mixed	22.37	20.87	19.37
Spastic	21.00	20.51	20.55

Table 3

Friedman Two-way non-parametric analysis of Pre-hits, Post-hits, and No-hits (2 degrees of freedom for each group).

Diagnosis/Mode	Variable	Rank Sum
Spastic/Auto	Pre-hit	109.50
	Post-hit	186.00
	No-hit	112.50
Spastic/Inverse	Pre-hit	173.50
	Post-hit	153.50
	No-hit	81.00
Spastic/Step	Pre-hit	201.00
	Post-hit	112.00
	No-hit	95.00
Mixed/Auto	Pre-hit	31.50
	Post-hit	43.50
	No-hit	21.00
Mixed/Inverse	Pre-hit	43.50
	Post-hit	34.50
	No-hit	18.00
Mixed/Step	Pre-hit	48.00
	Post-hit	28.00
	No-hit	20.00
Athetoid/Step	Pre-hit	18.00
	Post-hit	18.00
	No-hit	12.00
Athetoid/Inverse	Pre-hit	18.00
	Post-hit	19.00
	No-hit	11.00
Auto/Step	Pre-hit	24.00
	Post-hit	13.00
	No-hit	11.00

Table 4 Wilcoxin results for Pre-hit, Post-hit, and No-hit for each diagnostic category.

	significant at the p<0.01	significant at the p<0.05
Spastic		
Auto	*	*
pre vs post	*	*
pre vs no		
post vs no		
Inverse		
pre vs post	*	
pre vs no	*	
post vs no	*	
Step		
pre vs post	*	
pre vs no	*	
post vs no	*	
Mixed		
Auto		*
pre vs post		*
pre vs no		
post vs no	*	
Inverse		*
pre vs post		
pre vs no	*	
post vs no	*	
Step		
pre vs post	*	
pre vs no	*	
post vs no		*
Athetoid		
Auto		
pre vs post	(not significant)	
pre vs no	(not significant)	
post vs no	(not significant)	
Inverse		
pre vs post	(not significant)	
pre vs no	(not significant)	
post vs no	(not significant)	
Step		*
pre vs post		*
pre vs no		
post vs no	(not significant)	

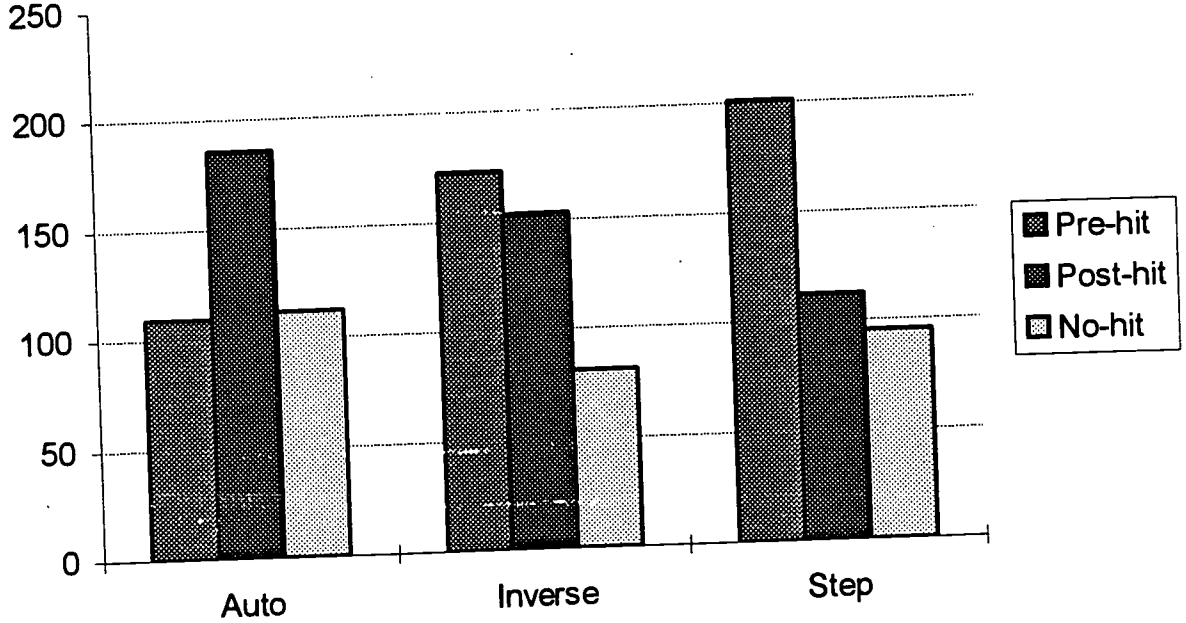


Figure 1 Pre-hits, Post-hits, and No-hits for Spastic Modes

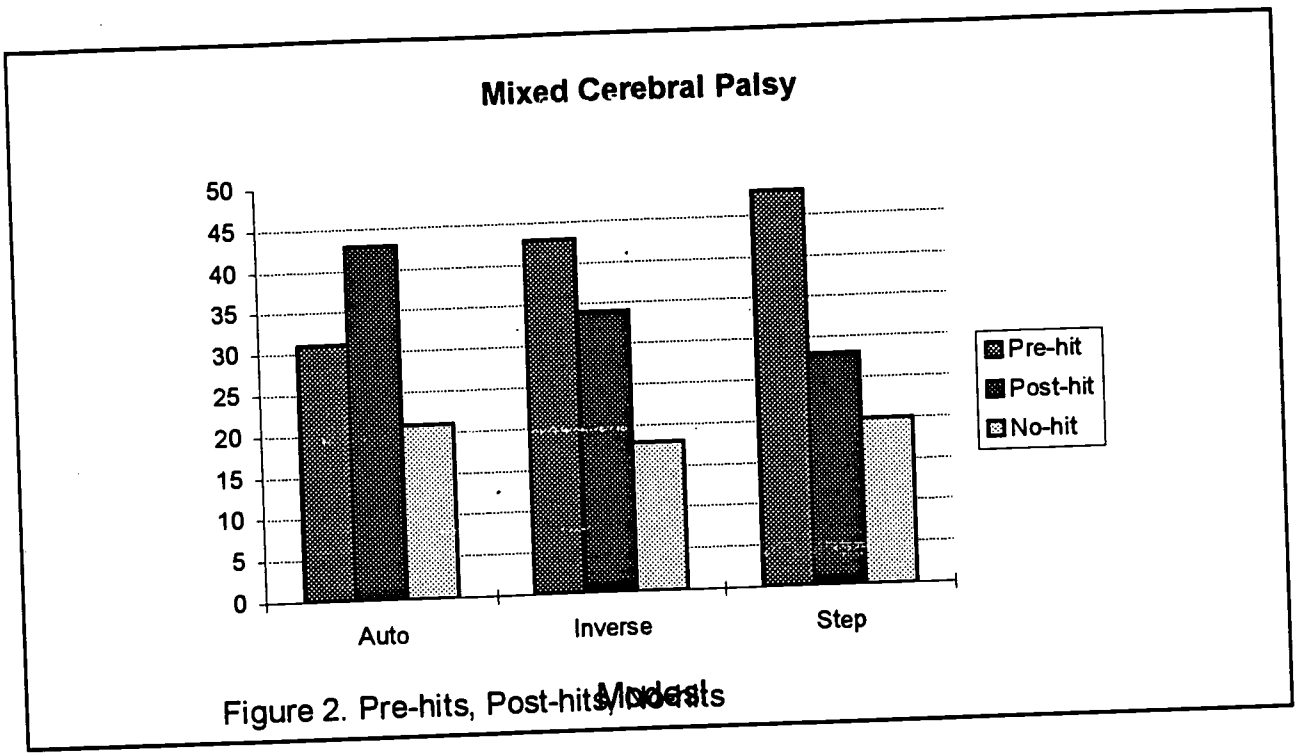


Figure 2. Pre-hits, Post-hits, No-hits

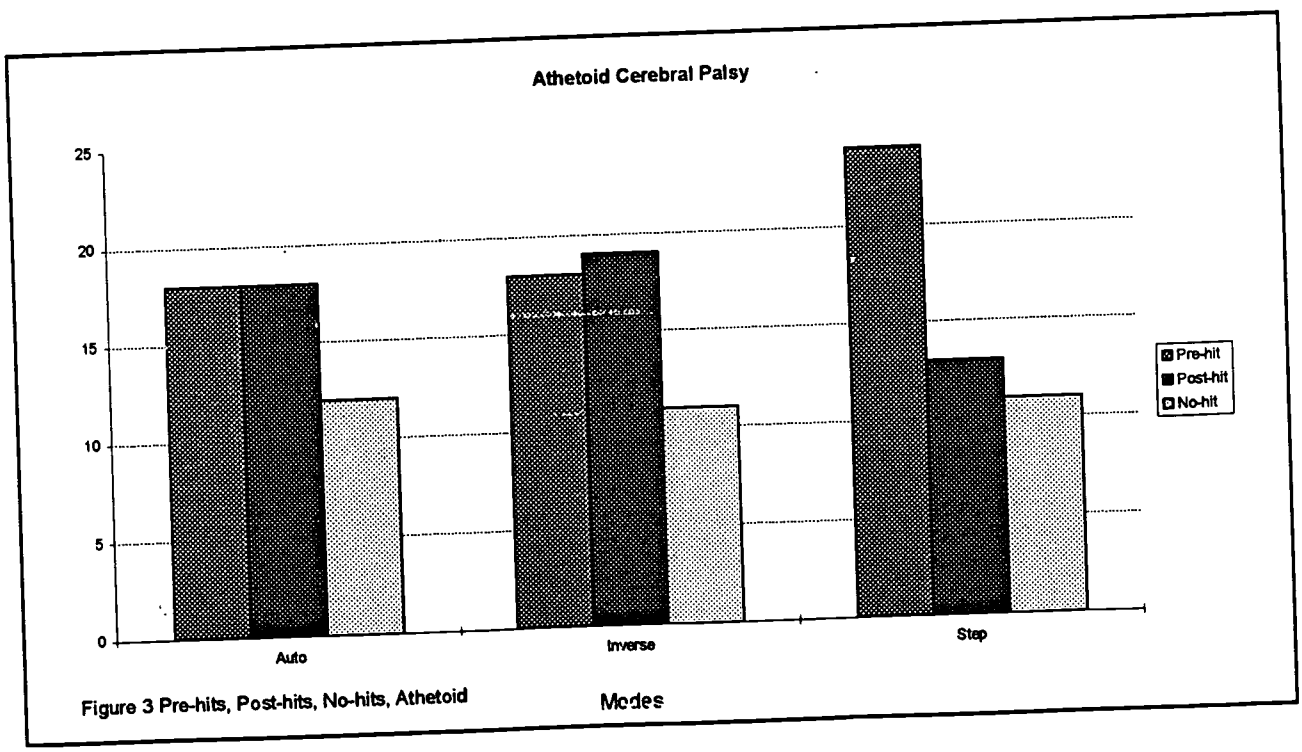


Figure 3 Pre-hits, Post-hits, No-hits, Athetoid

Advisory Board

The Advisory Board was made up of one augmentative communication specialist, one special education teacher and two parents. In total six parents were invited to attend, the other four parents did not feel they could make the commitment to be on the Board. The board met periodically to discuss the development of the Scanning Assessment Tool. The first meeting focused on the objectives of the project, to compare scanning modes for children with cerebral palsy and to develop a clinically useful tool to help clinicians assess scanning ability. The Board was shown the data collection scanning tool and then asked how they would see this tool being modified so that it would be helpful to clinicians, parents, and be motivating to children similar to their own.

The focus of the discussion centered on two areas, how to keep the students interested to maintain participation and how to make the results of the testing easy to understand and presented in a way that parents could follow.

Several suggestions were give on how to maintain motivation. The suggestions were keeping the rewards interesting and novel. The rewards should be frequent such as after very third trial. Animations and auditory feedback such as "Good", "Nice Job," or "Terrific." were suggested. The results in the graph form were clear and in this area the Advisory Board made no suggestions for improvement.

In addition to rewards and graphs, the Board gave additional feedback regarding the function of the program. The program should allow the clinician to cancel the trial. This trials being recorded that do not represent the child's true ability. Such as there is an interruption and the child makes an error due to no fault of his/her own. When the number of trials are all the same, they can be compared in a meaningful manner. The subject should have control over starting each trial. This will decrease the number of false starts. The subject will press the switch when they are fully prepared to begin the session. The number of trials should be standardized. Keeping the trials consistent was allowed comparison of the data.

The feedback from the Board was used in modifying the program.

Development of the Scanning Assessment Tool

After meeting with the board, the modifications were made. At this point, the Scanning Assessment Tool Software Program was beta tested. Twenty-seven clinicians who had experience working with people with cerebral palsy, had a basic understanding of using a Macintosh computer, and were familiar with assistive technology were invited to participate in beta testing the software program. Eighteen surveys were returned by the date requested. A follow-up letter asking the persons who had not yet return the survey to please do so was sent. In total twenty surveys were returned.

Results

Overall the respondents were satisfied with the software tool. Some of the reinforcers (the cartoon pictures) had loud noises accompanying them. Some individuals felt that the noise carried a scary quality instead of humor or amusement. Therefore noises that were loud were deleted and replaced with laughter in the final version. The respondents liked the ability to have the data printed out in a table or graph form. Most of the feedback was very positive. It was clear and useful

Dissemination

The results of this study have been disseminated. The citations are listed below. In addition a formal research paper is in the manuscript stage and will be submitted in 1995. Where possible, a copy of the paper accompanies this report.

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Appendix

Survey to Clinicians

Room 116 Pennsylvania Hall
November 4, 1993

FIELD(1)

Dear

Thank you for agreeing to beta test the Scanning Assessment Tool. The development of this tool is being sponsored by a grant from the Department of Education, Office of Special Education and Rehabilitation Services Grant No. H023A20038. This tool was originally developed to collect data in a research study, to date it has been used in two studies. In these studies, children with cerebral palsy were tested for their ability to use the three scanning modes, auto, inverse, and step with a single switch and a linear scan.

Currently, I am in the process of modifying the Scanning Assessment Tool from a research tool to a tool that clinicians like your self can use to test the scanning ability of clients/students. The purpose of this tool is to provide clinicians with quantitative information regarding the clients/students ability to use the three scanning modes auto, inverse and step.

While I have tried to make this program easy ot use, having experienced clinicians like you test the tool can only improve its ease of use and value in the clinical setting. The purpose of the beta testing is to provide feedback on the software program and manual. Please consider these questions as you review the software and manual. Was it easy to use? At what points in the program did you get lost? What made the program difficult to use?

Although it is ideal if you use the tool with clients, I realize that this is not always possible. You can still provide valuable feedback even if you do not have access to clients. Please use a colleague as a client and proceed through the program.

Please return the survey by December 15th in the self-addressed stamped envelope.

Thank you for your participation in this project. Your input is greatly appreciated. Please keep the disk with the scanning assessment tool program on it and return the survey from in the self addressed stamped envelop.

Sincerely,

Jennifer Angelo, Ph.D., O.T.R.
Co-Director, Occupational Therapy Graduate Program

Scanning Assessment Tool

Directions

Please familiarize yourself with the manual before beginning.

Although you can use the Scanning Assessment tool from the floppy disk, it runs much more slowly this way. **Please install it on your hard drive so that you do not have to wait between sessions.** The program may not work unless it is installed on a hard drive. Installation directions are in the manual.

You can use a colleague or client to go through the assessment program. If a colleague is volunteering in place of a client you can use the mouse to activate the program. If you are using a client and a switch for access, you will need to connect the switch to the Ke:nx or the Macintosh Switch Interface and then connect either device to your Macintosh in order for the switch to work with the program.

If you have any questions, please call me. My phone numbers are:

412 624 2843 work

412 367 0432 home

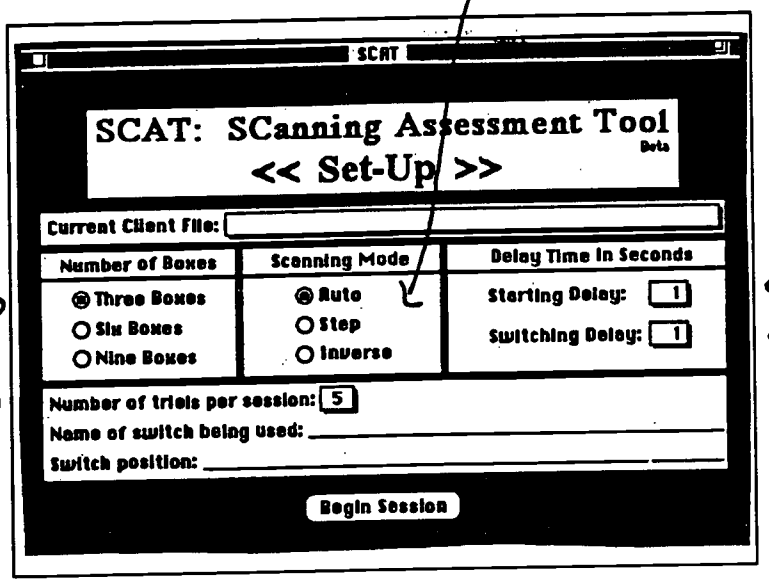
Eastern Standard Time

Thanks and good luck.

Jennifer

For testing purposes,

- Use 3 boxes.
- Set the 'Starting Delay' time for 1 second and;
- 'Scanning Speed' time for 1 second
- For number of trials type in 5.
- Use each scanning mode (auto, step, inverse) with your "client."
- Save your data.
- Graph the data. Graphing is under the SCAT menu at the top of the menu bar. Once you have gone through this process, please answer the following questions:

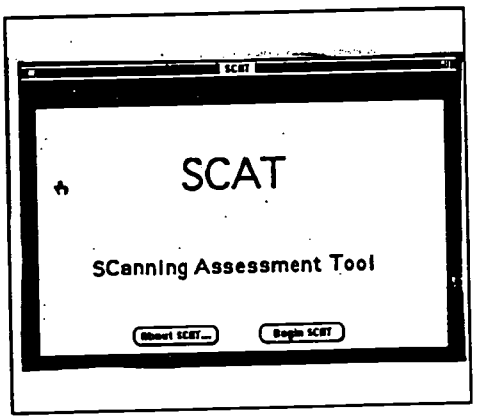


BEST COPY AVAILABLE

Scanning Assessment Tool
Beta Test Survey
1993

Please respond to the following statements by placing an X along the line that best reflects your experience with the program.

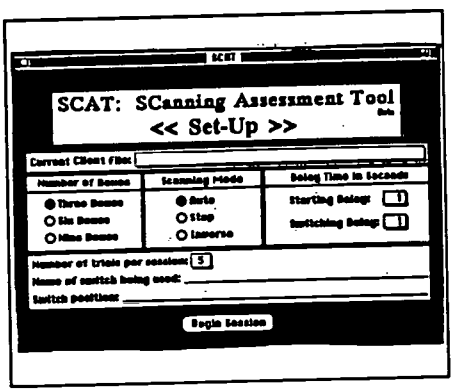
1. I understood how to start the program by viewing the opening screen.



Disagree | Neutral | Agree

|----------|----------|----------|----------|

2. The information on the set-up screen was clear.



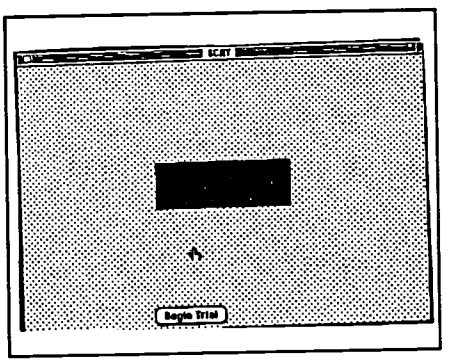
Disagree | Neutral | Agree

|----------|----------|----------|----------|

If you placed an "X" left of Neutral or disagreed with this statement, please specify where the screen was confusing or the meaning obscure. Draw arrows or write directly on the figure to help explain your comments. Please use the back of the page if you need more space.

Testing

3. It is clear how to proceed when this screen (testing) is in view.



Disagree Neutral Agree

|----------|----------|----------|----------|

If you placed an "X" left of Neutral or disagreed with this statement, please specify where the screen was confusing or the meaning obscure. Draw arrows or write directly on the figure to help explain your comments. Please use the back of the page if you need more space.

4. I was able to change scanning modes (auto step inverse) easily.

Disagree Neutral Agree

|----------|----------|----------|----------|

5. I was able to set the Starting and Switching Delays easily.

Disagree Neutral Agree

|----------|----------|----------|----------|

6. I was able to begin the session easily.

Disagree Neutral Agree

|----------|----------|----------|----------|

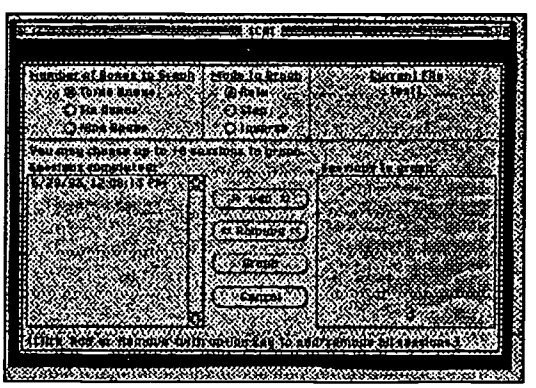
7. The auditory directions "Ready, Set, Go: are clear and provide enough information so that the client knows when to press the switch.

Disagree Neutral Agree

|----------|----------|----------|----------|

Test Results

8. The information presented on how to graph the data is clear.



Disagree Neutral Agree

|----------|----------|----------|----------|

9. The Graphing capability is useful.

Disagree Neutral Agree

|----------|----------|----------|----------|

10. I would use the Graphing capability. . .

Never Once in awhile All the time

|----------|----------|----------|----------|

11. It is difficult to have all the information that is possible appear on one graph. What information would you prefer to have displayed on one graph so that the graph makes sense, yet the information remains useful? The graphed information can become part of the clients permanent record and shown to parents and colleagues as to why one mode is being recommended over another. The options of graphically displaying the information are: modes, number of boxes, and Starting Delay and Scanning Speed times.

Some of the options are presented here. Please rank the following statements. 1 is your first choice and 3 is your last choice.

___ have all the modes displayed on one graph and only one set of boxes (3, 6, 9).

___ have the Starting Delay and Scanning Speed times (acceptance time for Step scanning) displayed on one graph and only one mode (auto, step, inverse).

___ have the Starting Delay times and Scanning Speed times (acceptance time for Step scanning) displayed on one graph and all modes on one graph.

Other. If you have an idea you would like to share, please describe them here:

12. The table printout option (available in the final version) is useful. I would use it . . .

Never | Once in awhile | Frequently

|----------|----------|----------|----------|

13. Additional information I would like to see added to the Test Results section is:

14. The information presented in the Test Results section that I would never use is:

Rewards/Incentives

15. The rewards, (the computer saying, Good, Excellent, and the animated head) are fine the way they are.

Disagree | Neutral | Agree

|----------|----------|----------|----------|

16. Suggestions for improving the rewards is:

Overall impressions

17. There is a need for this type of tool in the area of assistive technology.

Disagree | Neutral | Agree

|----------|----------|----------|----------|

18. I find this tool useful.

Disagree Neutral Agree

|----------|----------|----------|----------|

Please answer the following questions. Use this space to write down questions you have about the program or provide feedback. Use additional paper as necessary.

19. Was the program easy to use?

20.If not, what made the program difficult to use?

21. At what points in the program did you get lost? Please refer to the figures to help identify problem areas.

Demographic Information

22. Name_____ (optional)

23. Address _____ (optional)

24. City _____ State _____ Zip _____ (optional)

25. Gender M F

26. Age 21-25____, 26-30 ____, 36-40 _____, 41-45 ____, 46-50____, 51-55 ____, 56-60 _____, 61 or over _____.

27. Occupation: _____Communication Disorders Specialist, _____ Occupational Therapist, _____ Other (please specify) _____

28. Type of facility you work in:
_____ Public school, _____Clinical facility, _____Research facility, _____ University, _____, _____ Hospital, _____ Other (please specify).

Please specify the primary and secondary disability groups you serve.

29. Primary _____

30. Secondary _____

Please specify the age ranges of the primary and secondary disability groups you serve.

31. Primary group ages _____

32. Secondary group ages _____

33. Please state the average number of clients you see daily _____.

34. Number of years working in technology 0-2 _____, 3-5 _____, 6-10 _____, 11-15_____, 15-20_____, 21 and over _____.

35. For the Scanning Assessment Tool what was the total amount of time you spent

reviewing the manual, _____ hours _____minutes

reviewing the software, and _____ hours _____minutes

filling out the survey _____ hours _____minutes

36. Please check the box that best applies to your situation.

☐ I used a client in the beta testing.

☐ I used several clients in the beta testing. Please state how many you used it with _____.

☐ I used a colleague in the beta testing.

Thank you very much for filling out this survey!!! Please return it in the enclosed stamped envelope to:

Jennifer Angelo, Ph.D., O.T.R.
Rm 116 Penna Hall
University of Pittsburgh, PA. 15261
412 624 2843

The Scanning Assessment Tool

by Jennifer Angelo, Ph. D., OTR

Supported by grant #H023A20038 under
the Individuals with Disabilities Education Act.

Programmed by William E. DeRoo, M.A., CCC/SLP,
based on a pilot program by Robert J. Beichner, Ed. D.

Contents

Introduction

What is the Scanning Assessment Tool?

The Scanning Assessment Tool program provides scanning accuracy and speed information for single-switch users. This information is collected using three modes: auto, inverse, and step scanning. Data from up to ten sessions may be graphed or tabulated at once. In this way, a client's performance using different scanning modes and/or delay times ("speeds") may be compared, and improvement over time may be demonstrated.

Intended Users

The Scanning Assessment Tool was designed for use by Occupational Therapists, Speech-Language Pathologists, and other assistive technology providers, to help determine the most effective scanning technique for individual clients. This manual assumes basic familiarity with Macintosh™ use. Please refer to the documentation supplied with your Macintosh™ (including the "Macintosh Basics" program) for more information.

System Requirements

The Scanning Assessment Tool requires the following hardware:

- A Macintosh™ computer with 512x342 or greater screen resolution.
- Either HyperCard 2.1 or higher, or HyperCard Player.
- System 7.0 or higher.
- A hard disk drive.
- A Macintosh Switch Interface (Don Johnston Developmental Equipment part number M09), Ke:nx (Don Johnston Developmental Equipment part number M42), or equivalent.
- Switches.

Installation

Follow these steps to install the Scanning Assessment Tool on your hard drive:

- Turn on your Macintosh™ and open the folder on your hard drive where the Scanning Assessment Tool will be placed.
- Insert the Scanning Assessment Tool disk into the disk drive.
- Double-click on the Scanning Assessment Tool disk icon to open the disk.
- Drag the "Scanning Assessment Tool " and "Scanning Assessment Tool-LS" files to the desired folder on your hard drive.
- Check to be sure you have installed the Don Johnston Macintosh Switch Interface or Ke:nx according to the manufacturer's instructions.
- Refer to the Macintosh Switch Interface or Ke:nx user's manual to connect the desired switch.

It is important to use the Scanning Assessment Tool on your hard drive, and not on the floppy disk, to ensure accurate scan timing. To conserve hard drive space, the file "Scanning Assessment Tool-LS" may be eliminated on Macs with 512x342-resolution screens (e.g., Mac Classic).

Operation

Overview

The Scanning Assessment Tool consists of a set-up screen, three linear scanning arrays (3, 6, and 9 boxes), and graphing and tabulating utilities. When you run the Scanning Assessment Tool, a title screen is displayed (Figure 1). Click on the "Begin Assessment" button. At this time, the set-up screen is displayed (Figure 2). Specify the desired set-up parameters (number of boxes, scanning mode, delay time, name of switch, and switch position). To begin the first session, click the "Begin Session" button or choose "Begin Session" from the Assessment menu.

At the beginning of each session, the linear scan array is displayed with the scanning mode in the lower right corner (Figure 3). To begin each trial, position the mouse pointer over the "Begin Trial" button. Your client activates his or her switch to begin the trial. This avoids false starts and the client not being ready when the trial begins. After the switch is released, the computer says, "Ready, set, go," and the trial begins.

For each trial scan, after the computer says "Go," it waits for the amount of time you specified as the Starting Delay on the set-up screen. Then, the scan begins. A smiling face is displayed at the target box in the array. The hatch-marked, thick-bordered box is the current position of the scan.

If the client correctly selects the target box, two short beeps are heard. After every third correct selection, the computer provides verbal reinforcement ("Good!" or "Terrific!"). A buzzer sound is heard if the incorrect box is selected, or if no selection is made by the end of one scan through the array. This is the end of the trial.

After each trial is completed, you may cancel the trial or cancel the session if desired (see "Assessment Menu Commands," below). To continue with the next trial, position the mouse over the "Begin Trial" button. The client activates the switch to start the next trial.

After the session is completed or canceled, the program returns to the set-up screen. From there, you can make changes to the set-up (see "The Set-Up Screen," below). You can also graph the data, perform file-management operations, or quit (see "Assessment Menu Commands," below).

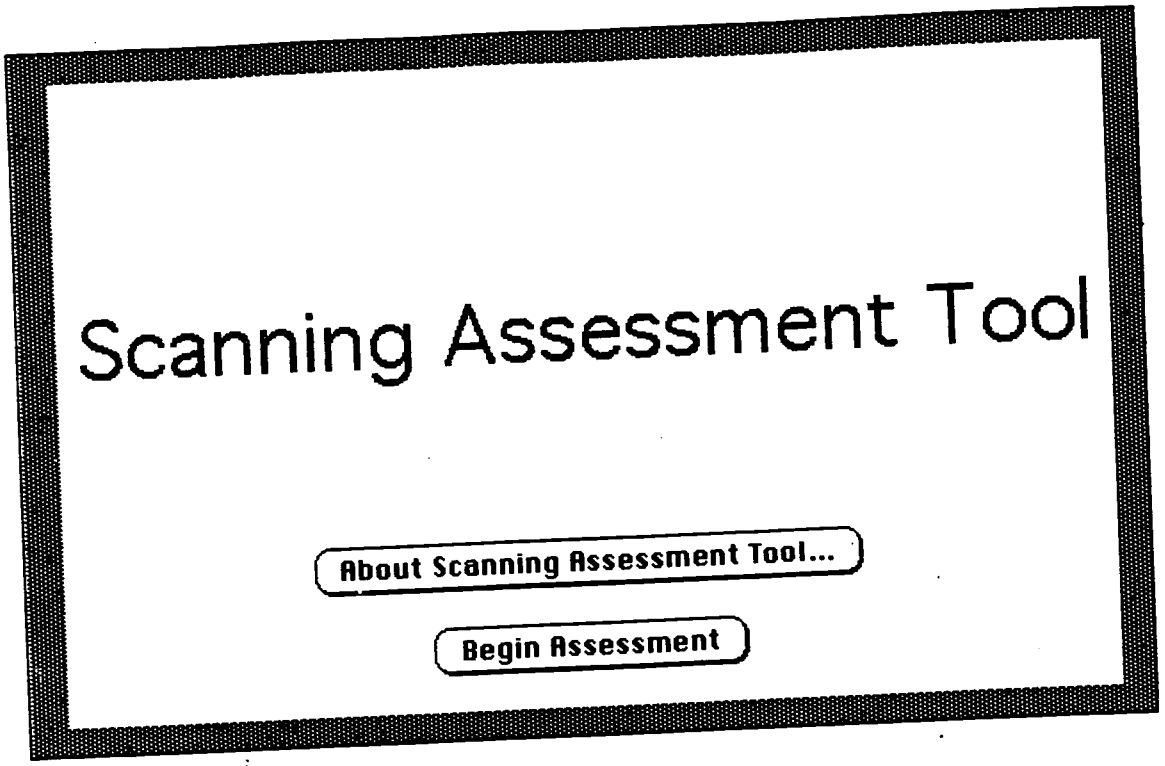


Figure 1: The title screen.

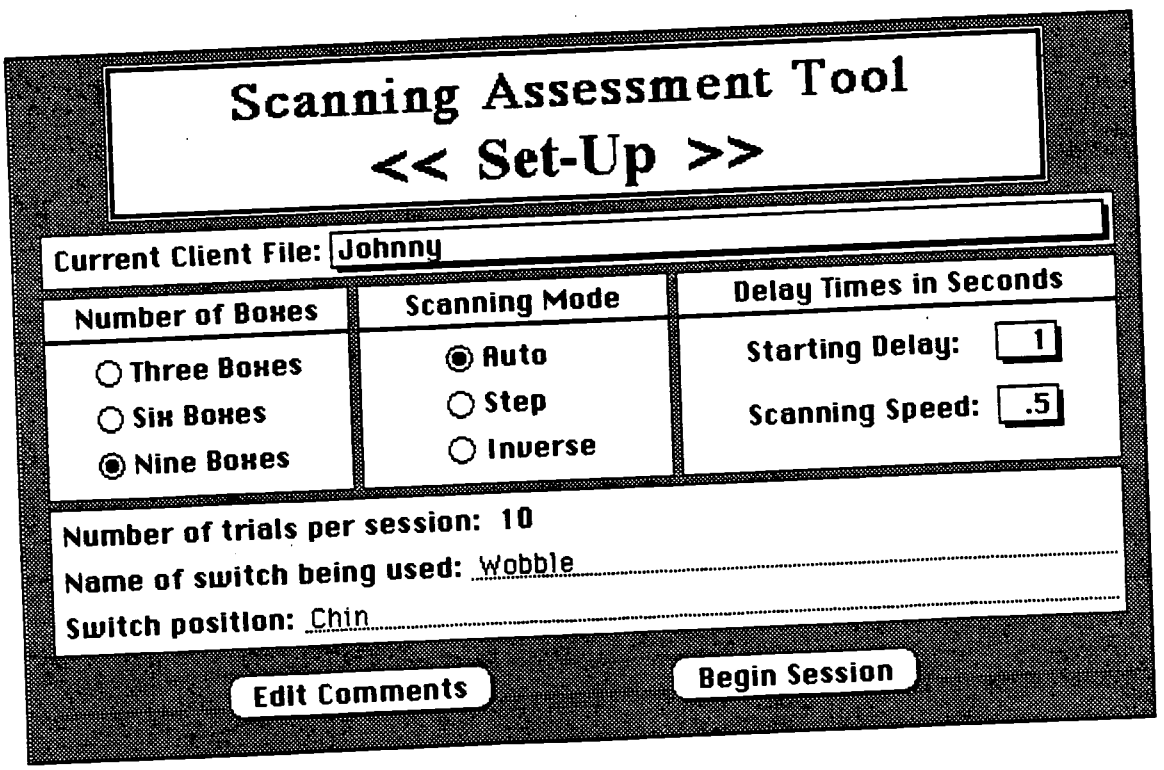


Figure 2: The set-up screen.

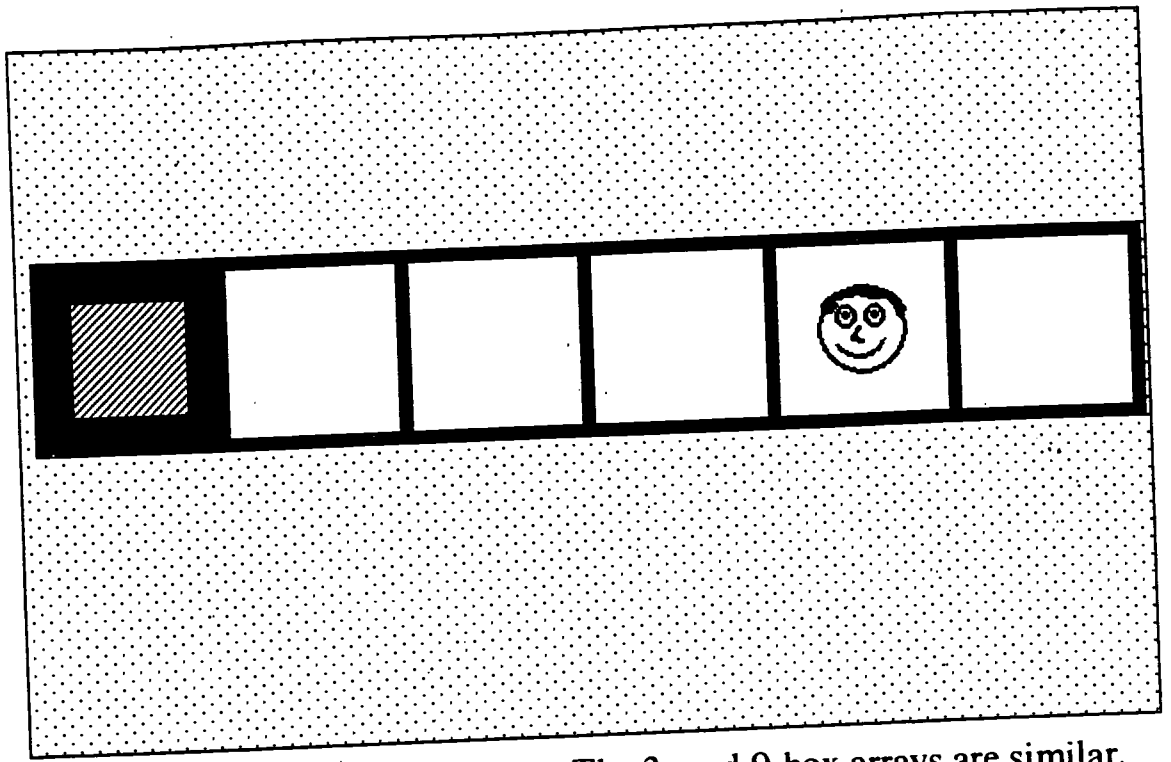


Figure 3: The 6-box scanning array. The 3- and 9-box arrays are similar.

The Set-Up Screen

The main display of the Scanning Assessment Tool is the set-up screen (Figure 2). It is where you specify the parameters of the scan, and the file to which performance data will be saved. The following controls are found on the set-up screen:

Current Client File

The box labeled "Current Client File" shows what client scan data file is open (Figure 2). Only one client file can be open at a time. After each scanning trial, the data for that trial are saved to the client file automatically. To start a new client file, or to open an existing file (to graph old data or append additional data), click on the box labeled "Current Client File." Please refer to "Assessment Menu Commands," below, for details about file commands.

Number of Boxes

The Scanning Assessment Tool provides linear scanning arrays of 3, 6, and 9 boxes in length for client testing. To select the number of boxes for subsequent test sessions, click on the "Three Boxes," "Six Boxes," or "Nine

Boxes" button (Figure 2). Please note that graphs and tables produced within the Scanning Assessment Tool do not specify the size of the scanning array. You can specify the number of boxes as a comment, however. Please refer to "Edit Comments," below, for more information about comments. Please refer to the "Graph/Tabulate Data" menu command, below, for more information about graphs and tables.

Scanning Mode

The Scanning Assessment Tool provides testing of auto, step, and inverse scan modes. To select the scanning mode for subsequent test sessions, click on the "Auto," "Step," or "Inverse" button (Figure 2). In auto scan mode, the cursor moves along the scanning array until the switch is activated; switch activation makes the selection. In step scan mode, each momentary activation of the switch advances the cursor to the next box; not activating the switch indicates the selection. In inverse scan mode, prolonged activation of the switch moves the cursor along the scanning array; releasing the switch makes the selection. Performance across modes can be compared using graphs and tables. Please refer to the "Graph/Tabulate Data" menu command, below, for more information about graphs and tables.

Delay Times

Auto, step, and inverse scan modes have associated delay times: starting delay, scanning speed, and acceptance time. These are specified on the set-up screen. The values are given in seconds for all three times. Please note that scanning speed appears for auto and inverse scanning, and changes to acceptance time for step scanning.

Starting Delay

For all modes, the starting delay is the amount of time between the display of the target box on the scanning array, and the start of the scan. To change the starting delay, click on the number in the box to the left of the words "Starting Delay" (Figure 2). Type the new starting delay time in the box that appears. Click the "OK" button to keep the new time after you have typed it, or the "Cancel" button to keep the old time.

Scanning Speed

Auto and inverse modes have a delay referred to as "Scanning Speed." This is the length of time the cursor remains at one box in the scanning array, before moving to the next box. (Note that this is not, strictly speaking, a "speed" value.) The scanning speed is displayed on the set-up screen whenever auto or inverse mode is used. To change the scanning speed, click on the number in the box to the left of the words "Scanning Speed" on the set-up screen. Type the new time in the box that appears. Click the "OK"

button to keep the new time after you have typed it, or the "Cancel" button to keep the old time.

Acceptance Time

Step mode has a delay referred to as "Acceptance Time." This is the length of time the switch must remain inactivated in order to select a box. The acceptance time is displayed on the set-up screen whenever step mode is used. To change the acceptance time, click on the number in the box to the left of the words "Acceptance Time" (Figure 2). Type the new selecting delay time in the box that appears. Click the "OK" button to keep the new time after you have typed it, or the "Cancel" button to keep the old time. Please note that acceptance time is also called a "speed" on graphs and tables produced by the Scanning Assessment Tool.

Number of trials per session

The Scanning Assessment Tool presents ten trials in each test session. the number is fixed to facilitate comparisons across sessions. For reference, the "Number of trials per session" is displayed on the set-up screen (Figure 2).

Name of switch being used

The blank space labeled "Name of switch being used" (Figure 2) allows you to record the type of switch in use. The switch name will be saved to the client's file and printed with performance graphs and tables. To edit the switch name, click just above the dotted line labeled "Name of switch to be used," then type in the name of the switch.

Switch position

The blank space labeled "Switch position" (Figure 2) allows you to record the position of the switch being used. The switch position will be saved to the client's file and printed with performance graphs and tables. To edit the switch position, click just above the dotted line labeled "Switch position."

Edit Comments

The Scanning Assessment Tool provides for comments to be saved in the client file and printed with graphs and tables. To edit the comments for the current client file, click the "Edit Comments" button (Figure 2). Please refer to the "Edit Comments" menu command, below, for more information and alternative forms of this command.

Begin Session

To begin a scan test session, you may click the "Begin Session" button (Figure 2). Please refer to the "Begin Session" menu command, below, for more information and alternative forms of this command.

Assessment Menu Commands

All program operations use menu commands. The Assessment menu appears in the menu bar at the top of the screen at all times while the Scanning Assessment Tool runs. The Assessment menu commands are as follows:

File commands

New Subject File...

To begin a new client file, choose "New Client File..." from the Assessment menu. You will be asked to name the new file. The program saves scanning data to the file automatically. You may wish to give each file the name of a client, for convenience in retrieving information later. To choose "New Client File..." using the keyboard, type command-N (hold down the ⌘ key and press N). You can also begin a new client file by clicking the "Current Client File" box on the set-up screen (Figure 2). Please refer to "The Set-Up Screen," above, for more information.

Open Subject File...

To continue to work with an existing client file, choose "Open Client File..." from the Assessment menu. You will be asked which file you want to open. After you open a file, the set-up screen (Figure 2) will reflect the parameters of the last scan saved in that file. You can graph and/or add to the data in the opened file. To choose "Open Client File..." using the keyboard, type command-O (hold down the ⌘ key and press O [not zero]). You can also open an existing client file by clicking the "Current Client File" box on the set-up screen (Figure 2). Please refer to "The Set-Up Screen," above, for more information.

Save File As...

To save a copy of the currently-open client file, and continue working with the copy, choose "Save File As..." from the Assessment menu. You will be asked to name the new file. The "Save File As..." menu command does not have a keyboard equivalent.

Test session commands

Begin Session

To begin a scan test session, choose "Begin Session" from the Assessment menu. At the beginning of each session, the linear scan array is

displayed (see Figure 3). To begin each trial, you position the mouse pointer over the "Begin Trial" button. Your client activates his or her switch to begin the trial. The computer says, "Ready, set, go," and the trial begins.

After three successful trials (trials in which the client selected the target box correctly), the program will provide verbal praise by speaking "Good!" or "Terrific!" After an entire session has been completed, the program will provide an audio-visual reward. After that, the program will return you to the set-up menu.

To choose "Begin Session" using the keyboard, type command-B (hold down the ⌘ key and press B). There is no keyboard equivalent for starting the trials within each session. You may also begin a session by clicking the "Begin Session" button on the set-up-screen (see Figure 2).

Cancel Last Trial

After a scanning trial has been completed, the data from that trial can be discarded if you decide the trial was invalid. To discard the data from the previous trial, choose "Cancel Last Trial" from the Assessment menu. To choose "Cancel Last Trial" using the keyboard, type command-T (hold down the ⌘ key and press T).

Cancel Current Session

Between trials or after the last trial during a session, the session may be interrupted. To interrupt a session, choose "Cancel Session" from the Assessment menu. You will be asked to confirm whether you want to interrupt the session. If any trials were completed in this session, you will be asked whether to keep or discard the data from those trials. To choose "Cancel Session" using the keyboard, type command-S (hold down the ⌘ key and press S).

Graphing commands

Graph/Tabulate Data

The data from any Scanning Assessment Tool client file can be graphed or tabulated. Choose "Graph/Tabulate Data" from the Assessment menu. A check mark will appear next to the "Graph/Tabulate Data" menu item. All sessions stored in the current client file will be displayed according to date, switch name, switch position, scanning mode, scanning "speed" (Figure 4). The number of sessions completed on each date with the same parameters (switch name and position, scanning mode and speed), is displayed as well. In this way, one line on the graph or one column in the table will include all sessions completed on the same date with the same parameters.

To graph or tabulate performance from one session (or one group of sessions with the same date and parameters), click on the line describing the session(s). The session(s) you have selected will appear in the lower section

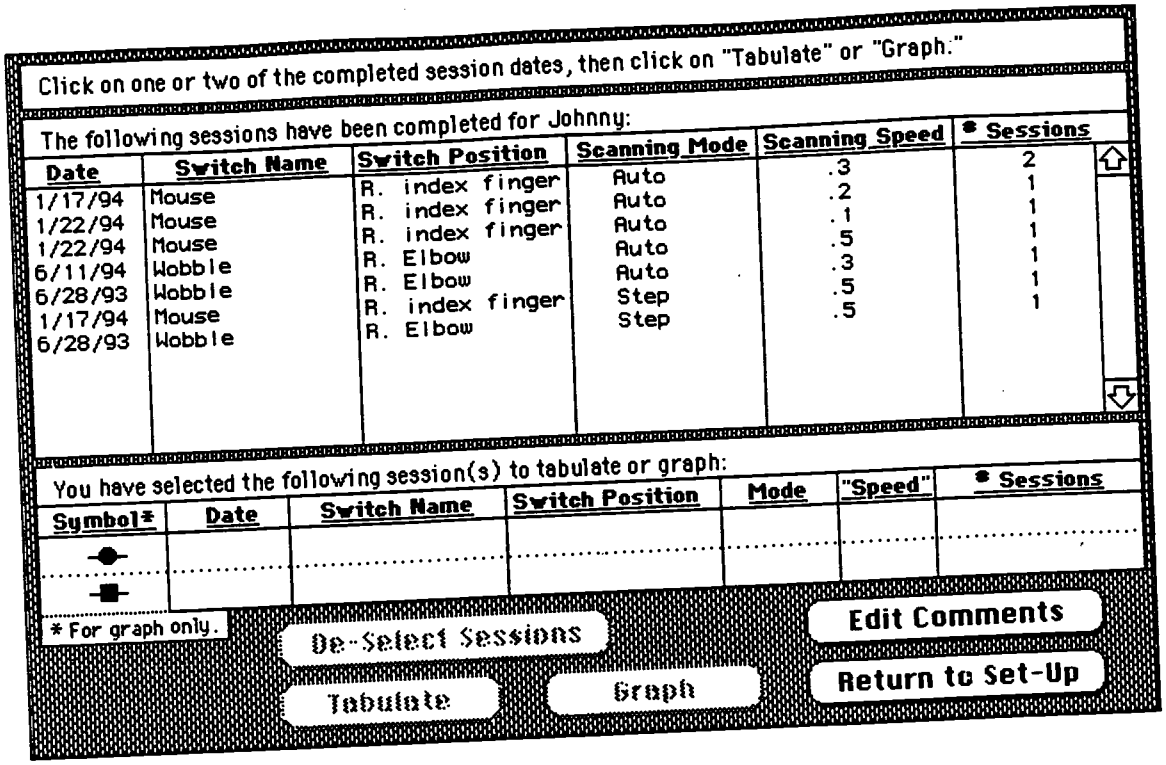


Figure 4: The session performance data available for tables and graphs.

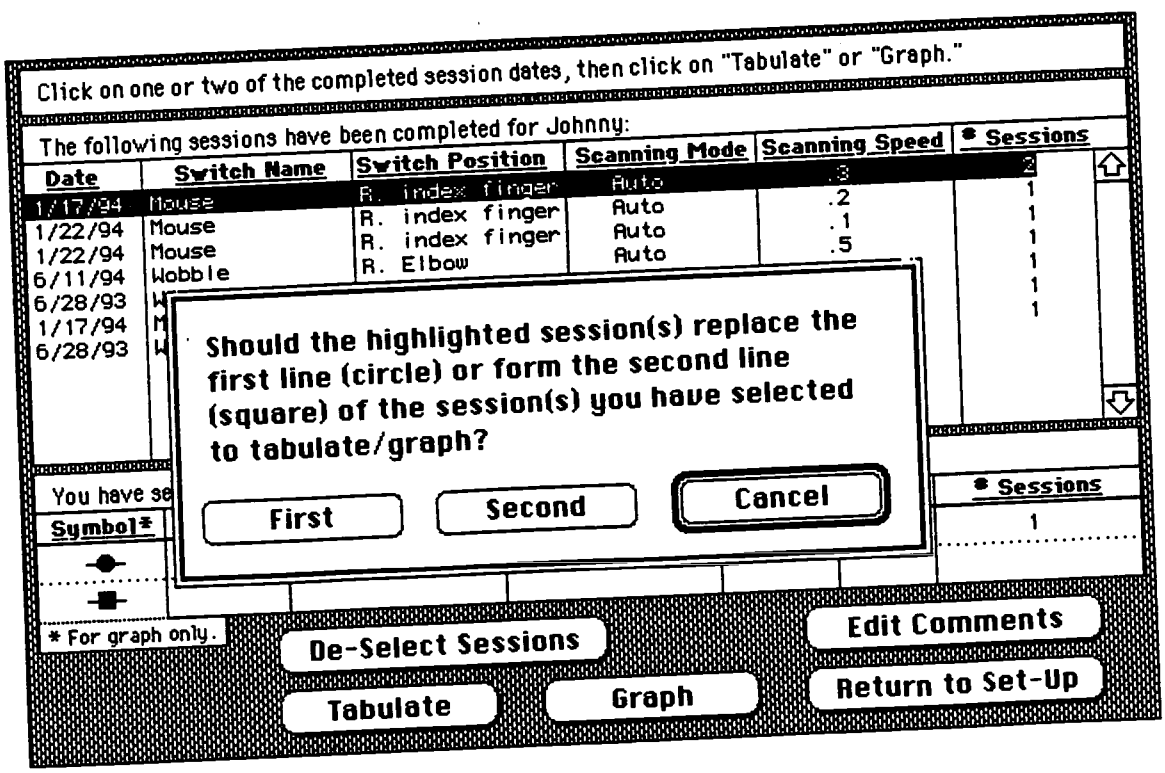


Figure 5: Selecting session(s) to be tabulated or graphed.

of the screen, next to the circle symbol. Click the "Tabulate" or "Graph" button to display the table or graph. The table and graph are explained further below.

A single table or graph may contain two sets of performance data. The Scanning Assessment Tool requires that no more than one parameter of the scan (switch name and position, scanning mode and speed) change across two data sets in the same table or graph. To compare performance across two sessions (or two groups of sessions) differing in more than one parameter, create separate tables or graphs for each, according to the procedure described above. Separate tables or graphs also are needed to compare more than two sessions or groups of sessions.

To compare performance across two sessions (or two groups of sessions) that differ in no more than one parameter, click on the line describing the first session(s). The session(s) you have selected will appear in the lower section of the screen, next to the circle symbol, and will become the left-hand column of the table or the circle symbol on the graph. Next, click on the line describing the second session(s). You will be asked whether you want to replace the first selection or to specify a second set of sessions (Figure 5). Click "Second." The session(s) you have selected will appear in the lower section of the screen, next to the square symbol, and will become the right-hand column of the table or the square symbol on the graph. Click the "Tabulate" or "Graph" button to display the table or graph. The table and graph are explained further below.

To replace one session (or group of sessions) with another, click on the line describing the new session(s), on the upper portion of the screen (Figure 4). You will be asked whether you want the new session(s) to form the first or the second part of the table or graph. To remove a session (or group of sessions) from the table or graph without replacing, click the "De-Select Sessions" button (Figure 4).

The Scanning Assessment Tool provides for comments to be saved in the client file and printed with graphs and tables. Please refer the "Edit Comments" menu command, above, for information about editing comments.

To return to the set-up screen (without tabulating or graphing), click the "Return to Set-Up" button (Figure 4), or choose "Graph/Tabulate Data" from the Assessment menu. To choose "Graph/Tabulate Data" using the keyboard, type command-G (hold down the ⌘ key and press G).

Display Table

To display a table of performance for the session(s) you selected, choose "Display Table" from the Assessment menu, or click the "Tabulate" button. A check mark will appear next to the "Display Table" menu item, and the table will be displayed (Figure 6). Each entry in the table consists of the number of correct trials in the session, followed by the number of each

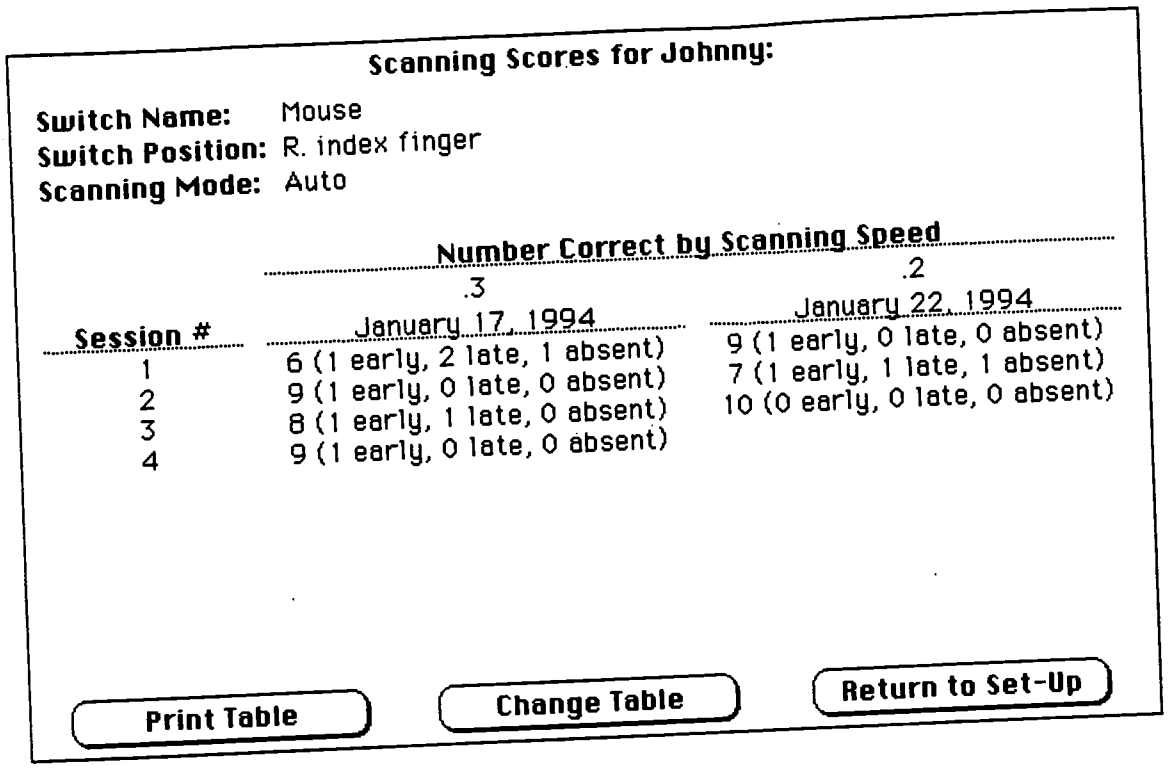


Figure 6: Sample table.

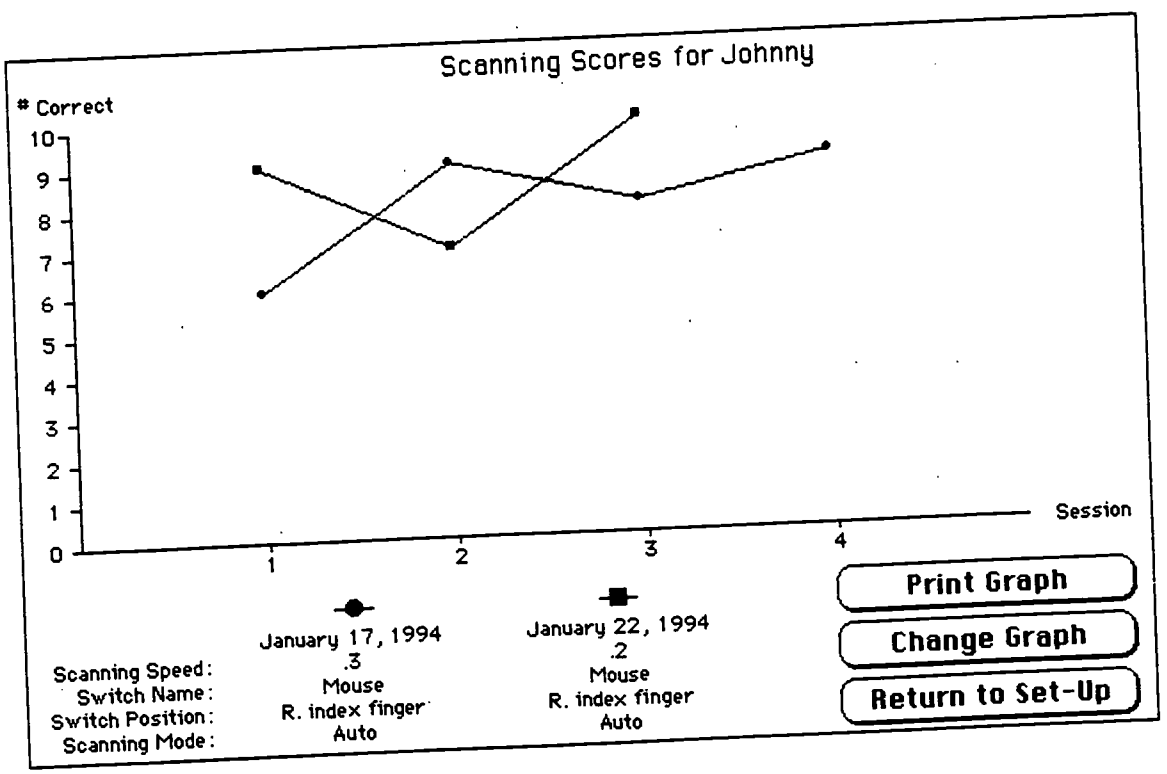


Figure 7: Sample graph.

type of error made during the session. Three types of activation errors are possible: early (switch activation before the target is reached), late (switch activation after the target is passed), and absent (no switch activation during the entire scan). These results are provided only in tables and not on graphs.

To print the table, click the "Print Table" button or choose "Print" from the Assessment menu. Please refer to the "Print" menu command, below, for more information and alternative forms of this command.

To edit the comments, choose "Edit Comments" from the Assessment menu. Please refer to the "Edit Comments" menu command, below, for more information and alternative forms of this command.

To select other data for display in the table, click the "Change Table" button or choose "Display Table" from the Assessment menu. The previous screen of completed and selected sessions will be displayed (Figure 5). Please refer to the "Graph/Tabulate Data" menu command, above, for more information about selecting sessions to be tabulated and graphed.

To graph the data displayed in the table, choose "Display Graph" from the Assessment menu. Please refer to the "Display Graph" menu command, below, for more information about this command.

To return to the set-up screen, click the "Return to Set-Up" button (Figure 6), or choose "Graph/Tabulate Data" from the Assessment menu. To choose "Graph/Tabulate Data" using the keyboard, type command-G (hold down the ⌘ key and press G).

Display Graph

To display a graph of performance for the session(s) you selected, choose "Display Graph" from the Assessment menu, or click the "Graph" button. A check mark will appear next to the "Display Graph" menu item, and the graph will be displayed (Figure 7).

To print the graph, click the "Print Graph" button or choose "Print" from the Assessment menu. Please refer to the "Print" menu command, below, for more information and alternative forms of this command.

To edit the comments, choose "Edit Comments" from the Assessment menu. Please refer to the "Edit Comments" menu command, below, for more information and alternative forms of this command.

To select other data for display on the graph, click the "Change Graph" button or choose "Display Graph" from the Assessment menu. The previous screen of completed and selected sessions will be displayed (Figure 5). Please refer to the "Graph/Tabulate Data" menu command, above, for more information about selecting sessions to be tabulated and graphed.

To tabulate the data displayed on the graph, choose "Display Table" from the Assessment menu. Please refer to the "Display Table" menu command, above, for more information about this command.

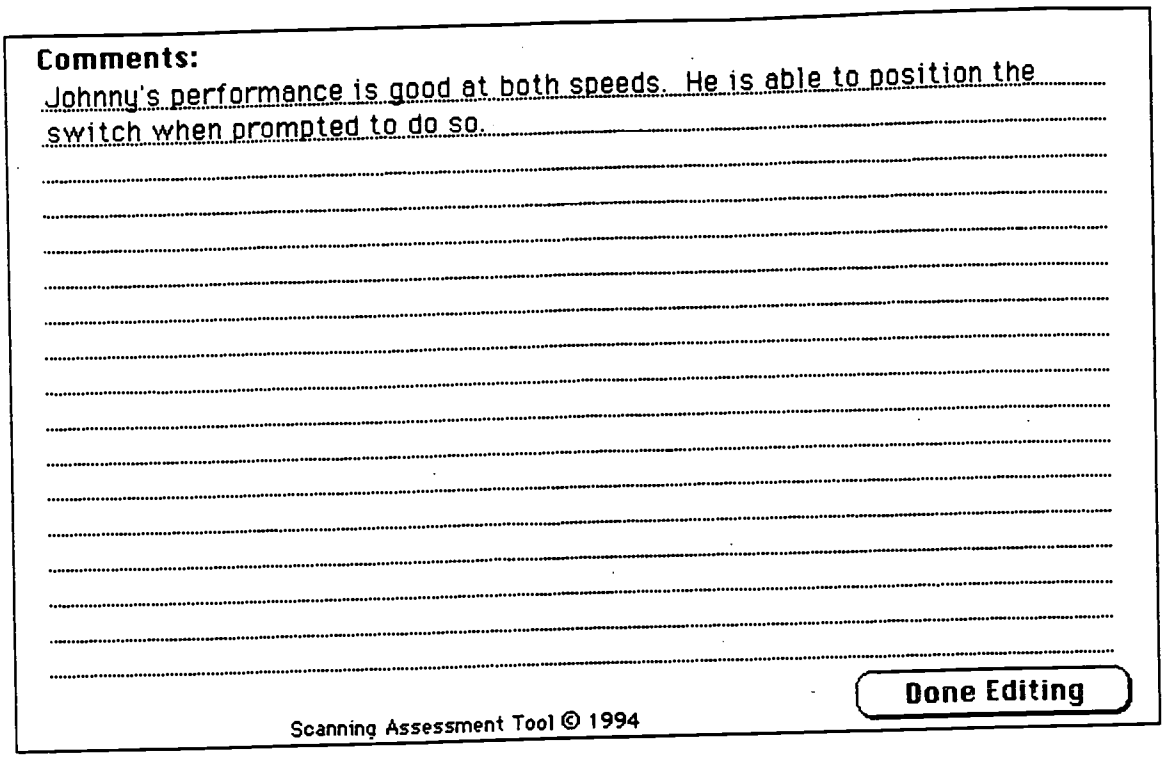


Figure 8: The comments field.

To return to the set-up screen, click the "Return to Set-Up" button (Figure 7), or choose "Graph/Tabulate Data" from the Assessment menu. To choose "Graph/Tabulate Data" using the keyboard, type command-G (hold down the ⌘ key and press G).

Edit Comments

The Scanning Assessment Tool provides for comments to be saved in the client file and printed with graphs and tables. To view and change the comments that may be printed with the table or graph, choose "Edit Comments" from the Assessment menu. The comment field will appear, with the current file comments, if any (Figure 8).

To add a comment, click on the first dotted line and type your comment. To change an existing comment, click at the location in the text that you want to change, and use the keyboard and the "Edit" menu to edit the comment. Please refer to the documentation supplied with your Macintosh, including the "Macintosh Basics" program, for more information about the "Edit" menu.

Note that only the most recent comments are displayed and printed. To retain previous comments for subsequent viewing and printing, you may choose to comment about each session by adding a new line.

Some screens provide an "Edit Comments" button. (Refer for example to the set-up screen). Clicking on this button is identical to choosing "Edit Comments" from the Assessment menu.

To continue using the program when you have finished editing, click the "Done Editing" button, or choose "Edit Comments" from the Assessment menu. To choose "Edit Comments" using the keyboard, type command-E (hold down the ⌘ key and press E).

Print

To print a table or graph, choose "Print" from the Assessment menu. To choose "Print" using the keyboard, type command-P (hold down the ⌘ key and press P). You can also print by clicking the "Print Table" or "Print Graph" button (see Figures 6 and 7).

During printing, you will be asked whether you want to print your comments along with the table or graph. Please refer the "Edit Comments" menu command, above, for information about editing comments.

Leaving the Scanning Assessment Tool

Quit Scanning Assessment

To leave the Scanning Assessment Tool, choose the "Quit Scanning Assessment" command from the Assessment menu. To choose "Quit Scanning Assessment" using the keyboard, type command-Q (hold down the ⌘ key and press Q).

Scanning Assessment Tool
Assessing Selection Control Techniques

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Abstract

People who use scanning for accessing assistive technology may not have been adequately assessed for the scanning mode (automatic, inverse, or step) they can control most accurately. Thus, their access to the assistive technology devices may be slower than necessary and cause fatigue. The Scanning Assessment Tool software program helps to evaluate scanning ability. This software program collects data on accuracy rate, switch used, switch position, and speed. This information can be used during assessments to compare effectiveness across scanning modes, switches, switch positions, and to document changes.

Introduction

Persons with muscle incoordination due to cerebral palsy or other impairments use assistive technology to increase their independence. Even with assistive devices some individuals still have difficulty controlling their movements to access keyboards that are connected to assistive technology devices. A more appropriate access method may be scanning.

Scanning involves the ability to press one switch reliably to operate computers and assistive devices for communication, writing, mobility, and/or environmental controls. Three scanning modes form the foundation of scanning; automatic, inverse, and step. In Automatic Scanning the switch is pressed and the cursor advances across the items automatically. When the cursor highligths the desired item, the switch is pressed again to indicate the desired item. For Inverse Scanning the cursor only advances while the switch is being pressed. The desired item is indicated by releasing the switch. The item that the cursor indicates when the switch is released is the item presented. In Step Scanning: the switch is pressed successively to advance the cursor item to item. When the cursor highligths the desired item, the user releases the switch. The absence of a switch press is the signal that a selection has been made[1].

When compared to direct selection, scanning is usually slower[2 3]. Because scanning is a slower method of interfacing with assistive technology every effort must be made to insure the user is using the scanning mode that will be most efficient.

Assessment

When evaluating persons who are potential candidates for scanning, it is necessary to establish their efficiency using each mode (automatic, inverse and step). After mode efficiency has been established, scanning patterns (row-column scanning, directed scanning, group-item scanning) can be evaluated to improve speed of scanning. In the assessment process selecting the appropriate mode comes after the switch and switch position have been established and before the

user begins examining scanning patterns.

Unfortunately, many times the scanning mode that may be most efficient for the user is not recommended. There are several reasons for this. First, persons who use scanning are not adequately assessed for the scanning mode they can most adequately operate. By this time in the assessment, the user may have fatigued or the allotted time for the assessment is nearly over. Since other major decisions have been made, such as seating issues, which switch, and position of the switch, the scanning mode may not be addressed. Many times, the recommendation will be to use automatic scanning due to fatigue of the client, time constraints of the assessment team and lack of a tool to help in assessing this area. Although automatic scanning is the mode most often seen in commercially available software[4,5], preliminary findings show that youths with spastic cerebral palsy perform most poorly using this mode[6]. Thus, persons who use scanning may be employing the mode that is least effective for them. Second, the cursor speed must be slow enough for the user to control the scan mode adequately. Using an inappropriate mode necessitates decreasing cursor speed to allow for accuracy. When using the appropriate scanning mode, the speed can be increased. Users are more efficient and faster using the proper mode. Third, when users make an error they must wait for the cursor to continue on its path of scanning all the items and then return to the item the user originally wanted; a time consuming process. Error rate can be decreased when user access the mode over which they have the most control. Thus, they scan more rapidly.

Scanning Assessment Tool

The Scanning Assessment Tool is a software program that provides numerical information that evaluators can use when recommending scanning modes. It is written in Hypercard, runs on a Macintosh computer. It requires a Macintosh computer with 512x342 or greater screen resolution, a hard disk, HyperCard 2.1 or higher, System 7.0 or higher, a Macintosh Switch Interface or Ke:nx (available through Don Johnston Developmental Equipment), and the switches the evaluator wishes to examine with the user. The switch plugs into the Macintosh Switch Interface or Ke:nx and the interface plugs into the computer.

The Scanning Assessment Tool has two components; a practice component and a test component. The practice component displays three boxes on the computer screen, with a smiling face in one of the boxes. Three boxes are the minimum necessary to allow practice without an undue amount of waiting while the cursor completes the scanning path. Users press their switch indicating they are ready to begin. The cursor, a shaded square, moves from one box to the next traveling across all three boxes. The subject presses the switch when the cursor moves to the box containing the smiling face. Cursor speed adjustment and learning how to use the scanning mode takes place during the practice component.

During the test component, the evaluator chooses between using three

six or nine boxes. Figure 1 displays how the screen appears with six boxes presented for testing.

For step mode, the cursor moves as fast at the user can press the switch. The acceptance time controls how fast scanning can proceed, that is; how long the cursor highlights an item before it is chosen as the desired one. If the acceptance time is set for a half-second, the user must press the switch within that time to move it to the next item, otherwise the item that the cursor is highlighting will be accepted as the item of choice.

The software collects data on accuracy and error scores, in which box the error was made, speed, mode, the time when subjects press their switch, switch being used, and switch position. The data can be express in graph or table form. Either form can be printed out for a hard copy to be kept in the users file and to visually demonstrate the user's performance using each mode.

Summary

The Scanning Assessment Tool can potentially affect the ability of persons with cerebral palsy and others who have muscle incoordination to effectively use assistive technology devices. It provides evaluators with numerical and visual data to help make scanning mode recommendations. The software can be used to keep records of improvements or changes in scanning ability. Both of these factors help ensure that persons using scanning will be using the interface method they are best able to control when using writing, augmentative communication and other assistive devices.

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3.Fishman I. (1987). Electronic Communication Aids. Boston, College-Hill.

4.Don Johnston Developmental Equipment P.O.BOX 639, Wauconda, IL 60084.

5.Words+, Inc., P.O.Box 1229, Lancaster, CA 93584.

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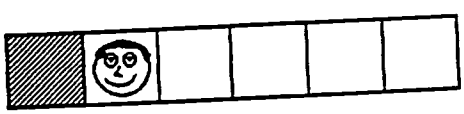
Figure 1.



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