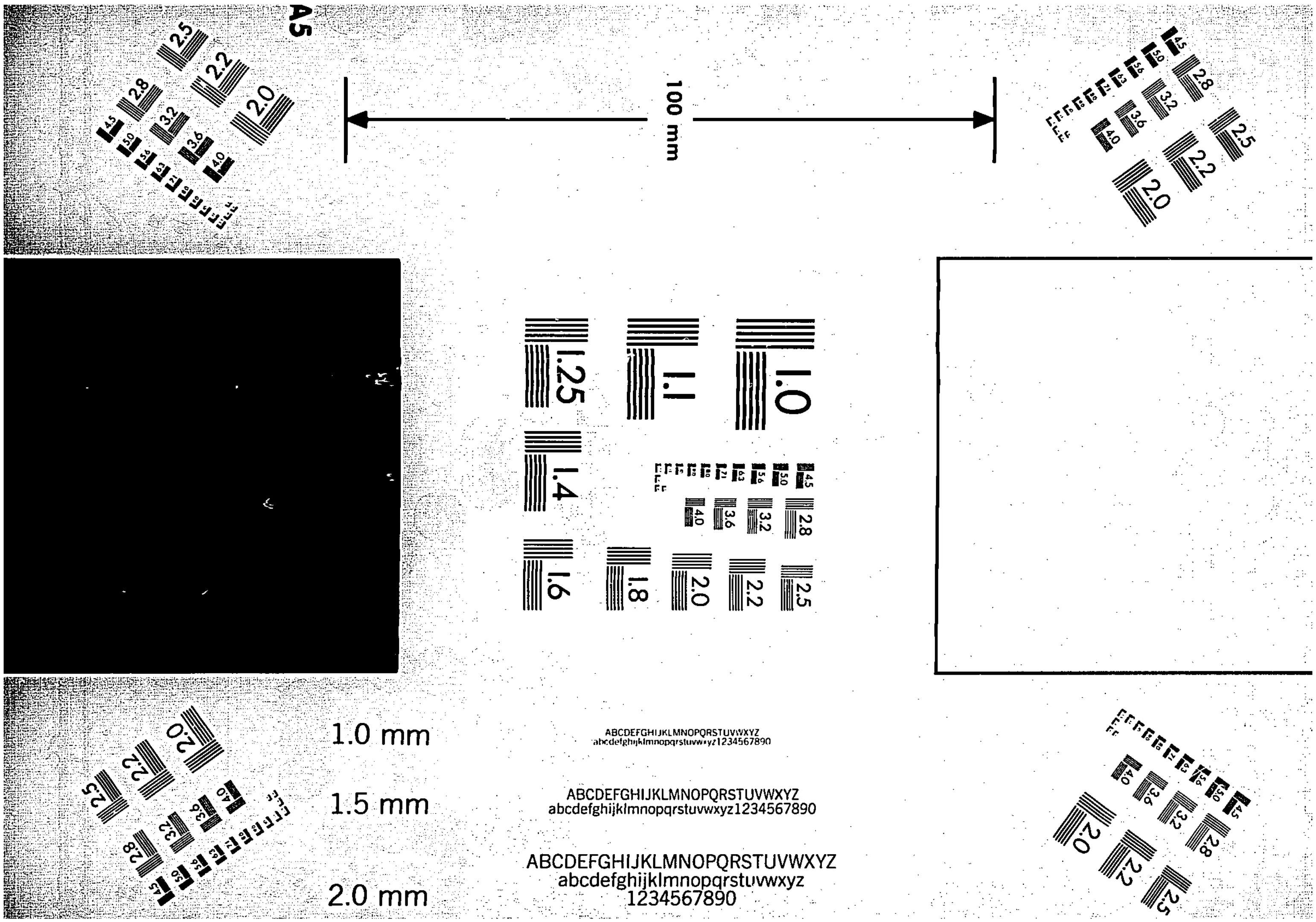
A5
100 mm
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
1.0 mm
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890
1.5 mm
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890
2.0 mm
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

DOCUMENT RESUME

ED 278 209 EC 191 776

AUTHOR	Teeter, Phyllis Anne; Smith, Philip L.
TITLE	Neuropsychological Assessment and Training of Cognitive Processing Strategies for Reading Recognition and Comprehension: A Computer Assisted Program for Learning Disabled Students. Final Report.
INSTITUTION	Wisconsin Univ., Milwaukee.
SPONS AGENCY	Department of Education, Washington, DC.
PUB DATE	[86]
GRANT	G008302986
NOTE	12p.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Cognitive Processes; *Computer Assisted Instruction; *Computer Assisted Testing; Elementary Education; Instructional Effectiveness; Instructional Material Evaluation; *Material Development; Microcomputers; *Reading Difficulties; Reading Instruction
IDENTIFIERS	*STAR Neuro Cognitive Assessment Program; *STAR Neuro Cognitive Reading Program

ABSTRACT

The final report of the 2-year project describes the development and validation of microcomputer software to help assess reading disabled elementary grade children and to provide basic reading instruction. Accomplishments of the first year included: design of the STAR Neuro-Cognitive Assessment Program which includes a reproduction of paired-letters task, a word sorting task, a verbal-interference task, and a spatial-interference task; conduct of a study to determine if subclassifications of reading disabled students utilize different cognitive strategies for processing information for verbal and non-verbal tasks; and determination of the validity of the STAR Assessment Program (in comparison to the Kaufman Assessment Battery for Children). The major second year accomplishment was development of the STAR Neuro-Cognitive Reading Program for grades 3 and 4 consisting of three separate approaches reflecting distinct cognitive processing strategies (simultaneous processing, sequential processing, and traditional processing). The program provides 30 lessons at each of the two grades for each of the three cognitive strategies. Validation of the reading program was not accomplished due to too few subjects. (DB)

Neuropsychological Assessment and Training of Cognitive Processing Strategies for Reading Recognition and Comprehension: A Ccmputer Assisted Program for Learning Disabled Students

FINAL REPORT

Phyllis Anne Teeter
Philip L. Smith
University of Wisconsin-Milwaukee

This project was funded through the U.S. Department of Education (Grant # G-00-8302986)

NEUROPSYCHOLOGICAL ASSESSMENT AND TRAINING OF COGNITIVE PROCESSING STRATEGIES FOR READING RECOGNITION AND COMPREHENSION: A COMPUTER ASSISTED PROGRAM FOR LEARNING DISABLED STUDENTS

FINAL REPORT FOR GRANT # G008302986

PROJECT OBJECTIVES FOR YEAR 1

The primary objectives for Year 1 were:

a) to develop and validate microcomputer software to assist in the identification and assessment of cognitive strategies used by reading disabled children;
b) to determine if subclassifications of reading disabled students utilize different cognitive strategies for processing information for verbal and non-verbal tasks; and,
c) to determine if the microcomputer experimental programs are as effective as traditional assessment procedures for identifying children with severe reading disabilities.

The three objectives were all met in the following manner.

OBJECTIVE A: four (4) microcomputer experiments (the STAR Neuro-cognitive Assessment Program) were designed and are described below. All the experiments were programmed in Applesoft Basic for the Apple II microcomputer series. These experiments are all available and can be obtained from the principal investigator.

Experiment 1, Reproduction of Paired-Letters. The Reproduction of Paired-Letters task was originally introduced by Aaron (1978), and was modified for the microcomputer. Each child was asked to draw a design that had been rapidly flashed onto the computer screen. Sixteen stimuli were constructed by placing two letters in close proximity to one another with a barely discernable distance between them, such as HH, TT, and WW.

Each letter-pair could be produced either as a complete visual-gestalt (indicative of simultaneous processing), or as two separate letters (indicative of sequential processing). For example, HH and TT could be reproduced: as HH and TT, reflecting simultaneous processing; or, as H   H and T   T, reflecting sequential processing.

Experiment 2, Word Sorting Task. The Word Sorting task was a modification of an earlier experiment conducted by Caplan nd Kinsbourne (1981). Children were asked to find one word from a set that didn't belong. In order to insure that subjects were able to read and comprehend the stimuli, words were selected from a graded word list and a word frequency text. Twenty words were selected at least 3 to 4 years below each grade level, and separate word lists were generated for grades 4, 5 and 6.

Words were chosen for semantic or shape pairing. For example, a word set for Grade 6 was: 1) direct, 2) guard, 3) guide. Matching of "guard" and "guide" would reflect pairing on the basis of visual-spatial processing strategies because both words begin with "g" and both have similiar shape configurations. Matching of "direct" and "guide" would reflect a verbal-analytic processing strategy because both words have similiar conceptual meanings. Matching of "guard" and "direct" would reflect an error.

Experiment 3, Verbal-interference Task. In this experiment, 24 words were projected onto the computer screen. Words were selected from graded word lists and a word frequency text, from the pre-primer, primer, and first grades. Four trials were presented to all subjects: 1) right hand tapping; 2) left hand tapping; 3) right hand tapping while reading; and, 4) left hand tapping while reading. Each trial was timed in 10 second intervals. The number of taps under the reading/tapping conditions were compared to the respective tapping only conditions. A greater reduction in tapping speed with the right hand (while reading) indicates activation of the left hemisphere, while a greater reduction of speed for the left hand suggests right hemisphere activation.

Experiment 4, Spatial-Interference Task. This program was modified from an experiment originally introduced by Gianutsos and Klitzner (1981). Sixty separate patterns were displayed on the screen, and the subject had to find a match to a pattern projected to the center screen. Three conditions were presented: 1) a search only; 2) a search with right hand tapping; and 3) a search with left hand tapping. There were 8 trials for each condition. The "match" stimuli were projected to both the right and left visual fields across trials (4 trials of condition by field). Latency times measuring how long it took to find the matching pattern were recorded for each trial, and were compared across the search and tapping conditions. Greater time scores for search and right hand tapping indicate that the left hemisphere is primarily activated, while longer search time with left hand tapping suggests right hemisphere activation.

OBJECTIVES B AND C: In order to test Objectives B and C, the following study was conducted.

Subjects

There was a total of 73 children in this study, with 37 normal and 36 reading disabled subjects. Subjects were selected from grades 4 through 6, and the groups did not differ across age in months (M = 128.87, SD = 10.71 for controls, and M = 128.81, SD = 11.24 for reading disabled). There were 24 males and 13 females in the control group, with 26 males and 10 females in the reading disabled group. Children in the control group were selected on the basis of: grade appropriate academic performance; average intellectual performance on group intelligence tests; and, no history of emotional, academic, or neurologic dysfunction. Children in the reading disabled group were taken from learning disabilities programs in their schools, and were classified on the basis of: at least average intelligence on individual IQ tests; reading achievement two or more years below age and grade peers; and, no other primary handicapping condition (i.e., emotional disturbance, physical handicap, or sensory handicap).

Procedures

Each subject was individually tested on the Kaufman Assessment Battery for Children (K-ABC) and the four microcomputer experiments by four research assistants. Subjects were randomly assigned to examiners and the order of each test was counterbalanced. The K-ABC was administered following standardized procedures as outlined in the test manual. To insure that all subjects understood the directions and were familar with the computer, practice trials were administered prior for all experiments. Two practice trials were given for both Experiments 1 and 2. Scores for Experiment 1 represented the number of stimuli drawn as separate letters, reflecting a sequential strategy. Scores were tabulated as the number of words sorted on the basis of conceptual pairings for Experiment 2.

Six practice trials were administered for Experiment 3 (Verbal-interference), 2 with right hand tapping, 1 right hand tapping while reading, 2 left hand tapping and 1 left and tapping while reading. The tapping and tapping while reading conditions were timed trials, in 10 second intervals. The number of taps was recorded by an internal counter in the computer program. Scores on Experiment 3 represent: 1) the total number of taps with the right hand while reading, 2) the number of taps with the left hand while tapping, and, 3) the percent reduction across the respective tapping only conditions.

Practice trials were administered for Experiment 4 (Spatial-interference) under search and search with tapping conditions (right and left hand). On these trials a boxed-in pattern was projected to the center of the monitor, with 60 stimuli presented around the center square. The child was asked to find the matching pattern. Once the match was located, the examiner hit a computer key to stop an internal timing device in the computer program. The child was then told whether the match was correct. If incorrect, the computer was programmed to present another trial in the same visual field as the error, under the same exprimental conditions (search or search while tapping). Scores on Experiment 4 were: 1) search time with no tapping; 2) search time with right hand tapping; and, 3) search time with left hand tapping. An increase in search time was calculated for the tapping conditions and across the right and left visual fields.

Results

The following means and univariate F tests show that the normal group scored higher than the LD group on the Simultaneous (SIS), Sequential (SES), and the Mental Processing Scales (MPS) of the K-ABC: 1) SIS for normals ($M = 110.92$) and LD ($M = 99.0$), $F = 14.39$ ($DF = 1, 69$), $p = .0003$; 2) SES for normals ($M = 105.68$) and LD ($M = 90.15$), $F = 31.22$ ($DF = 1,69$), $p = .000$; 3) MPS for normals ($M = 110.24$) and LD ($M = 94.32$), $F = 31.18$ ($DF = 1, 69$), $p = .000$.

Experiments 1 and 2. The LD and normal groups also differed in terms of the processing strategies used on Experiments 1 and 2: 1) Sequential strategy on Experiment 1, normal ($M = 7.76$) and LD ($M = 4.92$), $F = 6.63$, $p = .0122$; and, 2) Conceptual strategy on Experiment 2, normal ($M = 17.54$) and LD ($M = 8.75$), $F = 70.14$, $p = .000$. Chi-square results indicate that subjects with significantly higher SIS - SES differences on the K-ABC did not demonstrate consistently higher simultaneous processing strategies on Experiment 1 (Chi-square = 5.39, $DF = 4$, $p = .24$); or on Experiment 2 (Chi-square = 1.94, $DF = 4$, $p = .74$).

Discriminant analysis showed that two of the microcomputer Experiments had higher classification accuracy rates than did the K-ABC Scales: 1) K-ABC alone, 78% accuracy for normals, and 70.6% for LD; 2) Experiments 1 and 2, 94.6% for normals and 83.3% for LD; and, 3) Experiment 2 alone, 94% for normals and 83% for LD.

Experiments 3 and 4. Data from the Verbal-interference task (Experiment 3) were analyzed using a repeated measures ANOVA with one factor (tap hand reduction), and one between subjects factor (group). Data were analyzed using a multivariate ANOVA to avoid the effects associated with violations of the sphericity and compound symmetry assumptions of the univariate model. Data from Experiment 4 were analyzed using a repeated measures design with two within subjects factors (tap hand and visual field), and one within subject factor (group).

ANOVA results on Experiment 3 indicated that both the LD and the normal group demonstrated left hemisphere activation for reading ($F = 8.17$, $p = .006$); with no significant group by tap interaction ($F = .90$, $p = .35$). These results indicate that the verbal-interference condition had no differential effect on groups, and that the interference was greater for the right hand for both normal and reading disabled children.

There were no significant differences for the group ($F = .017$), tapping ($F = 1.796$), or group by tapping conditions ($F = .230$) on Experiment 4. The groups did not show differential hemispheric activation on this task.

Discussion

These data support previous research with the K-ABC, where LD children scored higher on the Simultaneous Scale compared to the Sequential Scale. The K-ABC also showed high classification accuracy rates for differentiating LD from normals, although the percent accuracy was not as high as has been previously reported. In fact, the Word Sorting Task (Experiment 2) was more accurate than the K-ABC for differentiating normals (16% higher) and LD (13% higher) children. On Experiment 2, LD children showed a preference for matching words on the basis of spatial-structural elements rather than on the conseptual-linguistic elements used by normal children. This is most likely a reflection of the rather limited language abilities of the LD group. These results are consistent with other studies which report that children using visual-verbal cognitive strategies score higher on reading tests than those using visual-spatial strategies.

LD children showed a perference for gestalt-like, simultaneous strategies on Experiment 1, which is similar to other studies of this nature. Normal readers appear to process the paired-letter stimuli from a symbolic-analytic perspective; that is, they are perceiving two distinct letters. The LD children do not appear to perceive the letter symbols as often as the normal readers, but rather they see the stimuli as single shapes or forms.

These results indicate that LD children do use different processing strategies than do normal readers on a variety of tasks; however, neither group showed "consistent" strategies across all the tasks (i.e., K-ABC, Experiments 1 & 2). This suggests that individuals may not have strong "preferred" or "consistent" strategies, but rather the demands of the task may influence the strategy used. This observation was further supported by the fact that scores on the tasks did not show consistent correlation patterns both within groups and when groups were combined. These results also show that the STaR Neuro-cognitive Assessment Program has utility for differentiating reading disabled from normal readers.

The results of the Verbal-interference task (Experiment 3) are similar to other research findings with dichotic listening tasks, where verbal information is more efficiently processed in the left hemisphere. In this study, both normal and reading disabled children showed a greater reduction of tapping speed with the right hand while reading. Although the reading disabled group had lower tapping speeds than the normal group across all trials, they did not show differential hemisphere activation.

The results of the Spatial-Interference task (Experiment 4) did not reveal significant main or interaction effects in search time across groups, tapping conditions, or visual fields. This indicates that normal and LD children showed similar abilities on the spatial-interference task, and that neither hemisphere was dominant. There are at least two plausible explanations for the finding that neither hemipshere appeared dominant for this task. First, these results may suggest that the search task was complex and involved integrated, global brain activation. Even though the task was spatial and required visual discrimination (presumed to be primary right hemisphere activation), the subjects may have used searching or planning strategies involving both hemispheres. Further analysis are warranted to determine if subjects utilized specific cognitive strategies to scan, search, and match patterns, or whether they employed verbal mediators to solve the problem. Second, the tapping condition may not have been a sufficient interference to show differential hemispheric effects. This explanation seems less likely given the significant findings with the vrbal-interference task (Experiment 3).

SUMMARY OF YEAR 1 ACCOMPLISHMENTS

All objectives for Year 1 were achieved on schedule. Products that were generated include the STaR Neuro-cognitive Microcomputer Assessment Program for differentiating reading disabled students from normal readers. These computer programs are available from the principle investigator.

PRIMARY OBJECTIVES: YEAR 2

Primary objectives for Year 2 were:

a) to develop 3 different microcomputer reading instructional programs (traditional reading curriculum, sequential reading curriculum, simultaneous reading curriculum) for three grade levels (2nd, 3rd, 4th);
b) to validate the microcomputer programs; and,
c) to determine if students taught with instructional programs that match their cognitive processing strategies will show greater reading gains than a control and a non-matched group.

The three objectives were met in the following manner.

OBJECTIVE A: The STaR Neuro-cognitive Reading Program was developed for grades 3 and 4 only. Due to the time involved in writing, programming, and "de-bugging" each lesson, Grade 2 was not developed. There was a total 180 lessons generated which took from 15 - 20 hours a piece to develop.

The StaR Reading Program is a 10 week instructional program, with 3 reading lessons per week. There are two reading levels, one for third grade and one for the fourth grade level. The three lessons per week are: Lesson 1, Vocabulary Development; Lesson 2, Sentence Comprehension; and, Lesson 3, Main Idea and Paragraph Comprehension. Each lesson has approximately 30 to 45 minutes of instruction. In Lesson 1, new vocabulary words are introduced and word meanings are taught through direct definitions and in sentence and paragraph context. Five to seven new words are taught each week, and the word meanings are reinforced in each successive lesson. In Lesson 2, sentence comprehension is taught using chunking of meaningful phrases and sentence combining. Time-effect words (e.g., before, after, and then) and cause-effect words (e.g., because) are also incorporated in Lesson 2. Finally, in Lesson 3 paragraph comprehension is taught by separating general from specific ideas, by identifying categories from specific information, and by recognizing topic sentences.

Each lesson introduces its main objective, provides numerous examples to illustrate the objective, and then poses questions to the user. Questions are presented in a multiple choice, fill in the blank, and open response format. Feedback is tailored to specific student responses, and provides extended reinforcement of the concepts being taught. When a student has difficulty on a particular question, the program branches to additional instructional segments to teach the concept from a new perspective.

Three separate programs were developed for each grade level which reflect distinct cognitive processing strategies. The following is a description of the three different programs: simultaneous processing; sequential processing; and, traditional processing. The programs contained exactly the same instructional lessons, and differed only in the visual presentation of these.

SIMULTANEOUS PROGRAM. Simultaneous strategies emphasize wholistic, gestalt processing. Information is visually presented in a synthesized manner using "flow charts" and diagrams. Verbal relationships between concepts and thoughts are highlighted visually. That is, phrase, sentence, and paragraph meanings are illustrated by using lines and figures. This presentation was designed to help the child to see the word relationships more immediately, to make verbal conclusions more immediately, and to make the verbal comprehension process more visually concrete.

For example, a new definition is typically presented like this: "The word peril means a situation of real danger". The simultaneous presentation may look like this:

```
      PERIL
        /
       /
      /
MEANS -----------> A SITUATION OF
                   REAL DANGER.
```

Another presentation might appear like this:

```
********************          ********************
*                  *          *                  *
*                  *          *                  *
*    PERIL         * MEANS    *  A SITUATION OF  *
*                  *          *                  *
*                  *          *    REAL DANGER.  *
*                  *          *                  *
********************          ********************
```

This diagramatic scheme allows the child to process quickly, in a gestalt-like fashion, thereby capitalizing on their cognitive strengths.

SEQUENTIAL PROGRAM. Sequential processing strategies have been encorporated into the reading programs be emphasizing the serial ordering of information. Sentences and paragraphs have been broken down into small, meaningful verb or noun phrases (three to six words in length), which are presented on the screen. The phrases are separated by delays, thereby controlling the amount of information presented on the screen at any given time. This should allow the child the opportunity to process information in discreet time series, and it reduces the amount of information that has to be processed all at once.

An example of this can illustrate the difference in the processing emphasis. A sentence is normally written like this: "You would be in peril if you were on a plane that was crashing". In the sequential program, the sentence may look like this:

You would be

[DELAY]

in peril

[DELAY]

if you were in a plane

[DELAY]

that was crashing.

By controlling the amount of stimuli that is presented, the child is able to process reading segments in smaller units.

TRADITIONAL PROGRAM. The Traditional Program was presented as normal reading text similar to any other computer assisted reading program.

OBJECTIVES B AND C. Objectives B and C were only partially met. The validation and analysis phases of Year 2 were limited due to the difficulty in getting a sufficient number of subjects to participate in a 10 week research project. The initial validation study (Year 2) started with a potential of 60 reading disabled subjects and ended with only 19. There were several reasons for this drop. First, schools without a sufficient number of computers for the reading disabilties programs were unable to participate. Second, many reading disabled students were mainstreamed into regular classes for the majority of the school day and were not available for three 45 minute computer lessons a week. Finally, the subjects were screened carefully to meet federal guidelines for classification as reading disabled. A number of subjects did not fit strict and consistent guidelines and were not included in the study.

Because there were only 19 subjects who completed the entire 10 week reading program, the utility of the cognitive-processing programs could not be adequately tested. There were 6 different treatments: 1) traditional, Grade 3; 2) simultaneous, Grade 3; 3) sequential, Grade 3; 4) traditional, Grade 4; 5) silmultaneous, Grade 4; and, 6) sequential, Grade 4. Children were assigned to reading programs based on their Simultaneous and Sequential Scale scores on the Kaufman Assessment Battery for Children. Children with significantly higher Simultaneous scores were randomly assigned to treatment groups, as were children with higher Sequential scores. Pre- and post-test reading diagnostic tests were administered to all subjects, however because there was never more than 3 subjects in each cell, the results of this study can not be reliably assessed.

SUMMARY

Although the utility of these reading programs and the theory underlying the development has not been fully tested, Year 2 did produce and pilot two graded computer instructional programs. There are a total of 30 lessons for grade 3 and 30 lessons for grade 4, for each of the traditional, simultaneous, and sequential programs. Each lesson took approximately 15 - 20 hours to write, program and "de-bug", and there are a total of 180 lessons available across all the conditions. In the process of writing the computer programs, the staff also developed an authoring system for programming interactive instructional lessons for the Apple II series computer.

SOFTWARE DEVELOPMENT

Teeter, P.A., Smith, P.L., & Ryder, R. (1985) The STaR Neuro-cognitive Reading Programs. (This is a 10 week reading program for grades 3 and 4).

Teeter, P.A. & Smith, P.L. (1985) The STaR Neuro-cognitive Assessment Program. (This is a software program that contains 4 experiments for differentiating reading disabled from normal readers.)

Smith, P.L., Teeter, P.A., & Ryder, R. The STaR Authoring System for the Apple II E Series. (This is an authoring system with graphics for programming interactive instructional software.)

TECHNICAL MANUALS

Teeter, P.A. & Smith, P.L. (unpublished). Manual for the use and interpretation of the STaR Neuro-cognitive Assessment Program.

Smith, P.L. & Teeter, P.A. (unpublished). Manual for the use of the STaR Authoring System for the Apple II E Series.

PAPERS AND MANUSCRIPTS GENERATED

Teeter, P.A. (1986) Standard neuropsychological batteries for children. Book chapter for J.E. Obrzut & G.W. Hynd (Eds.). Child neuropsychology: Clinical practice. New York: Academic Press.

Teeter, P.A. (in press) Neuropsychological approaches to the remediation of educational deficits. Book chapter for C.R. Reynolds (Ed.) Handbbok of child clinical neuropsychology. New York: Plenum Press.

Teeter, P.A. & Smith, P.L. (1985) Lateralization of functions during a verbal and a spatial-interference task: A microcomputer experiment. Paper presented at the Annual Meeting of the National Academy of Neuropsychologists. Philadelphia, PA.

Teeter, P.A., Smith, P.L., & Ryder, R. (1986) The STaR Neuro-cognitive Reading Program for dyslexics: A computer assisted instructional program. Paper presented at the 27th International Conference for the Development of Computer-based Instructional Systems. New Orleans, LA.

Teeter, P.A. & Smith, P.L. (1986) The classification accuracy of the STaR Neuro-cognitive Assessment Program for differentiating LD from normal readers. Research Symposium on Special Education Technology sponsored by the Council for Exceptional Education. Washington, D.C.

Smith, P.L. & Teeter, P.A. (1986) A comparison of processing strategies for normal and disabled readers. Paper presented for the Annual Meeting of the American Psychological Association. Washington, D.C.