

APPLICATIONS
OF MICROCOMPUTERS IN
VISUAL ATTENTION

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ABSTRACT

This project attempts to address the topic of visual attention via the use of microcomputers. In some children, learning is impeded by attention deficits. We propose that a method of increasing the capacity of visual selective attention may improve the ability to learn. Programs were written for pre-school and elementary age children with a timed answer approach where the child must attend a computer screen and answer with the keyboard. We presume a therapy regime with these programs may improve visual attention and most importantly learning.

INTRODUCTION

Attention has been said to be a prerequisite for learning (1). Stated another way, learning requires selective attention as at any given moment, a person receives stimuli from a great many sources and through every sense receptor. Visual, auditory, tactual, kinesthetic and proprioceptive nerve fibers are constantly carrying impulses which often demand conflicting, mutually incompatible responses (2).

As an entity, attention is difficult to address because it is complex and consists of several facets, including arousal, capacity, and selective attention. This project attempts to address the topic of selective attention, specifically visual, and its potential relation to learning. If attention can be improved by some method in the early pre-school and elementary years, the ability to learn may be enhanced. Lahaderne (1969) reported that school achievement at the sixth grade level is positively related to attention to instructional stimuli (3).

An effective method of establishing visual selective attention capacity would be useful in the endeavor to address the impact of enhancements of attention on academic achievement. Pre- and post-treatment documentation is a prerequisite to adequate program evaluation. As such, the use of microcomputer generated programs to probe visual selective attention has been proposed (4).

PURPOSE

The purpose of my project was to determine if proven and accepted visual attention microcomputer programs, originally written for the Radio Shack TRS-80 microcomputer, could be adapted and expanded for the Commodore 64 microcomputer (C-64).

METHODS AND DISCUSSION

The C-64 was chosen for this project because of its wide availability, acceptance, use by many school systems including Big Rapids, use in homes, low cost, and features for multi-color graphics and sound.

Programs were written with a timed answer approach where the child has to identify certain given variables presented in a sequence of objects or letters on the computer screen by pressing any key on the keyboard. This concept was based on literature which states: measures of attention might be a simple motor response like pushing a button to be made on the occasion of the appearance of a readily discriminable stimulus. Also, the use of simple motor responses, which require no skill in order to be emitted while presenting stimuli in a fashion with which a subject could not have had any previous experience permits one to study attentional processes relatively unconfounded by learning. Furthermore, when one analyzes data from groups of subjects, one can use statistical methods of control for such artifacts as individual differences in fatigue and motivation.(5)

Utilizing these concepts, the basic TRS-80 programs used a sequence of single letter presentations where the child had to identify the variable "AX" by hitting any key on the computer keyboard. This basic program was converted to C-64 language and once operational, was expanded to other programs to add variety and interest. Explana-

tion of the programs will help show how the concepts of a simple attentional task with minimal learning involved might help increase attentional skills, specifically visual, and therefore improve learning and school performance.

LETTERS

"Letters" is the original program where single letters are flashed at center screen and the child responds by pressing any key on the keyboard at the presentation of the variable "AX." With the C-64, features were added such that sequences of up to 500 letters could be presented at any time interval, any time presentation, and any number of characters. Also, the C-64 color capabilities offered the opportunity to incorporate a white background, black border, and black presentations resulting in high contrast. The sequences presented are scored by the computer while the exercise is operating. The number right, number wrong, percent right and percent wrong are displayed at the completion of the exercise.

The scoring is based upon these conditions: if an "AX" is presented and the child hits any key, a correct or right response is recorded. If the child was not attending and misses the "AX", an incorrect or wrong answer is recorded. Similarly, if a single letter is presented and the child does not hit a key as s/he recognizes that the letter is not the correct variable, a correct answer is recorded. If a single letter is presented and the child hits a key, a wrong answer is registered.

With different time presentations available, the option lies to program slow sequences for the child or even quicker paced sequences for increased difficulty. Of course, the frequency at points is too slow to keep attention or too fast to answer before the next character is displayed.

The different ratios of AX's to single letters available yields another way to control difficulty. The more the AX's and opportunities to respond, I presume it is easier to keep attention. The original programs used 1 to 10 ratios. My programs have two 1 to 10's, and one each of 1 to 7, 1 to 5 and 1 to 3 ratios available. Other ratios are easily incorporated. The above ratios are arbitrary.

The program at one point offers five choices for ratios. The operator chooses which ratio. Then the stored programmed sequence ratio is used from computer memory or disc storage.

In summary, the operator has these options when running the Visual Attention "Letters" program: the time of presentations, time between presentations, number of presentations, and ratio of the given variable to the other letters. The operator also is asked her/his name. The return button is pressed when the subject is ready to start. At the conclusion of the exercise, the scores are displayed and the subject is asked if s/he would like to try again. If so, the program starts again at the beginning with all the above options available. If not, the computer is ready for any other program. See Chart 1 for the computer directions to operate "Letters."

Generators 1, 2, 3, 4 and 5

To generate and store the sequences for "Letters," five programs were written which randomly generate sequences with any number of characters and ratio of correct to incorrect responses. These programs are called G1, G2, and so on. Written into "Letters," "G1" and "G2" correspond to the 1 to 10 ratio of correct to incorrect responses. "G3" is 1 to 7. "G4" is 1 to 5 and "G5" is 1 to 3. If the "G" programs are used, the previous sequence generated or stored is automatically wiped out of memory. This avoids filling the disc to capacity with unneeded sequences. Of course, once sequences are generated, there is no real reason to change them unless a particular random sequence appears quite "unrandom." See Chart 2 for computer directions to operate "G1."

RANDOM LETTERS

The second major program is called "Random Letters." This is a replica of "Letters" except presentations of the single letters and the target "AX" are presented at any location on the screen as randomly placed by the computer. The major change in this program is the random screen location generators written. The same black border and presentations exist on the white background. All the same options of time of presentations, time between presentations, number of presentations, ratio of presentations and choice of five sequences are available. The scores are calculated as before.

G1, G2, G3, G4 and G5

The same generators are used for the program with the ratios of two 1 to 10's and one each of 1 to 7, 1 to 5 and 1 to 3 available.

WORDS

The third major program is "Words." This uses the same concept of "Letters" except that the subject identifies a target word out of a timed sequence of presented words. Here again, with black border and letters on white background, the subject chooses the arbitrary word "BLACK" out of possibilities of the words black, red, green, yellow and blue. Again, sequences of up to 500 words can be used with choices of interval time, time of presentation, and ratio of incorrect to correct words. The scores are computed and displayed at the completion of the exercise. This program was written to add variety to this concept of treatment for attentional deficits.

G16, G17, G18, G19, G20

To generate the "Words" sequences, G16 through G20 were written. They generate sequences of up to 500 characters with any ratio of correct to incorrect responses available. These programs generate and store the sequences to be used by "Words."

SHAPES

The fourth major program is "Shapes." Here sequences of shapes are presented. The subject chooses the arbitrary triangle shape

out of a sequence of triangles, rectangles, circles, diamonds, and pluses. These shapes are placed at center screen black on the white background. The same black border is present. Any number of presentations, time of, interval between, or ratio of correct to incorrect responses may be used. Again, the score is computed at the end of the sequence. Shapes were used to add variety and interest. The C-64 offers the option of creating the shape presentations.

G6, G7, G8, G9 and G10

Generators G6 through G10 were written to create and store the sequences for "Shapes." Any number of presentations up to 500 with any ratio can be generated, stored or changed at any time.

COLORS

The last or fifth of the major programs is called "Colors." Here, using the C-64 color capabilities, sequences of colored blocks are presented at center screen. The subject is to identify the arbitrary black block and press any key when it is presented in a sequence of black, red, blue, yellow or green blocks. Any number, time of, time between or ratio of blocks can be used. The score is calculated at the completion of the exercise. The color is vivid offering quite a stimulus on which to attend. This might be the easiest of all the programs.

G11, G12, G13, G14 and G15

Generators 11 through 15 generate the colored block sequences. Any number up to 500 and any ratio of correct to incorrect variables may be generated and stored. As in all, when a new sequence is generated, the old is erased to save disc space.

Table 1 summarizes all of the programs written. Table 2 shows what ratios correspond to each generator.

The main thrust of this project was to orient myself with the work and procedures needed to write optometric computer programs. The potential exists to test these programs and use them in an educational or even private practice situation. It would be interesting to evaluate the programs in an order of difficulty and also determine if the options of interval and presentation times along with different presentation ratios have any effect on performance. Of course, the main goal of any further work would be to determine if any of these programs can derive improvements in a child's visual vigilance, and therefore school performance.

Since all of these programs use the same basic concepts, expansion would be quite easy. For example, making any of the programs into a random screen placement mode might increase the difficulty. Also, other shape and color variations could be developed. The music or sound capabilities of the C-64 offer auditory or even visual-auditory programs possible.

CONCLUSIONS

With the conversions of certain commands, it was indeed possible to convert TRS-80 language into C-64 programs. With much further work, it was possible to expand and improve the basic visual attention programs.

The experience I have gained is very valuable as I now know that almost any visual training or optometric program can be written with some effort. I now plan to computerize my future office from business aspects to records to visual training to patient education. . .

The potential is limitless.

TABLE 1

NAME OF PROGRAM	GENERATORS	TARGET TO BE IDENTIFIED	OTHER VARIABLES	SPECIAL FEATURES
Letters	G1,G2,G3, G4, and G5	AX	B,C,D,E,F, G,H,I, and J	original program
Random Letters	G1,G2,G3, G4, and G5	AX	B,C,D,E,F, G,H,I, and J	random screen placement
Shapes	G6,G7,G8, G9, and G10	triangle	rectangle, circle, diamond and plus	computer generated shapes
Colors	G11,G12,G13 G14, and G15	black block	red, blue, green, and yellow	vivid colored presentations
Words	G16,G17,G18, G19, and G20	the word BLACK	the words red blue green and yellow	variety to create more interest

All offer:

- up to 500 presentations available,
- five different sequences with ratios of correct target to other variables available,
- ratios of 1 to 10, 1 to 7, 1 to 5, and 1 to 3,
- any time of target presentation and time interval between in milliseconds, and
- scores computed and displayed at the completion of every exercise.

Table 2

Generators (ratio of correct to incorrect variables)

Generator	Ratio	Visual Attention Program
G1	1:10	"Letters" and "Random Letters"
G2	1:10	
G3	1:7	
G4	1:5	
G5	1:3	
G6	1:10	"Shapes"
G7	1:10	
G8	1:7	
G9	1:5	
G10	1:3	
G11	1:10	"Colors"
G12	1:10	
G13	1:7	
G14	1:5	
G15	1:3	
G16	1:10	"Words"
G17	1:10	
G18	1:7	
G19	1:5	
G20	1:3	

Chart 1

To operate "Letters:"

1. Set up Commodore 64 with disc drive and color monitor. Turn on switches.
2. Insert "Letters" disc label side up and with label toward front of disc drive.
3. Type: 'LOAD "LETTERS",8'. Then press 'RETURN'.
4. Once the computer says 'READY', type 'RUN'.
5. VISUAL ATTENTION will appear. You will be asked time of presentation in milliseconds, time wanted between presentations in milliseconds, and the number of presentations. Type your desired entry and press 'RETURN' after each entry.
6. Type your name when asked and press 'RETURN'.
7. After reading the directions on the screen, press 'RETURN' when you are ready as the program will start immediately.
8. Once done, record scores displayed on screen if desired.
9. You will be asked if you would like to try again. If so, type 'Y'; if not type 'N'. If you said YES, the program will return to direction step 5.
10. If you typed NO, load any other program you wish such as:
 - 'Load "RANDOM LETTERS",8'
 - 'Load "SHAPES",8'
 - 'Load "COLORS",8'
 - 'Load "WORDS",8'

Start at direction step 4 to operate any of these programs.

Chart 2

To operate Generator 1 or "G1:"

1. Be sure that you want to create a new sequence before you attempt this program as the previous sequence will be purged from the memory.
2. Type 'LOAD "G1",8' and press return. Use G1 through G20 to correspond to the sequence you would like to generate for the Visual Attention programs.
3. Type the number of characters you want generated. This is typically 500. Press 'Return.'
4. Type the ratio of correct responses to other variables that you want. Again, consult the Visual Attention programs or Table 2 to determine which sequence and ratio you are generating.
5. The generator will start automatically and will display the generated sequence in the upper left hand corner of the screen.
6. Type 'NEW' when done and then load any program you wish.

REFERENCES

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*P.S.

Anyone interested in seeing &/or working with these programs should see Dr. M. Cron.
