Australian Orthoptic Journal 1993; 29: 13-17

A COMPUTER GENERATED METHOD OF TRAINING ECCENTRIC VIEWING

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Abstract

Visual rehabilitation programs typically require a wide selection of source materials capable of being rapidly accessed and, as required, conveniently interchanged. Computer technology has facilitated the creation, storage and access of data, in both text and graphic image form. Consistent with this, computer technology has the potential to provide an efficient medium for visual rehabilitation programs. A computer program has been developed to assist in training persons with central field loss to eccentrically view. The program has four components: a module to establish the eccentric viewing point at an appropriate angle and degree of eccentricity; an exercise module to reinforce the chosen eccentric viewing position; a module to encourage the application of eccentric viewing technique to visual tasks other than reading including exercises for clients unable to appreciate print material; a module comprising advanced reading material to extend reading skills for appropriate persons. Initial clinical trials indicate that this computer program provides a successful method of teaching eccentric viewing technique.

Key words: *Computer-based rehabilitation, eccentric viewing training, central field loss.*

INTRODUCTION

Pathology of the macular region is associated with a reduction in visual acuity which can cause significant functional handicap, loss of independence and emotional distress. These outcomes are of particular significance to the elderly, an age group which has a high incidence of macular disease.[1,2] The impact of vision loss associated with macular degeneration can be ameliorated with appropriate rehabilitation programs.[3,4] The clinical experience of one of the researchers (KF) indicates that effective rehabilitation programs must comply with certain criteria:

- The materials used to train refixation should consist of high resolution characters against a background which provides optimum contrast.
- A range of resource materials should be available; conventionally such resources have consisted of print or pictures of varying size which are presented to the client.
- The materials must be readily accessible and be able to be manipulated in terms of character size and format.

Storage of such resources makes demands on space and reproduction of resources to provide a variety of sizes often results in a compromise of contrast and legibility.

The personal microcomputer has many applications including data storage and manipulation.

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Computers have been used within the vision related health sciences in various applications such as assessment tools[5,6] and as a medium for presenting therapy.[7,8]

Computers have also been widely used as a means of providing information to visually-impaired people. The computer has certain features which correspond to the requirements of assessment and rehabilitation of visually-impaired persons. These include the ability to store large amounts of data in a format which is easy to access; the ability to manipulate the data on display and to interchange data efficiently; and the availability of high resolution monitors that permit display of data in a clear high contrast manner. The personal computer should provide an effective medium for the presentation of visual rehabilitation programs. Based on the need to find a more efficient means of providing eccentric viewing training and the recognised features of the personal computer, a software package has been developed to assist persons with macular degeneration to enhance their visual function by the accurate relocation of fixation.

MATERIALS AND METHODS

The computer used for development and initial trials was an IBM compatible PC 386 with super VGA monitor. The trial program was developed based on the information gained from visually-impaired clients in relation to the legibility of letters and graphics and from clinical orthoptists in relation to the development of the user interface. Design features such as ease of movement from one screen of information back to the previous screen or forward to the next screen, ease of transfer from a module back to the main menu, footnote displays of prompts and availability of a help function were addressed in the development of the program.

Preliminary clinical trials were carried out in the Visual Rehabilitation Clinic, La Trobe University, with four legally blind clients who had central field loss due to age-related macular degeneration or Leber's optic atrophy. Each training session was typically 45 minutes duration. The training sessions were conducted by one of the researchers (KF), who is the co-ordinator of the Visual Rehabilitation Clinic. Permission from clients for their participation in the trials was sought by informed consent following discussion of the computer package.

The computer program consists of four modules:

- A module to establish the eccentric viewing point at an appropriate degree of eccentricity.
- An exercise module to reinforce the chosen eccentric viewing position.
- A module to encourage application of eccentric viewing technique to visual tasks other than reading. This module also provides exercises for clients unable to appreciate print material.
- A module of advanced reading material to extend reading skills for appropriate persons.

Selection of a module is facilitated by the use of a menu. Following module selection a sub-menu enables definition of the parameters of exercise materials specific to the requirements of each client.

Module 1

The sub-menu allows the clinician to choose print size, viewing angle and eccentric position in relation to the fovea. Once these parameters are set, an image of a letter, number or simple shape as determined by the clinician appears on the screen. The position of the image is in the appropriate area of field to ensure stimulation of the most efficient eccentric viewing position. This position will have been previously identified by the clinician in pre-training assessment. A second image provides a reference point to assist the client to appreciate the size of the refixation movement required to attain the eccentric viewing position.

Module 2

The sub-menu allows the clinician to define various parameters, including degree of eccentricity in relation to the primary position; viewing angle; number of letters in a word stimulus; and print size. Words of chosen size and length appear on the screen at the designated position to stimulate the most viable section of retina.

Module 3

This module consists of 6/60 and 6/36 equivalent size shapes which can be generated at various locations on the screen. Using the sub-menu the clinician can choose the size of the shape and whether the shape will be randomly generated by the computer or selected by the clinician. The location of the shape on the screen can be randomly generated or predetermined by the clinician.

Random generation and location of shapes encourages the client to search the field of view to find an object and then to use the eccentric viewing technique to identify that object. The facility for the clinician to determine the shape and its location on the screen provides exercises to increase awareness of a particular area of the visual field or to become familiar with specific shapes.

The shapes that form the library for this module may also be used for persons unable to cope with print material. The variety of shape size and contrast ensures some images that all clients can see in order to develop their confidence. The library of shapes also includes some images that are more difficult to recognise or have more detailed components. This inclusion was intended to provide a means of challenging the skill levels of more advanced clients.

Module 4

This module consists of narrative material, graded in length and varying in content. The sub-menu provides a choice of: print size (N18 or N14); the number of lines to be displayed (1 through to 12 lines); narrative length and narrative content. These choices allow narrative of appropriate length and content to be chosen for each client. The ability to display a given number of lines of text assists clients who experience the "crowding" effect in the initial stages of text reading when using eccentric viewing technique.

RESULTS AND DISCUSSION

Results of the initial evaluation trials with clients of the Visual Rehabilitation Clinic, La Trobe University are summarised in Table 1 and described below. The trials were carried out over a period of 12 months.

TABLE 1
Summary of results from clinical trials

Client	Pre VA	Post VA	No. Sessions
KM	N36	N14	24
LW	N48	N14 words N18 text	6
MW	N48	N24	9
RB	N36	N14	17

Client KM

Diagnosis: Age-related macular degeneration with a near visual acuity of N36 assessed with a Curpax near acuity test without optical aids.

Eccentric viewing training had commenced with the conventional print exercises using an eccentric viewing angle of 4° in dextro-elevation. Progress was slower than anticipated and KM was losing confidence. When the computer-based training program became available, it was decided that this method would be of benefit to this client. The computer-based training method commenced with the graphic image exercises from module 3 as a strategy to restore client confidence. The 6/60 and 6/36 equivalent shapes were easily recognised by KM. Achieving this recognition gave the client confidence in her ability to use residual sight and reinforced the fact that some sight remained. As she became more confident, module 2 was commenced using three letter words of N24 size. The client was able to read these words although she confused letters that were similar in shape. The strategy was varied to commence each session with graphic images from module 3 to establish confidence and was followed by words from module 2. At each successive session, words of increasing length were presented. At the completion of 24 sessions, KM is working from module 4 and reading N14 size text. Long words and those composed of similar shaped letters still provide a challenge, but she is reading confidently and with a reasonable level of fluency.

Client LW

Diagnosis: Age-related macular degeneration with a near visual acuity of N48 assessed by the

Curpax near visual acuity test without optical aids.

Training commenced with the computer package using an eccentric viewing angle of 3° in elevation. Training commenced with the graphic images of module 3 as the client lacked confidence in the accuracy of her residual vision. The graphic images were readily identified and the client progressed to the more visually demanding exercises of module 2. At the completion of six sessions, LW was reading N14 words and N18 text. This rate of improvement in six sessions is unusual using conventional training techniques based on the extensive clinical experience of one of the researchers (KF). At this stage, the client chose to discontinue training because of transport problems. Near visual acuity could probably have been improved with further training. However, a significant reduction in print size was achieved in a small number of sessions.

Client MW

Diagnosis: Age-related macular degeneration with near visual acuity of less than N48 assessed on the Curpax near visual acuity test without optical aids.

Training commenced using the computer package and an eccentric viewing angle of 2° in depression. This client is not interested in reading but is very keen to use her sight for craft related activities. Initially only the graphic image exercises from module 3 were used until the shapes were confidently and accurately identified. As MW gained confidence with module 3, she requested to try the word exercises from module 2. At the time of writing she had completed nine training sessions and was reading N24 size words accurately and fluently.

Client RB

Diagnosis: Leber's optic atrophy with a near visual acuity of N36 assessed on the Curpax near acuity test without magnifying aids.

Previously, RB had spent many sessions using conventional training methods. This client has not found it easy to use one eccentric viewing position and has alternated between potential eccentric viewing positions of elevation and depression. His pathology has progressed since training commenced and he loses confidence easily.

When the computer based training became available, and following consultation with client RB, the decision was made to change to this method of training. Computer training commenced with module 1 to establish an eccentric viewing point. The eccentric viewing position was established at 14° in depression. It was noted that RB could identify the shapes but not the letters presented in module 1. Based on this information, module 3 was used in preference to module 2 as a means of reinforcing the chosen eccentric viewing point. Initially RB could identify the bold shapes at 6/60 and after two further sessions, he was able to identify 6/60 and 6/36 shapes with ease. Once RB had gained confidence through success with this module, he was able to return to module 2 and read N24 words. At the completion of the training program over a period of 17 sessions, RB was working from module 4 and reading N14 print size. He no longer alternated between elevation and depression, but settled on one eccentric viewing area and realised he was able to reduce the angle he had originally used to 5° depression. RB progressed well having gained confidence from his success with module 3.

SUMMARY

Client responses during the trials to date suggest that the computer program is viable as a method of training eccentric viewing. The preliminary results suggest that computer-based eccentric viewing training can provide an alternative to conventional training methods by achieving performance at a level and rate that, for the clients tested, exceeds one that would have been predicted by the clinician involved in the testing. The access to exercises which are not print dependent has been an apparent advantage to some clients and has facilitated progress which was previously not being achieved through use of conventional training.

An important component of further trials is to assess whether these preliminary results can be sustained in a different context, in which the

clinicians involved in the testing have not been involved in the development of the program. Because of the small sample size of the client base in the preliminary testing, further evaluation trials must be undertaken to investigate the versatility of the program with a wider range and greater number of clients in a variety of settings. An important component of these further trials will be obtaining feedback from both clients and clinicians with a view to modifying, as appropriate, the user interface.

ACKNOWLEDGEMENT

The development and evaluation of this computer package was funded by a Research and Development Grant from the Commonwealth Department of Health, Housing and Community Services.

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