Australian Orthoptic Journal 1994; **30: 27-31**

VIZASSESS A COMPUTER GENERATED TEST OF VISUAL FUNCTION

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Abstract

Assessment of the visual function of children with severe intellectual disability or gross developmental delay is a challenging and difficult task. Conventional tests of visual function are inappropriate and generally unsuccessful. Clinicians are often forced to rely on assessments which are of limited interest to the child and do not provide a quantitative result. Vizassess is a software package developed to determine the presence of vision and where possible a measure based on the standard Snellen fraction. The test presents a range of familiar images constructed in Snellen equivalent sizes. Movement and image manipulation are used to attract attention and facilitate non verbal responses. Clinical trials indicate that the test is reliable and able to be used with some of the children incapable of response to conventional tests of vision.
Key Words: *Computer Software, visual function, visual assessment, non verbal communication.*

INTRODUCTION

What do I see and how well do I see it? For the majority of people this question can easily be answered by administering appropriate tests of visual function. Clinical experience suggests that children with developmental delay, severe intellectual handicap or a severe communication problem are not so easily assessed. However a number of studies have reported a high incidence of ocular dysfunction in this population[1,2]. These studies report the incidence of sight threatening ocular pathology excluding refractive error and strabismus as 30 to 40%.

The importance of gaining an insight into the level of visual function is apparent given the significance of vision as a sense through which information about our environment is gained. Commonly used resources for learning such as; books, videos and computers are based on visual input. When vision is impaired a range of devices are used to ameliorate the effects of vision loss on learning and daily living[3,4]. Such devices are only provided following careful assessment of the extent of vision loss.

Clinically, the assessment of visual function in children with developmental delay, severe intellectual handicap or severe communication problems is difficult[5,6]. Some of these difficulties relate to features of the clinical tests in use. Conventional tests of visual acuity rely on the patient providing a definitive response to the test applied by the clinician. This response can

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take one of two forms:

1. A verbal response identifying a letter or shape.
2. A response where the patient matches the test optotype to a choice card which contains a number of possible selections.

Both responses require a degree of cognitive function which is beyond the capabilities of a severely intellectually handicapped subject[6]. Other researchers note that lack of verbal, manual and locomotor responses contribute to the difficulty of assessment[7]. Research involving children with cerebral palsy and mental retardation has shown that the children with severe motor disorders varied more from test to test and produced lower mean acuity levels. Children who were severely retarded showed greater day to day variability[8].

These difficulties have been acknowledged and have resulted in the development of tests of vision which do not require a formal response from the subject. A preferential looking paradigm incorporating the presentation of picture cards and the use of visual pointing as an indicator of vision has been reported[7,9]. Limitations are reported in using preferential looking technique which include the short attention span of the children and the boring nature of the grating optotypes[9]. One solution to this problem has been the incorporation of vanishing optotypes[10].

One researcher reports an intensive training program aimed at teaching an intellectually handicapped child to match shapes as being successful[11]. It should be noted that this solution is time consuming and only appropriate for children who have the cognisance to learn and the motor skills to match.

An alternative form of testing is to employ tests of reflex responses which do not require any level of cognition such as, the pupil response to light. Such tests do not provide any graded measure of visual function and do not contribute to our knowledge of the child's ability to use vision as a means of obtaining information.

Accurate knowledge of the visual function of children with developmental delay, severe intellectual handicap or a severe communication problem is intrinsic to understanding the child's development and ability to obtain information. This data is also valuable when determining the presentation of new information and developing training programs for that child. To facilitate the collection of data on the visual function of the target group a preliminary test program has been developed. This test is computer-based using movement to attract the child's attention and allowing the child to respond using visual pointing. A computer-based test was chosen as computers are used routinely in special development programs and to date have provided a stimulus of interest to the target group (personal communication, KF, teachers and therapists Glenallen school). The computer can store and provide access to a large variety of optotypes and allow the size, shape and presentation to be easily varied. A description of the pilot program and the results of clinical testing are presented.

METHOD

Subjects:

Thirty seven multihandicapped children attending the Glenallen school in Victoria were tested. The subjects ranged in age from 6 to 13 years with 16 being female and 21 male. The general pathology is shown in table 1, cerebral

Table 1
General Pathology

Subject Pathology	
Diagnosis	%
Cerebral Palsy	61
Rett's Syndrome	8
Developmental Delay	5
Spina bifida	5
Alexander's Syndrome	3
Peripheral neuropathy	3
Down's Syndrome	3
Myotonic Dystrophy	3
Kidney failure	3
Microcephally	3
Joubert's Syndrome	3

palsy being the most common. Permission was obtained from the Regional Education Authority, the school and informed consent was obtained from the parents. All children who returned an informed consent agreement were included in the study.

Procedure:
This trial compared the subject's performance on the computer-based assessment to that using the Kay's picture test. The tests were presented in alternate order. A positive response to the Kay picture test was considered to be an accurate definition of the picture displayed or an accurate match using a choice of picture cards. This test was administered at 3 meters. A positive response to the computer test was considered to be a positive identification of a picture, an accurate matching of a picture or the ability to change fixation to accurately locate a picture or accurately follow a moving picture. The computer test was viewed at 0.5 meters to give a minimum 6/12 acuity or 1 metre to provide a 6/6 equivalent measure.

Vizassess:
The computer test consists of 3 modules:
Module 1. A test which presents a moving target. The target can be varied in form and size. The speed of movement can also be varied.
Module 2. A test which presents a target which will increase in size. The target can be varied in form.
Module 3. A test which presents one or two targets at specified locations on the screen. The targets can be varied in form, size and location.

The shapes generated are of specified size both in terms of the overall shape and the width of the lines used to compose the shapes. These sizes are consistent with those used to generate conventional tests of visual acuity and relate to the area of retina to be stimulated. The smallest shape is equivalent to 6/12 at the viewing distance of 0.5 meters and 6/6 at a viewing distance of 1 metre. The range of size being 6/60, 6/48, 6/36, 6/24 and 6/12 at 0.5 meters and 6/30, 6/24, 6/18, 6/12 and 6/6 at 1 metre. The shapes chosen for this pilot test were: a house, cat bottle, cup, man and hand. These shapes were chosen to reflect commonly seen objects and they are consistent with shapes used in the Kay's picture test and other shape based tests for reliability of comparison. The subjects were presented with all three modules and a positive response on one or more modules considered an indication of vision. Each module is intended to stand alone as a test of acuity, the variety in modules allowing for a change in stimulus and to allow for the range of response capabilities between subjects. Vizassess was presented to all subjects at the 0.5 metre distance, those subjects who demonstrated a 6/12 equivalent at this distance were retested at 1 metre to provide assessment at 6/6 equivalent size.

RESULTS
Of the 37 subjects tested 38.7% were able to respond to both the Kay's picture test and Vizassess, a further 30.61% were assessable using the computer generated method. 30.61% were unable to be assessed using either test, figure 1. The percentage of subjects responding to each module is summarized in table 2.

Figure 1
Subject responses to VA Tests

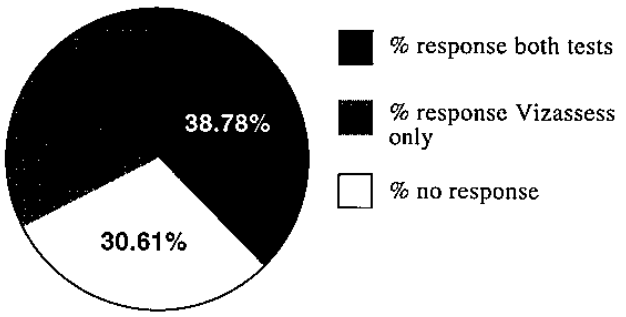

Table 2
Percentage of subject responses to Vizassess modules

Module 1	Module 2	Module 3	Modules 1,2 &3
82%	67%	82%	67%

N = 27

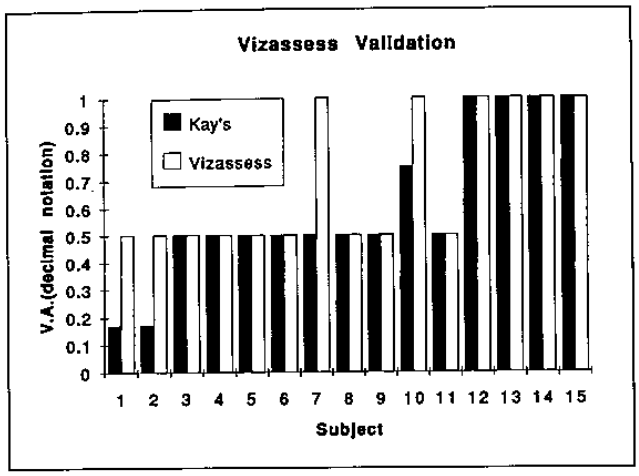

Figure 2.

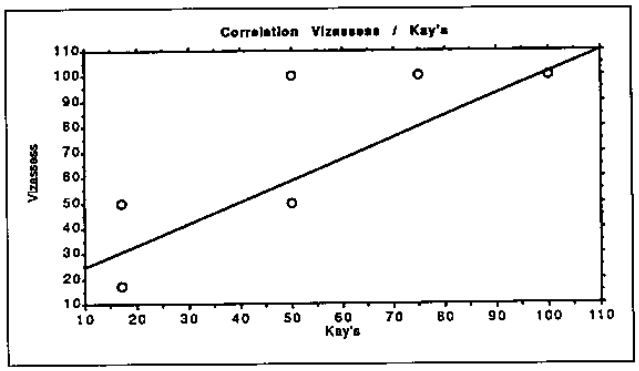

Figure 3.

Figure 2 indicates the results obtained by those subjects able to respond to both Kay's pictures and Vizassess. The level of visual acuity in the majority of cases is the same using either test. The correlation of these results is shown in Figure 3, which indicates a strong positive correlation (r=.847) and this relationship was significant at the 0.0002 level of confidence.

DISCUSSION

The clinical trial sought to answer two questions:

1. Are the vizassess optotypes a reliable measure of visual acuity?
2. Will the Vizassess program provide information about the visual function of severely impaired subjects who can not be assessed by conventional tests of vision?

The strong positive correlation between visual acuity results obtained on each test used during clinical trialing suggests that the optotypes presented in the Vizassess computer program are a reliable assessment of visual acuity when compared with the standard Kay's picture test. Four of the subjects showed a variation in visual acuity between the two tests. The variation for two of these subjects was two or less lines of Snellen acuity (6/12 and 6/9 Kay's; 6/6 Vizassess) the remaining two subjects showed a larger variation of 6/36 Kay's to 6/12 Vizassess. There is no clear reason for these differences and fatigue seems unlikely as the order of test presentation varied between these subjects. The difference may have been due to the level of interest created by the use of a computer or the dynamic presentation of optotypes however there is insufficient data to provide more than speculation in relation to these four subjects.

Sixty one percent of all subjects could not provide a reliable response to the Kay's picture test. Half of the non-responding subjects were able to provide a reliable response to the Vizassess test. Features of the Vizassess method which may have facilitated subject responses include the short working distance of the Vizassess method. A number of subjects did not maintain concentration over the 3 metre testing distance of the Kay's test but did maintain concentration at the 0.5 metre working distance of Vizassess. This finding is consistent with that of other researchers[9]. The close working distance also enabled the clinician to maintain contact with the subject, this facilitated observation of responses such as visual pointing and promoted rapport increasing subject confidence.

Subjects who were unable to communicate using the required responses to the Kay's picture test were able to visually follow the optotypes of module 1 or refixate to locate a single optotype of module 3. These ocular indicators were repeated with optotypes of the same size before being accepted as a reliable response. The use of visual pointing as a reliable indicator of response is supported by the finding of previous researchers[7,9]. These subjects were unable to communicate by matching and the Vizassess program at this stage does not provide a series of images for subject choice so that visual acuity in these cases reflects the

subject's ability to see an image, but not necessarily recognize it.

Further advantages of the Vizassess method include the ease of changing the size and presentation of the optotypes. This enabled the presentation of a range of stimuli incorporating continuous movement (module 1), change of location (module 3) and change of size. This dynamic form of presentation was not possible using the Kay's test. The Vizassess method was easily operated by one person where as some subjects required a second clinician to facilitate the use of the Kay's picture test.

The computer is used in training activities with the children attending Glenallen school. Teachers at the school report that the children are motivated by the use of computers and are familiar with them. This provided a motivational advantage for the Vizassess test. The children generally were keen to look at the computer screen and susceptible to the suggestion that the test was a game, this concept was more difficult to convey in relation to the Kay's test.

CONCLUSIONS

This pilot project supported Vizassess as a reliable test of visual acuity. The use of computer generated optotypes has provided a test which can be used successfully with some subjects who are unable to respond to conventional tests of visual acuity. The trials and subsequent discussions with teachers and therapists have raised several suggestions for improvements to the pilot program. Such improvements may facilitate assessment of the remaining 30% of subjects who did not respond to either test. A revised computer program based on the information obtained from this pilot trial is currently under development.

ACKNOWLEDGMENTS

The authors wish to thank the staff and students of Glenallen school for their participation and support of this project.

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