

Pacific University

CommonKnowledge

College of Optometry

Theses, Dissertations and Capstone Projects

5-1995

A clinical comparison of visual acuity between the Cardiff acuity test and the Teller acuity and Snellen acuity tests in an adult population

John L. Bass
Pacific University

Coby S. Ramsey
Pacific University

Bruce D. Robertson
Pacific University

Recommended Citation

Bass, John L.; Ramsey, Coby S.; and Robertson, Bruce D., "A clinical comparison of visual acuity between the Cardiff acuity test and the Teller acuity and Snellen acuity tests in an adult population" (1995). *College of Optometry*. 1105.

<https://commons.pacificu.edu/opt/1105>

This Thesis is brought to you for free and open access by the Theses, Dissertations and Capstone Projects at CommonKnowledge. It has been accepted for inclusion in College of Optometry by an authorized administrator of CommonKnowledge. For more information, please contact CommonKnowledge@pacificu.edu.

A clinical comparison of visual acuity between the Cardiff acuity test and the Teller acuity and Snellen acuity tests in an adult population

Abstract

The newly introduced Cardiff Acuity Test developed at the University of Wales College, Cardiff UK was compared to the standard Snellen Acuity charts and the Teller Acuity cards. Acuity readings were obtained from 100 eyes (50 subjects) at distances of 1 meter and 3 meters. A significant difference was found between the 3 acuity tests with a greater deviation at distance (3 meters) than at near (1 meter). The Teller cards measured the highest (best) acuity level followed by the Cardiff and the Snellen measuring the lowest (worst) acuity.

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

Paul Kohl

Keywords

Cardiff Acuity, Teller, Preferential looking, Snellen Acuity, Cycles per degree, Optotype, Visual Acuity's

Subject Categories

Optometry

Copyright and terms of use

If you have downloaded this document directly from the web or from CommonKnowledge, see the "Rights" section on the previous page for the terms of use.

If you have received this document through an interlibrary loan/document delivery service, the following terms of use apply:

Copyright in this work is held by the author(s). You may download or print any portion of this document for personal use only, or for any use that is allowed by fair use (Title 17, §107 U.S.C.). Except for personal or fair use, you or your borrowing library may not reproduce, remix, republish, post, transmit, or distribute this document, or any portion thereof, without the permission of the copyright owner. [Note: If this document is licensed under a Creative Commons license (see "Rights" on the previous page) which allows broader usage rights, your use is governed by the terms of that license.]

Inquiries regarding further use of these materials should be addressed to: CommonKnowledge Rights, Pacific University Library, 2043 College Way, Forest Grove, OR 97116, (503) 352-7209. Email inquiries may be directed to: copyright@pacificu.edu

A CLINICAL COMPARISON OF VISUAL ACUITY
BETWEEN
THE CARDIFF ACUITY TEST
AND THE
TELLER ACUITY AND SNELLEN ACUITY TESTS
IN AN ADULT POPULATION

PACIFIC UNIVERSITY LIBRARY
FOREST GROVE, OREGON

BY

JOHN L. BASS

COBY S. RAMSEY

BRUCE D. ROBERTSON

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May, 1995

Advisor:
Paul Kohl, O.D.

JOHN L. BASS

Born in Portland, Oregon and grew up in the Parkrose suburb of N.E. Portland. A graduate of Pacific University Liberal Arts College in 1991, with a Bachelor of Science degree majoring in Biology. A member of the Pacific University Varsity Basketball team during undergraduate studies at Pacific. Entered Pacific University College of Optometry in 1991 and has been active in Amigo's and a member of BSK and PTU.

COBY S. RAMSEY


Raised in Rock Springs, Wyoming and a graduate of Rock Springs High School. Attended Brigham Young University where he graduated with a B.S. in Zoology with minors in German and Music. Began his Optometric studies in 1991 at Pacific University College of Optometry. Coby was married in 1989 and has three daughters.

BRUCE D. ROBERTSON

Raised in Richland, Washington and a graduate of Richland High School. Attended Columbia Basin Community College for two years where he excelled in basketball and was highly recruited. Decided to attend Pacific University to finish his Optometry pre-requisites and continue his basketball career. Began his Optometric studies in 1991 and plans to return to the Richland area after graduation. Bruce was married in 1992 and now has two kids.

SIGNATURE PAGE:

AUTHORS:



John L. Bass



Coby S. Ramsey

Bruce D. Robertson

ADVISOR:

Dr. Paul Kohl

Abstract

The newly introduced Cardiff Acuity Test developed at the University of Wales College, Cardiff UK was compared to the standard Snellen Acuity charts and the Teller Acuity cards. Acuity readings were obtained from 100 eyes (50 subjects) at distances of 1 meter and 3 meters. A significant difference was found between the 3 acuity tests with a greater deviation at distance (3 meters) than at near (1 meter). The Teller cards measured the highest (best) acuity level followed by the Cardiff and the Snellen measuring the lowest (worst) acuity.

Key Words

Cardiff Acuity, Teller, Preferential looking, Snellen Acuity, Cycles per degree, Optotype, Visual Acuity's

Introduction

Optometrists are constantly seeking ways to improve their exams and to examine a wide range of patients. Visual acuity is a vital part of an optometrist's examination but testing acuity of children at a young age can be extremely challenging. The most widely used acuity test for infants and toddler is Preferential Looking (PL), which relies on a striped pattern to draw the interest of the child or non-verbal patient if the stripes are seen by the patient. One problem with such tests is that their results do not compare very well with standard optotype tests. (i.e. Snellen) The Snellen equivalent seems to be consistently higher than grating acuity's. In many studies the poorer the subjects recognition acuity, the larger the difference between grating and recognition acuity. 2,9,11,14 A study by Mayer DL, et.al showed the mean grating acuity and mean recognition acuity to be; 2.0 min. arc or 20/40 Snellen and 3.3 min. arc or 20/70, respectively. The Preferential Looking acuity test, which is used extensively in infant testing, has not been shown to be a test of choice for determination of Snellen equivalent acuity. A procedure that could test the same population but produce acuity's that correlate better with Snellen would be very useful.

A new test for acuity measurements has been developed that is specifically designed to test toddlers or children with intellectual impairment. The new Cardiff acuity cards uses disappearing optotypes of animals and different objects to measure visual acuity's within a Preferential looking paradigm. Cardiff has the dual effectiveness of a recognition and resolution test. The one drawback of this recognition type test is that it is affected by the child's familiarity with the object. Culture and other social factors play a part in the child recognizing the figure. This optotype acuity card does give the added advantage of maintaining the child's interest and at the same time also allows the optometrist to obtain results in an efficient and reliable manner.

The developers of the test reported on a preliminary study on seven normal adults and 24 children ranging from one to 3.5 years old. Their study on adults showed that the Cardiff acuity test was very comparable with both the Teller acuity test and the Standard Snellen acuity tests. The study did show that the Cardiff acuity test gave higher "better" acuity readings compared to Snellen but not PL..

Children under the age of three have a difficult time matching shapes so a disappearing optotype is perfect for this age group because if

they can see it then they can look and point at it or orient towards it without having to know the name. If they know the name then they can tell you what the shape is, as in other resolution type tests. Other tests such as the Broken Wheel, Landolt C's, Tumbling E's, and the STYCAR have been used for acuity assessment. All these work well for kids in the ages of three and up but there has to be some sort of verbal or auditory understanding and a knowledge of either the concept of "broken or not", or the concept of left, right, up, and down. These tests also compare better with Snellen acuity. With the Cardiff and Preferential Looking tests there is no need for any interaction other than an eye movement by the patient towards the target.

In order for clinicians to be confident using the Cardiff test on toddlers and children a large group study comparing Cardiff acuity to other acuity tests, with accepted standardized norms should be conducted. The purpose of this study was to assess whether Cardiff visual acuity's correlate well to PL and Snellen visual acuity's when used on a verbal adult population. Results may shed light on apparent differences being reported from clinics concerning differences between Snellen, Cardiff, and Teller acuity, when used with the infant/toddler populations.

Subjects and Methods

Subjects

The 50 subjects (100 eyes) were Pacific University College of Optometry students, faculty, friends and family of the students. Any individual could participate regardless of refractive status. Prior to participation a brief explanation of the study was presented to each subject and an informed consent was obtained. Of the 50 subjects, none had any corneal problems, lens opacities or retinal problems. Ages ranges from 18 to 42 with a mean age of 26.

Methods

The examiners involved in the study consisted of three third year optometry interns. All examiners were trained and allowed adequate time to practice using the various acuity tests thus being able to obtain measurements accurately and efficiently. The exam room, room luminance and testing procedures were kept constant for all subjects. Snellen acuity's were first obtained at 1 and 3M. Then the examiners would randomly choose either the Teller acuity cards or Cardiff acuity cards to test next. Snellen acuity's were tested using the Bailey-Lovie chart at 3 meters and the Lighthouse near visual acuity test with Sloan letters at 1 meter. A criterion of four out of five letters on Snellen and 4 out of 5 presentations on the Cardiff and Teller cards was considered a pass for any acuity level.

To begin the study the subjects were seated in the exam chair and asked to occlude their left eye. They were then instructed to call off the lowest row of letters they could see clearly on the Snellen charts. The occluder was transferred to the right eye and left eye was tested. A comparable Teller or Cardiff Acuity card was then presented to the patient. For the Teller cards they were asked if they could tell if the grating pattern was on the right side or left side of the card. For the Cardiff cards they were asked if the optotype was on the top half of the card or the bottom half. They did not have to be able to discern the shape of the objects on the cards. This would be similar to an infants response to the cards.

Due to the restrictions of the acuity levels on the Cardiff cards, visual acuity's over 20/70 at 3 meters were not obtainable.

In order to measure congruent acuity's some Teller and Cardiff acuity card presentation distances had to be altered. For example, to measure 20/20 acuity's at 3 meters, Card F of the Cardiff cards,

which is 20/64 at 1 meter was moved back to 3.06 meters rather than just 3 meters to exactly match a 20/20 demand. Similar type conversions were made for all cards that needed to be adjusted.

Examiner bias was eliminated by following a standard procedure protocol and repeating the protocol if the subjects had any questions. One examiner would hold the acuity charts, one would record the results and the other would present the instructions, therefore bias was not a concern.

All of the data was entered into a spreadsheet after converting the acuites measured to cycles per degree in preparation for statistical analysis.

Results

For each test subject a measurement was obtained for the right eye and left eye at a distance of one and three meters unaided and habitual. Only the right eye data was used for statistical analysis. All three visual acuity tests were administered at each test distance. The results of each test were changed from their Snellen equivalents (20/20, 20/80, etc.) into cycles per degree and then into LOGMAR units. These units were then organized into similar groupings compared to Snellen acuity. The mean for each acuity found for the Cardiff and Teller tests for each Snellen acuity interval were calculated. A graph of these mean measures of the acuity at the test distance of three meters are displayed in figure 1. A second graph of the mean measures of the acuity at the test distance of one meter are displayed in figure 2.

The acuity data (LOGMAR units) were compared using a one factor ANOVA repeated measures test. The statistical tests which were used were all on the *Stat-Vue* software program. All the data were then compared for significance using the Scheffe F-test with .05 level of significance. Snellen data was compared to both the Cardiff data and the PL data and the Cardiff data was compared to the PL data.

The results for the three meter test distance showed no significant difference between Cardiff compared to PL using the Scheffe F-test. There was a significant difference between Snellen compared to Cardiff, and Snellen compared to PL. At the near test distance, of one meter, there was no significant difference between the Snellen as compared to the Cardiff. There was a significant difference between Snellen compared to PL and between Cardiff and PL.

A table with the mean acuity's for Snellen, Cardiff and PL, at the 3M test distance, is shown in table 1 and at the 1M test distance, is shown in table 2.

Discussion

The results of this study suggest that the Cardiff Acuity cards give a closer measure to Snellen acuity's at 1 meter than at 3 meters. They also measure closer to Snellen than the Teller cards. From the information gathered the Teller and Cardiff acuity cards do not compare well to Snellen at a distance of 1 and 3 meters and would consistently measure a higher (better) acuity.

It is apparent for both the 1 and 3 meter test distance that as Snellen acuity's get lower (worse) that both Cardiff and Teller do not get worse at near the same rate. It is our feeling that the artifacts of each test (the border interactions of either the gratings on the Teller cards or lines on the Cardiff) made it easy for these adult subjects to notice something on the left, right, top or bottom of the cards. Whether children will be affected in the same way can only be tested by another study. When questioned, our subjects reported they could see borders or edges, but could not tell us what the picture was or which direction the grating was oriented. A modification to the Cardiff may be to ask the older child, "what is the picture?" This may provide closer acuity's to Snellen for the Cardiff test.

While statistical analysis yielded similar results for Cardiff and Snellen at the 1 meter test distance it can be seen from our table 2 and figure 2 that large differences exist at visual acuity's worse than 20/30. This paradox is probably due to the fact that more than 73% of our acuity data was for visual acuity's better than 20/30. Only 8 out of 71 had visual acuity's of 20/100 or worse. For the 3 meter test distance where 15 of 71 people had visual acuity's of 20/100 or worse, there was a significant difference between the two tests. Had there been more people with lowered Snellen visual acuity's at the 1 meter test distance we would have probably seen the same significantly different results.

It is a concern of the examiners that the Cardiff and Teller test do not identify people with lowered visual acuity's as a Snellen chart would. This would mean that a child or a disabled individual with a severe acuity problem would go undetected.

Other studies should be performed with the Cardiff cards before making a conclusive statement on the role of the Cardiff acuity card system within the pediatric optometric practice. Such studies would include actual testing on a pediatric population, testing at 50 cm and a study where correctly naming the optotype image presented on the

Cardiff card was compared to Snellen, to ascertain whether there was better agreement when Cardiff was presented as a resolution not just a recognition test.

In this preliminary study of the Cardiff Acuity cards the cards proved to be extremely easy to use and more accurate than the Teller cards when compared to standard Snellen acuity's. Features that were liked by the examiners were its different object shapes, ease of administration and portability. Future studies will help the practitioner determine whether the expense of the Cardiff cards is justified and whether it would be a valuable test to measure acuity's in a pediatric optometric practice.

Figure 1

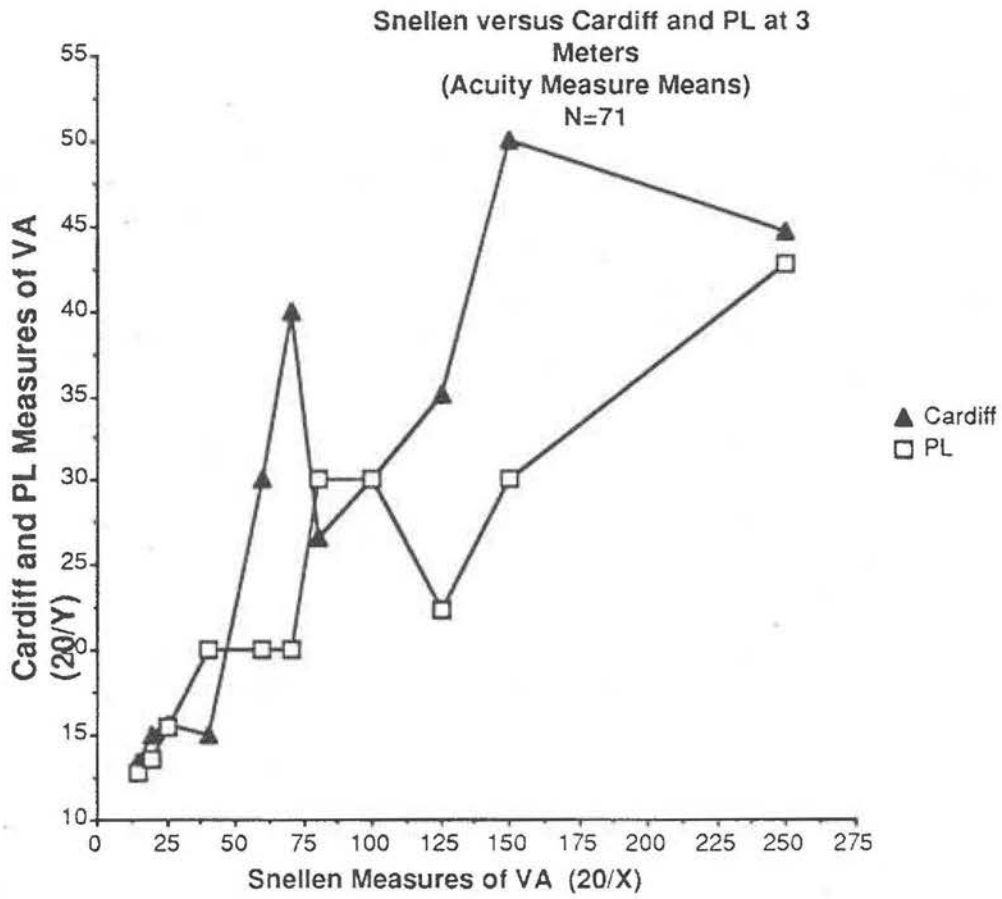


Table 1
Mean Acuity Comparisons at 3 Meters
(Snellen Equivalentents)
N=71

Snellen	Cardiff	Std Dev.		PL	Std Dev.	
		Low	High		Low	High
20/15	20/13.45	20/11.24	20/16.74	20/12.79	20/10.34	20/16.75
20/20	20/15	20/12.00	20/20	20/13.59	20/10.68	20/18.67
20/25	20/15.7	20/9.00	20/21.39	20/15.43	20/12.46	20/20.26
20/40	20/15	20/15	20/15	20/20	20/20	20/20
20/60	20/30	20/30	20/30	20/20	20/20	20/20
20/70	20/40	20/40	20/40	20/20	20/20	20/20
20/80	20/26.67	20/18.12	20/50.46	20/30	20/30	20/30
20/100	20/30	20/30	20/30	20/30	20/30	20/30
20/125	20/35.07	20/20.02	20/141.2	20/22.36	20/13.55	20/64.03
20/150	20/50	20/50	20/50	20/30	20/30	20/30
20/250	20/44.68	20/37.31	20/55.67	20/42.74	20/36.59	20/51.37

Figure 2

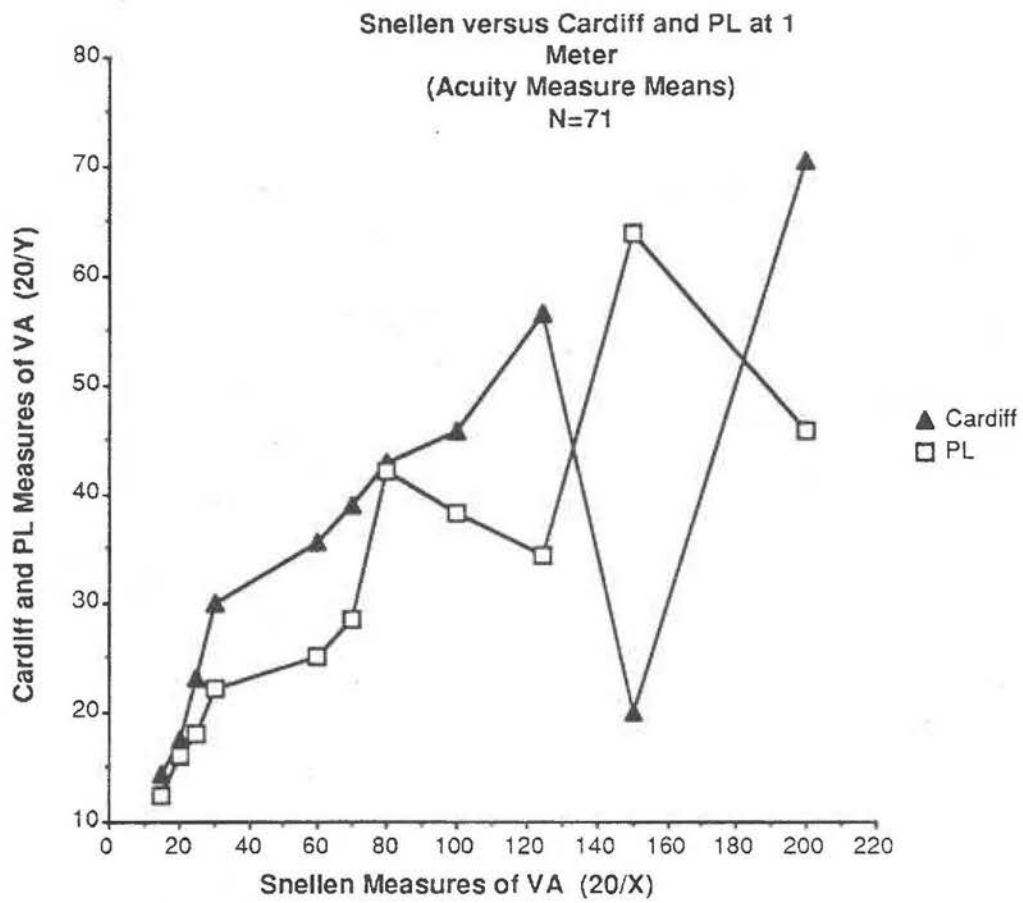


Table 2
 Mean Acuity Comparisons at 1 Meter
 (Snellen Equivalentents)
 N=71

Snellen	Cardiff	Std Dev.		PL	Std Dev.	
		Low	High		Low	High
20/15	20/14.44	20/11.87	20/18.43	20/12.38	20/9.69	20/17.14
20/20	20/17.56	20/13.47	20/25.22	20/16.03	20/11.74	20/25.22
20/25	20/23.20	20/17.92	20/32.91	20/18.11	20/12.96	20/30.03
20/30	20/30.00	20/30.00	20/30.00	20/22.22	20/19.21	20/26.36
20/60	20/35.50	20/30.63	20/42.22	20/25.00	20/25.00	20/25.00
20/70	20/39.01	20/29.78	20/56.55	20/28.57	20/17.79	20/72.55
20/80	20/42.86	20/29.40	20/34.11	20/42.11	20/33.08	20/57.92
20/100	20/45.91	20/36.59	20/61.60	20/38.29	20/35.67	20/41.32
20/125	20/56.50	20/47.69	20/69.28	20/34.29	20/28.52	20/42.98
20/150	20/200	20/200	20/200	20/63.83	20/63.83	20/63.83
20/200	20/70.59	20/51.64	20/111.5	20/45.87	20/36.56	20/61.54

References

1. Atkinson, J., Braddick, O. and Pimm-Smith, E. Preferential looking for monocular and binocular acuity testing in infants. *Br. J. Ophthalmol.* 66, 264-268 (1982).
2. Courage M.L., Adams R.J. Visual Acuity Assessment from Birth to three years using the Acuity Card Procedure: Cross-Sectional and Longitudinal Samples *Optometry and Vision Science.* Vol. 67, No. 9 1990. pp. 713-718
3. Dobson V. Clinical application of preferential looking measures of visual acuity. *Behavioral Brain Research* 1983 10:25-38
4. Dobson, V., Salem, D., Mayer DL, et al: Visual acuity screening of children 6 months to 3 years of age. *Invest Ophthalmol Vis Sci.* 26: 1057-1063 (1985).
5. Ffooks O: Vision tests for children: Use of symbols. *Br. J. Ophthalmol.* 49:312-314 (1965)
6. Frisen, L. New type of acuity test letters. *Arch. Ophthalmol.* 104, 1194-1198 (1986).
7. Gwiazda, J., Brill, S., Mohindra, I. and Held, R. Preferential looking acuity in infants from two to fifty-eight weeks of age. *Am. J. Optom. Physiol.* 57, 428-432 (1980).
8. Howland B., Ginsburg A.P., Campbell F.W. High Pass Spatial Frequency letters as clinical optotypes. *Vision Research* Vol.18 1978 pp. 1063-1066
9. Jenkins, PL, Simon, JW, Kandel GL, Forster, T.: A simple grating visual acuity test for impaired children. *Am. J. Ophthalmol* 99: 652-658 (1985).
10. Kay, H. New method of assessing visual acuity with pictures. *Br. J. Ophthalmol.* 7, 131-133 (1983).
11. Mayer, DL, Fulton, AB, Hansen, RM: Grating and recognition acuity's of pediatric patients. *Ophthalmology* 91: 947-953 (1984).

12. McDonald, Mary Alice. Assessment of Visual Acuity in Toddlers. Survey of Ophthalmology, Volume 3 No. 3. Nov-Dec 1986.
13. Quinn G.E. Berlin J.A., James M. The Teller Acuity Card Procedure. Ophthalmology Volume 100, Number 4 April 1993. pp. 488-493
14. Simons, K.: Visual acuity norms in young children. Surv Ophthalmol 28: 84-92 (1983).
15. Woodhouse J.M., Adoh T.O. , Oduwaiye K.A., Batchelor B.G., Megji S., James N. New Acuity Test for Toddlers Ophthal. Physiol. Opt. Vol 12, April 1992 pp. 249-251.