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A Comparison Between the Randot Animals and the Randot Forms in a Screening Setting

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Biography

Barry Huse is a 1988 graduate of Pacific University with a Bachelor of Science degree in Visual Science. Optometry prerequisites were completed at Washhington State University in Pullman Washington. Raised in Tacoma, Washington, he plans to reside and practice optometry in western Washington.

Neal Garhofer is 1985 graduate of North Dakota State University with a Bachelor of Science degree in Zoology. He recieved his degree in Optometry at Pacific University College of Optometry in 1990.

Paul Min is from Seoul, Korea, and a 1988 graduate of pacific University with a B.S. degree in Visual Science. Optometry schol prerequisites were completed at Columbia College in Columbia, Missouri, and University of Colorado at Denver, Colorado. Anticipated date of graduation is 1990 from Pacific University. In the future, Paul plans to open the first Optometry school in Korea.

Abstract

A comparison of the the Randot animals (non random dot stereotest, NRDS) and the Randot forms (random dot stereotest, RDS) was accomplished using 255 first grade children at a Pacific University elementary school screening. The purpose was to determine which of the two stereotests was clinically more sensitive for detecting vision problems in grade school children as indicated by failing any portion of the screening. The findings indicate that children with significant refractive errors (hyperopia, astigmatism and/or anisometropia) or any type of binocular anomaly do worse on the RDS than on the NRDS. Based on these results, a random dot stereotest would be a valuable test to include in a grade school screening programs, since it provides a substantial amount of information with relatively little effort and time.

Introduction

Clinical testing to determine stereopsis and/or the level of stereoacuity has traditionally been done with the Titmus Stereo Fly test. One problem with this test is that the figures contain monocular cues, such as obvious lateral displacement, which allow an individual who is not binocular to correctly identify the stereoscopic objects[1,2]. Since the Titmus test was developed, there has been the introduction of random dot stereograms by Julesz[3]. These stereotests contain no monocular cues and have a hidden object which can only be seen by binocular viewers[4].

Much attention has been given to stereopsis testing since the arrival of random dot stereograms. To pass a stereotest like the Randot forms the patient must have equal acuity, accurate eye pointing, equal image size and stable binocularity as well as binocular depth perception[5]. Patients with significant uncorrected refractive error will also have difficulty passing this test[5,6].

The purpose of this study was to utilize the clinically available Randot stereo tester in a screening situation and compare both the animals (a non random dot target) and the RDS forms to the modified clinic technique (MCT) to see how well each of these stereo tests could identify referrals as compared to the MCT. The MCT was divided into cover test at near and far, visual acuity at near and far, and retinoscopy.

The Randot test booklet contains three test sections: circles, animals, and random dot stereo forms. Only the animals and randot forms were used in this study. The animal targets are created by using polarized crossed targets embedded in a block of non polarized dots which act to mask the offset of the displaced elements. This is not a true "hidden" random dot stereo test and due to the fact that the background conceals the lateral disparity, it is only slightly more difficult than the Titmus[7]. People unfamiliar with this may be performing stereotesting with the animal portion alone, falsely assuming that the Randot utilizes random dot in all portions of the testing booklet. The Randot forms on the other hand, are computer generated random dot stereotesting devices devoid of monocular cues[4,6]. See appendix A for the stereo acuity demands for each of the tests.

Methods

Subjects: 255 first grade students from two elementary schools in Woodburn, Oregon were screened utilizing the modified clinical technique by second, third, and fourth year optometry students from Pacific University College of Optometry. The MCT included visual acuity far and near, cover test far and near, and retinoscopy.

Visual acuity was assesed using Snellen charts at far and near and if the student was unable to read the letters a childs chart was used. Cover testing was performed while the student was fixating a target at far (letter on acuity chart) and at 40 cm. (fixation bead). Any amount of tropia and high phorias were quantified using prism bars. Retinoscopy was performed while the student was watching a cartoon in the distance (approximately 6 meters). Refractive errors were neutrilized with lens bars using the sphere/sphere method. Astigmatism was classified as with or against the rule, no axis was specified. See appendix B for the pass/fail criteria of each portion of the screening.

Procedures: After completion of the general screening, the Randot was administered at a 40 cm. distance by a 3rd year student. The animal portion was always given first followed by the RDS forms. The tester was not aware of the MCT results at any time during the testing procedures. After completing the two stereopsis tests, animals and RDS forms respectively, an assistant recorded the stereopsis results and then checked and recorded the MCT results.

Stereopsis Testing

Instructions: The subject was given the polaroid glasses and told that they were magic glasses which would make some objects appear to float. The student was then shown the animals and asked to point to the animal in row A which was floating off the page closer to them than the rest of the animals. Row B and C followed respectively. If the child missed one animal, the examiner would repeat a correctly identified row before retesting the previously missed row.

The RDS forms were then used. The student was shown the eight test boxes, and told that some of the boxes contained hidden pictures while others contained nothing at all. The examiner pointed to each box and asked the child what geometric shape he/she saw in the box. Once again, if the student missed one of the boxes, he/she was initially retested on a box which he had correctly responded to before retesting the miss. In the case of shy students, they were allowed to respond by pointing to a picture card with the same pattern on it, or simply answer "yes" or "no" if they saw an object floating in the box.

Results

43 of the 255 students failed one or more portions of the screening resulting in a failing rate of 16.9%. The differences between the data obtained with the RDS vs the NRDS are shown in Table 1.

Table 1	NRDS		RDS	
Total Failing Screening	Pass	Fail	Pass	Fail
43	38	8	24	19

Of those who failed any portion of the screening, the RDS identified more than twice as many of those failing then did the NRDS. The pass/fail results from each of the tests performed on the screening and their correlation to performance on the RDS and NRDS tests are discussed below.

Retinoscopy: The majority of the students who failed the retinoscopy portion of the screening (Table 2) had a refractive error between +1.25 to +2.00 (Hyperopia). Although neither of the stereotests were very sensitive in identifying this group, the RDS did detect 4 more students than the NRDS. A greater difference, however is seen in the hyperopes greater than +2.00D. All but one student failed the RDS while only half failed the NRDS.

Since there was little impairment of visual acuity at near all of the myopic children passed the RDS and only one failed the NRDS, as could be expected.

One subject with astigmatism greater than 1.00D (OD: 3.00 WTR; OS: 2.00 WTR) failed the RDS, while all students in this group were able to pass the NRDS. The 2 astigmats who passed both stereotests has refractive errors of +1.00-1.00 WTR OD, +1.50-1.50 WTR OS & +1.00-1.50 WTR OU.

Table 2: Failing refractive error as determined by retinoscopy

	Fail Retinoscopy	Fail NRDS	Fail RDS
Astig 1.00-3.00D	3	0	1
Myopia 0.75-2.50D	3	1	0
Hyperopia 1.25-2.00D	16	1	5
Hyperopia 2.00-6.00D	10	5	9
Aniso. 1.00-1.50D*	5	0	1
Aniso. 3.75-5.50D*	3	2	3
TOTAL	**40**	**9**	**19**

*These students are included in other portions of the table also

Neither of the stereotests were efficient in detecting low amounts of anisometropia, but with higher amounts of anisometropia the RDS became more sensitive (See Table 2). One student was able to pass the NRDS even with 5.50D of anisometropia.

Cover Test: Many studies have shown the random dot stereotest's ability to detect any type of tropia. Hill[8] and Cooper[9] reported that microtropes were unable to pass random dot stereotesting in their respective studies. Cooper and Feldman[4] also reported that all microtropes, constant strabismics and amblyopic strabismics failed stereotesting using a random dot stereogram.

11 of the 43 students failed the screening based on cover test (See Table 3). Of these, 7 also failed other portions of the screening. The NRDS identified 5 of 11 while the RDS identified 8 of 11. Of the 4 who failed only the cover test, the RDS identified 2 of the 4 while the NRDS failed but 1 of the 4.

Table 3

Cover Test Results	**Other areas failed**	**NRDS**	**RDS**
1. Alt. Exotrope F&N*	Near VA	Pass	Fail
2. F:5 Exophoric N:Microtrope(Exo)	Far & Near VA; Retioscopy	Pass	Fail
3. F:3 Exotrope N:Ortho	Near VA; Retinoscopy	Fail	Fail
4. F:3 Exotrope N:Ortho	Retinoscopy	Fail	Fail
5. F:Ortho N: Const. Exotrope*	Far & Near VA	Pass	Pass
6. F:3 Alt Esotrope N:Ortho	Far VA; Retinoscopy	Fail	Fail
7. 15-20 Alt Exotrope F & N	NONE	Fail	Fail
8. F:5-10 Esophoric N:5 Esophoric	NONE	Pass	Pass
9. F:10 Exotrope N:3 Esophoric	NONE	Pass	Fail
10. F:Ortho N:Alt Exotrope*	NONE	Pass	Pass
11. F:15 Exotrope N:Ortho	Far VA; Retinoscopy Trauma to OD at age 4	Fail	Fail
TOTAL	**11**	**5**	**8**

All cover test values given in prism diopters
*Values not quantified

Near visual acuity: Using the Random dot E, Reinecke and Simons[10] reported that no patients with more than 2 lines difference in visual acuity, or with VA of 20/40 or worse passed their stereotest.

Of the 16 subjects who failed the near VA test (See Table 4) only 3 failed the NRDS while 9 of the 16 failed the RDS including those with mild acuity impairments. Seven of the students had a VA difference betweem the two eyes of 2 lines or more. Five of these students passed the NRDS, but only 3 were able to pass the RDS.

Table 4: Failed Screening Based on Near VA

	Fail Near VA	Fail NRDS	Fail RDS
20/30-20/40	9	2	4
20/50-20/60	4	0	3
>20/60	3	1	2
TOTAL	**16**	**3**	**9**

Far visual acuity: Based on far VA the RDS was superior in detecting impairments in visual acuity at far. The RDS was able to identify three times as many failures as did the NRDS (See Table 5).

Table 5: Failed Screening Based on Far VA

	Fail Far VA	Fail NRDS	Fail RDS
20/30-20/40	9	1	4
20/50-20/80	5	1	3
>20/80	4	1	2
TOTAL	**18**	**3**	**9**

Discussion and Conclusion

The purpose of this project was to determine which of the two stereotests, the Randot figures or the Randot animals was most sensitive in detecting vision problems in grade school children in a screening situation.

Although the data does not lend itself to statistical analysis, Table 6 clearly shows that the RDS is clinically more sensitive in identifying children with significant refractive errors leading to reduced visual acuity at far or near and/or various types of binocular problems.

Table 6: Individual Portions of the Screening

	Failing Portion of Screening	Fail NRDS	Fail RDS
Retinoscopy	32	7	15
Cover Test	11	5	8
Far VA	18	3	9
Near VA	16	3	9
TOTAL	**77**	**18**	**41**

If used by itself, only retinoscopy was close to RDS in screening for vision problems. The NRDS was worse than retinoscopy, equal to far VA and only slightly better than near VA. Of any of the tests used, the cover test identified the least number of subjects. If the stereotests and the individual portions of the screening were ranked in the ability to detect vision problems the order would be as follows:

#1. RDS (41 out of 77 failures detected)
#2. Retinoscopy (32 out of 77 failures detected)
#3. Far VA/NRDS (18 out of 77 failures detected each)
#4. Near VA (16 out of 77 failures detected)
#5. Cover test (11 out of 77 failures detected)

This fits with our hypothesis which states that stereopsis requires equal acuity, low or no uncorrected refractive error, accurate eye pointing, equal image size and stable binocularity as well as binocular depth perception.

Thus, it is recommended that a random dot stereotest rather than a non random dot stereotest should be used in PUCO screenings and other screenings. This one test provides a large amount of information in a short period of time and in this study it identified more failures than any other test in the screening. However, additional study should be done to investigate adequate testing distance, illumination, and instruction.

APPENDIX A: Stereo Acuity Demand

A. Animals	
1. first row	400 arc seconds
2. second row	200 arc seconds
3. third row	100 arc seconds
B. RDS forms	
1. top four boxes	500 arc seconds
2. bottom four boxes	250 arc seconds

APPENDIX B: Pass Fail Criteria

A. MCT

1. Visual Acuity . . . . .20/30 D or poorer either eye.
2. Refractive Error
   a. Hyperopia . . . .+1.50 D or more.
   b. Myopia . . . . -0.75 D or with VA loss.
   c. Astigmatism . . . . $\pm$1.00 D or more.
   d. Anisometropia . . . . $\pm$1.00 D or more.
3. Cover Test
   a. Distance
      1. Tropia . . . . .any tropia.
      2. Esophoria . . . . 5 prism D or more.
      3. Exophoria . . . . .5 prism D or more.
      4. Hyperphoria . . . . .2 prism D or more.
   b. Near
      1. Tropia . . . . .any tropia.
      2. Esophoria . . . . 5 prism D or more.
      3. Exophoria . . . . .5 prism D or more.
      4. Hyperphoria . . . . .2 prism D or more.

B. Stereo Tests

1. Animals . . . . miss any animal row twice.*
2. RDS forms .miss any form twice.**

All of the above performed with habitual corrective lenses.

*The majority of the subjects who failed this test missed all 3 rows. However, A small number were able pass the first row and were still considered a fail.

**Almost all of the students failing the RDS were able to corectly identify 2 out of the first 4 test blocks.

References

1. Kohler L. Stigmar G.: Vision Screening of Four Year-old Children. Acta Paediatr Scand. 62: 17-27, 1973.

2. Simon K, Reinecke R: A Reconsideration of Amblyopia Screening and Stereopsis. Am J Ophthalmol. 78: 707-713, 1974.

3. Julesz B: Binocular Depth Perception in Computer Generated Pattern. Bell System Tech. 39: 1125, 1960.

4. Cooper J, Feildman J: Random-Dot-Stereogram Performance by Strabismic, Amblyopic, and Ocular Pathology Patients in an Operant-Discrimination Task. Am J Optom & Physical Optics. Vol. 55, No. 9: 599-605, 1971.

5. Lavasik JV, Szymkiw M: Effects of Aniseikonia, Accommodation, Retinal Illuminance and Pupil Size on Stereopsis. Investigative Opthalmology and Visual Science. 26: 741-749, 1985.

6. Simons K: A Comparison of the Frisby, Randon-Dot, TNO, and Randot Circles Stereotests in Screening and Office Use. Arch Opthalmol. 99: 446-452, 1981.

7. Fineman M: Facilitation of Stereoscopic Depth Perception by a Relative Size Cue in Ambiguous Disparity Stereograms. J Exp Psychol. 90: 215-221, 1971.

8. Hill M, Perry J, Wood ICJ: Stereo-Acuity in Microtropia, in Moore S, et al (ed): Orthoptics: Past, Present, Future. New York, Stratton Inter-continental Medical Book Corp., pp 25-29, 1976.

9. Cooper J: Random Dot Stereograms. Pt 1-2 in Sherman J (ed): Advanced diagnostic Procedures, Series 2, pp 1-13 Optom Ext Prog nov-Dec, 1976.

10. Reinecke, RD, Simons K: A New Stereoscopic Test For Amblyopic Screening. Am J Opthalmol. 78(4): 714-721, 1974.