A COMPARISON OF FIVE STEREO TESTS COMMONLY USED IN CLINIC

April 16, 1987

By Ricky L. Scalcucci

INTRODUCTION

Stereopsis in children depends upon many factors which include, but is not limited to, physiological factors, a childs willingness to respond, fear of failure, and many others. With this in mind, the optometrist is offered an array of stereo tests to assess the stereo acuity in children. It has become difficult for the practitioner to decide exactly which test gives the most reliable results in the most time effective manner. Therefore, the focus of this paper will be to compare five different stereo tests commonly used today to find out which test is easiest to administer, which test the child accepts or rejects, and to see if there is any correlation between any of the five tests. The first of the tests used in this study was the Random Dot E, (RDE). This test uses Julesz's pattern for stereoscopic development.(1) It is based upon " random-dot " patterns, or visual noise.(2) It is designed in such a way that when held at certain distances from the eye, the amount of disparity can be computed. It must also be noted here, that the further from the subject you get, not only is the disparity reduced, but the visual angle as well. Therefore, the results of this test may be under estimates of the actual stereo acuity. Another test used in this study was the Frisby Stereo Test. This test has three square plates with four squares of random patterns on each plate. The plates vary in thickness from six millimeters, to three millimeters, to one millimeter. On one of the four random patterns on each plate is a circle of random pattern that can be seen in depth due to the circle and its surround being printed on

opposite sides of the plate. Since this test is based on actual depth, (i.e. the thickness of the plate), there is no need for stereoscopic glasses. This test is done at distances of 30, 40, 50, 60, 70, and 80 centimeters, and depending on the thickness of the plate used at each given distance you can determine the amount of stereopsis from 300 seconds of arc to 15 seconds of arc. The third test used in this study was the Titmus Fly. This test uses the ever-so-popular, fly, for determination of gross stereo. Assymetrical animal forms are used for stereopsis of 400, 200, and 100 seconds of arc, and Wirt rings, set up in nine boxes, with four rings in each box in diamond form, are used for stereopsis ranging from 400 seconds of arc in box one to 40 seconds of arc in box nine.

Another test similar to the stereo fly used in this project was the Reindeer Stereo Test, which the author feels was designed to be more pleasant for the children than the stereo fly. With this test, the child views a reindeers head and antlers for gross stereo, while again viewing Wirt rings for stereopsis of 585 seconds of arc down to 30 seconds of arc. This time, however. the rings are set up in six linear rows with five rings in each row.

The fifth and last test used in this study was the Randot Stereo Test, (RDS). This test uses random dot patterns and require an individual to identify a form of figure from ground without the help of any monocular visible contours. The figures being a circle, a star, or an "E" for 500 seconds of arc, while a square, a triangle, or a plus sign for 250 seconds of arc. The Randot Stereo Test also has the assymetrical animal forms with

random dot ground for stereopsis of 400, 200, and 100 seconds of arc. And finally, it has ten boxes of Wirt rings set up with three rings in linear form in each box, with stereo ranging from 400 seconds of arc in box one to 20 seconds of arc in box ten.

PROCEDURE

The stereo tests given in this project were conducted in as close a clinical situation as possible. The one thing that was strictly adhered to, however, was very critical measurements were taken on each test throughout the project. To minimize any errors that would result from knowing what stereo to expect from each child, the children were given one test at a time, and each child was selected for each test by random order. That being the discression of the childs teacher. Each test was also administered by the same clinician using the same polaroid glasses for each test and under the same environmental conditions as well.

The instructions for the Random Dot E was the same for each child and were as follows:

1. Show each child the raised model E and ask, if he/she can see anything on the card. The response was 100% that the child could see the letter E.
2. Next, each child was shown the two RDE cards at different distances and asked to pick out the card that has the E on it, while wearing the polaroid glasses.

3. The order the E was presented was also the same for each child. The sequence was, left, right, left, left, right, left, right.
4. The test was started at 50 cm.,and every 50 cm. incriments until a distance of five meters was reached, or until threshold was met. Threshold was considered two consecutive wrong answers.

For the Frisby stereo test, the directions were as follows:

1. Show the child the model raised circle that accompanies the test. Ask the child if she is able to see the raised circle. If not, point it out, to the child and tell her this is a raised circle and is what to look for when shown the series of plates. If she can see it, then just ask her to point it out when shown the series of plates.
2. Again, the sequence was the same for each child. Show the child the six millimeter plate at 40 cm. and see if they could locate the raised circle. If they could, the plate was moved back at 20 cm incriments to 80 cm. If the child correctly chose the right square for the whole plate, then the three millimeter plate was used, and if the child scored all correct responses on the three millimeter plate, then the one millimeter plate was used. At the point the child could no longer distinguish the raised circle, the plate was moved in 10 cm. at a time until the child could distinguish it. Then back out until he could not. This was determined to be the stereo acuity for this test.

The instructions for the Titmus Stereo Fly test were as follows:

1. Open the book 40 cm. in front of the child and observe her reaction without saying anything.
2. Once the initial reaction is observed ask the child to pinch the wings of the fly by coming in from the side. Do not come from the top. Since this was a clinical setting, no true measurement was taken as to how far off the page the child pinched the wings, but it was noted if a high, low, or a medium pinch was observed.
3. After the fly was observed attention was focused to the Wirt rings and the child was asked if if he could see a circle in the box that appeared to be closer or standing off the page. If he answered correctly, he was asked to look at the third box, then the fifth, seventh, and finally the ninth. When an incorrect response was given, the child was asked about the previous box and then each box in order until two consecutive misses were given for a response. This point was considered their threshold.
4. If the child could not do the Wirt rings or their response indicated less than 100 seconds of arc, they were directed to the animals at the bottom of the page and asked in each of the three rows which animal appeared to be closer than the others in that particular row.

The next test that was given to each child was the Stereo Reindeer test and the directions for that test were as follows:

1. Open the book and observe the childs response without saying anything.
2. Ask the child to pinch the reindeers nose, and again observe if it was a low, medium, or high pinch.
3. Direct is attention to the circles on the other side of the page and ask if any circles appear to be closer or to be coming off the page in row A.
4. If a correct response in row A was given, the child was directed to row C, E, and F respectfully.
5. If an incorrect response was given in any of the rows the child was asked about the previous row, then each row in order until he gave two incorrect responses.

The fifth and last test given in this project was the Randot Stereo test and the instructions were as follows:

1. Open the book an direct the child to the Randot forms on the right side of the page. Ask the child if he can see any forms or patterns in the upper four boxes. If he could not, the child was asked if he could see a circle, a star, or an E in any of the boxes. If he could, he was asked to point to them.
2. Then direct the childs attention to the lower four boxes and ask the same questions as above.
3. Now direct the childs attention to the rings in the boxes on the left hand side of the page. Again the child was asked if one circle appeared to be closer to him or appear to be coming off the page.

4. With a correct response in box one, the child was directed to box three and five. With a correct response in box five, the child was directed to box six at the top of the second column. He was then asked about box eight and ten. When a child gave an incorrect response to any of the boxes, he was directed to the previous box and then asked about each box in order until he gave two consecutive misses.
5. If a child could not respond to 100 seconds of arc on the rings, he was directed to the animals on the bottom of the page and asked for each row if there appeared to be an animal closer to him than any of the others.

At the end of this test each child was asked his own opinion as to which test he/she liked to to best.

RESULTS

Eighty three students at St. Mary's Elementary School in Big Rapids, Michigan were used for this study. The ages of the children ranged from five to thirteen. Of the eighty three students tested, only one could not do any of the stereo tests. This student was not used in the final correlation. There was also one student who could not do the Frisby stereo test but could do the rest. His scores were also not used in the correlation, but were as follows; 100 seconds on the RDE, 40 seconds on the stereo fly, 30 seconds on the deer, and 20 seconds on the RDS. It is not known why he could not do the Frisby stereo test, and again, this was the only incident where a certain test could not be correlated with the others. His scores

were also not used in the final results.

In conducting this correlation the two major concerns were the correlation coefficient (r) value, and the tail probability for T-test (Tp). Note, this is not a T value. For a correlation of this type, we would want a Tp value of .05 or less, and an r value of greater than .5 for a good correlation to exist.

From table one we can see the one single test that correlates most with all other tests used in this study, was the stereo fly. This was followed closely by the RDS, then the Deer, the Frisby, and finally the RDE. Of interesting note here is, the Frisby stereo test and the RDE test when compared to each other did not correlate well with each other at all. However, both the Frisby and the RDE correlated well with all the other tests.

An important consideration the clinician is concerned with is the time factor involved in doing a stereo test in a clinical situation. From table two we can see that the stereo reindeer was the overall fastest test to determine stereo in clinic. This was followed by the Fly, RDS, Frisby, and finally the RDE. It should be noted here, that this is for stereo threshold and not just whether the patient has stereo or not.

As for which test the children liked best, there was not a clear cut choice. Nineteen children prefered the the Frisby stereo test, while seventeen children chose the RDE. The fly and deer were equal at with sixteen children choosing each of these. Six children had no preference for any particular test. An interesting fact here is, the younger children prefered the fly

and deer, while the older children seemed to prefer the Frisby and RDE. Also of interesting note, the younger children were quick to respond on the RDE and Frisby, while the older children were very cautious before responding. Eye contact here showed the older children knew which response was correct, but they still delayed their response until they were absolutely sure.

CONCLUSION

As you can see from this study, determining stereopsis in children can and is done in many ways. Which test is the most accurate was not the concern of this study. However, studying the correlation of the most common clinical stereo tests was. It is the authors opinion, any of the book tests (i.e. Fly, Deer, and RDS), are quick and reliable for determining the stereopsis in children, while the RDE, considered the standard by many, is much to time consuming and generally gives the same results as the book tests.

TABLE ONE

Top Number = r value
Bottom Number= tp value

	RDE	FRIS	FLY	DEER	RDS
RDE	-	0.1877	0.3683	0.4110	0.2335
	-	0.0105	0.0001	0.0000	0.0444
FRIS	0.1877	-	0.5021	0.3752	0.4179
	0.0105	-	0.0000	0.0001	0.0000
FLY	0.3683	0.5021	-	0.6465	0.9075
	0.0001	0.0000	-	0.0000	0.0000
DEER	0.4110	0.3752	0.6465	-	0.6464
	0.0000	0.0001	0.0000	-	0.0000
RDS	0.2335	0.4175	0.9075	0.6464	-
	0.0004	0.0000	0.0000	0.0000	-

As we can see by looking at the above table the stereo test that correlates most with all other tests in this study is the stereo fly, followed closely behind by the random dot stereo test.

TABLE TWO

Average time to conduct each stereo test. (In seconds)

TEST	AVERAGE TIME	STANDARD DEVIATION
RDE	107.05	44.23
FRIS	82.70	35.97
FLY	32.10	18.03
DEER	21.70	17.20
RDS	32.54	11.15

REFERENCES

1. Reinecke, Robert D. and Simons, Kurt.: A New Stereoscopic Test For Amblyopia Screening. Am. Jol. of Ophthalmology. 78:04, 1974

2. Julez, B.: Binocular Depth Perception in Computer Generated Patterns. Bell Systems Tech. J. 39:1125, 1960.