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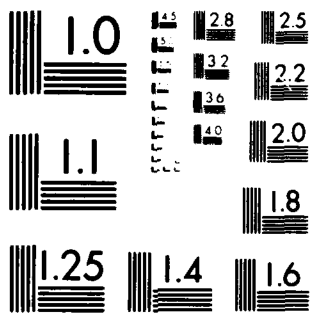

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Report PERLAB-001

DISTRIBUTION OF STEREOANOMALIES IN THE GENERAL POPULATION

Millicent Newhouse and William R. Uttal

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July, 1982

Technical Report

Prepared for:

Engineering Psychology Programs
Office of Naval Research
800 North Quincy Street, Code 455
Arlington, Virginia
22217

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER PERLAB-001	2. GOVT ACCESSION NO. AD-A118	3. RECIPIENT'S CATALOG NUMBER 219
4. TITLE (and Subtitle) Distribution of Stereoanomalies in the General Population		5. TYPE OF REPORT & PERIOD COVERED Technical Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Millicent Newhouse and William R. Uttal		8. CONTRACT OR GRANT NUMBER(s) N00014-81-C-0266
9. PERFORMING ORGANIZATION NAME AND ADDRESS Institute for Social Research University of Michigan Ann Arbor, Michigan 48109		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NR197 -070
11. CONTROLLING OFFICE NAME AND ADDRESS Engineering Psychology Programs, ONR 800 North Quincy Street, Code 455 Arlington, Virginia 22217		12. REPORT DATE July, 1982
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

For Public Release; Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Stereopsis
Stereoanomaly
Random Dot Stereogram
Depth Perception

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Large proportions of the general population have frequently been reported to be stereoscopically anomalous. However, when we tested a large sample (103 persons) we found all (with the exception of three truly stereoblind observers) to be able to initially detect depth in Julesz random dot stereograms within two minutes. Some persons, however, were not able to detect depth when retested immediately with reversed disparity, but half of those were able to see depth on retesting a few days later. We conclude that stereoanomalies are much rarer

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) than previously suggested and that any putative one-way (ie., restricted to crossed or uncrossed disparity) deficiencies are actually due to strategy or sequence effects rather than to neural deficiencies.

Distribution of Stereoanomalies in the General Population

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Perception Laboratory

Institute for Social Research

University of Michigan

Stereopsis — depth perception cued by disparity differences between the images projected on the two retinae by a single object — has been reported to be frequently anomalous in the general population. Richards (1970), for example, has reported that as much as 30% of the general population may suffer from at least a partial form of stereoanomaly. Similarly, Jones (1977) found six cases of stereoanomaly out of thirty observers. However, in the search for participants in experiments carried out by our laboratory, our experience has been that most candidates pass informal screening tests for stereopsis. We, therefore, set out to determine if the previously reported high levels of stereoanomaly were valid by surveying a larger sample of the general population in a controlled experiment. The results of our survey indicate that, if care is given to the order of testing, most initially suspect stereoanomalies disappear and that stereoscopic vision is deficient in only a very small proportion (less than 6%) of the population. This conclusion has also been recently drawn by Patterson and Fox (1982). We all agree that previous reports of high levels of stereoanomaly in the general population are due to uncontrolled sequence effects and that the actual rate of occurrence is much lower than previously reported.

METHODS

Observers

One hundred and two (33 male and 69 female) randomly selected employees of the University of Michigan Institute for Social Research volunteered to serve for a single test session lasting approximately ten minutes.

Procedure

The purpose of the experiment was explained to each participant, and a data sheet asking general biographical questions was compiled. The observers were then shown a series of anaglyphic random dot stereograms (Fig. 1.0-1, a triangle; Fig. 2.4-1, a square; and Fig. 8.1-2, a series of squares with decreasing correlation, all of which were taken from Julesz, 1971). The first two stereograms are samples designed to teach the general method. Following this pretraining with these two high correlation samples, the series of seven stereograms with decreasing proportions of correlated dots (100%, 90%, 80%, 70%, 60%, 50%, 40%) was presented in order. The time it took for the observer to report the appearance of depth was measured for each stereogram with a Micronta electronic LCD Quartz stopwatch.

Each observer was given a maximum of two minutes in which to detect depth for each picture. When the observer reported depth, the time was recorded and the observer was asked to describe what was seen. If the description of the form was correct on the two sample forms, the series of stereograms with decreasing correlation was presented. Participants were timed for each stereogram in the series either until the 40% minimum correlation stereogram had been presented, or until a stereogram was presented for which they were unable to report depth in the alloted two minute period. The participant was then asked to reverse the red-green lenses (so that the red filter was positioned in front of the left eye and the green filter in front of the right eye) and then retested with the decreasing correlation series. This was done to determine if the response to either crossed or uncrossed disparity was deficient — those disparity conditions being reversed when the lenses were exchanged in front of each eye.

RESULTS

Of the 102 observers, all but three initially reported depth in the two sample (triangle and square) stereograms. The point at which depth was no longer perceived in the series of stereograms with decreasing correlation varied. Decreasing proportions of the survey group reported depth as the series of stereograms were presented in order of decreasing correlation. These data are summarized in Fig. 1.

When the colored lenses were reversed three male and nine female participants were initially unable to detect the pattern. To determine if this finding was due to a bias or sequence effect, we retested each of these 12 participants with the two sample patterns several days later with the lenses initially in the reversed condition. Six of the twelve participants did report depth and correctly identified the sample pattern correctly in the retest. The other six (4 female and 2 male) did not correctly identify the patterns in the allowed two minute period.

We also measured the time it took each observer to report depth in the two sample stereograms up to the two minute maximum. Fig. 2 is a graph showing the proportion of the group reporting depth at the indicated times. As indicated in this graph, half of the subjects reported depth in five seconds or less and virtually all in 25 seconds or less. Beyond 25 seconds, all points plotted are for only one or two participants. Figure 3 plots the same information for the series of stereograms with decreasing correlation. Obviously, there is a progressive prolongation of the time taken by the group to detect a stereogram as the correlation decreases. This graph shows that 61% of the people saw the first stereogram in the series (100%) , a little over 32% of the participants identified the 90% and 80% , 13% saw the 70%, and 19% the 60% stereograms in less than 5 seconds. In general, the lower the correlation, the longer it took to perceive depth.

CONCLUSION

Our results indicate that the distribution of total stereoblindness is smaller than previously reported. Only 3 of our observers were totally stereoblind. Of these three, one it turned out, had only one real eye, one had a history of surgically corrected congenital strabismus, and only one was visually normal in all other regards (as well as quite surprised to discover that she suffered from this anomaly.) The small number of participants who were determined to display stereoanomaly in either the crossed or uncrossed direction (but not both) is also smaller than previously reported. Most importantly, given that all except the three stereoblind participants initially saw depth in the sample pattern, we conclude that one way stereoanomaly is more likely to be a sequence effect than the result of a neural deficiency.

Footnotes

1. This research was supported by Office of Naval Research Contract #N00014-81-C-0266 to the University of Michigan.

2. Millicent Newhouse is the current (1981-1982) ONR Science Apprentice in the ISR Perception Lab. Miss Newhouse is a senior at Ann Arbor Huron High School.

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Figure Captions

1. Percentage of observers reporting depth in less than two minutes as a function of the binocular correlation of random dot stereograms. △ indicates a triangular sample stimulus pattern; □ indicates a square sample stimulus pattern; and the circles indicate a series of square stimulus patterns with decreasing binocular correlation.

2. The percentage of observers reporting depth for the two sample stereograms (triangle and square) as a function of observation time.

3. The percentage of observers reporting depth for the series of decreasingly correlated stereograms as a function of time.

FIGURE 1

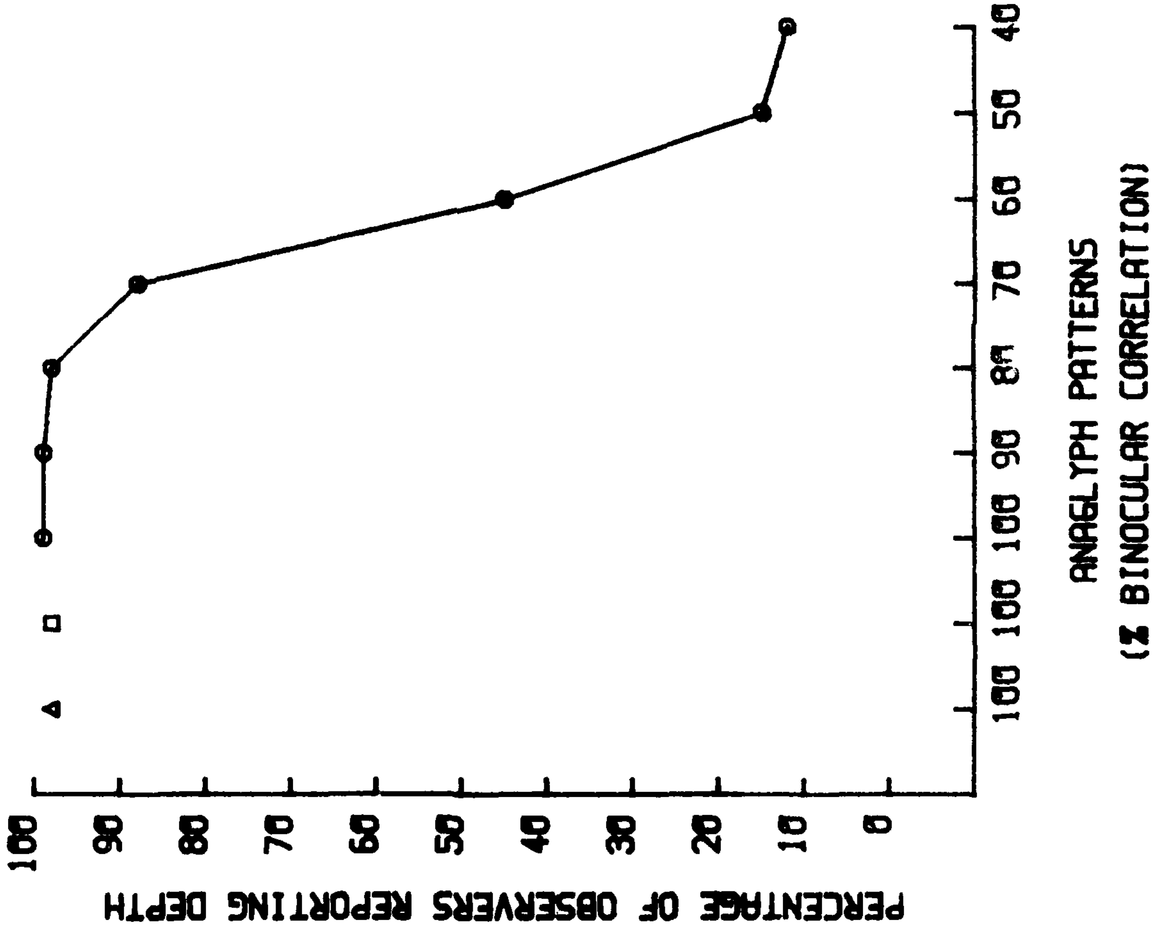
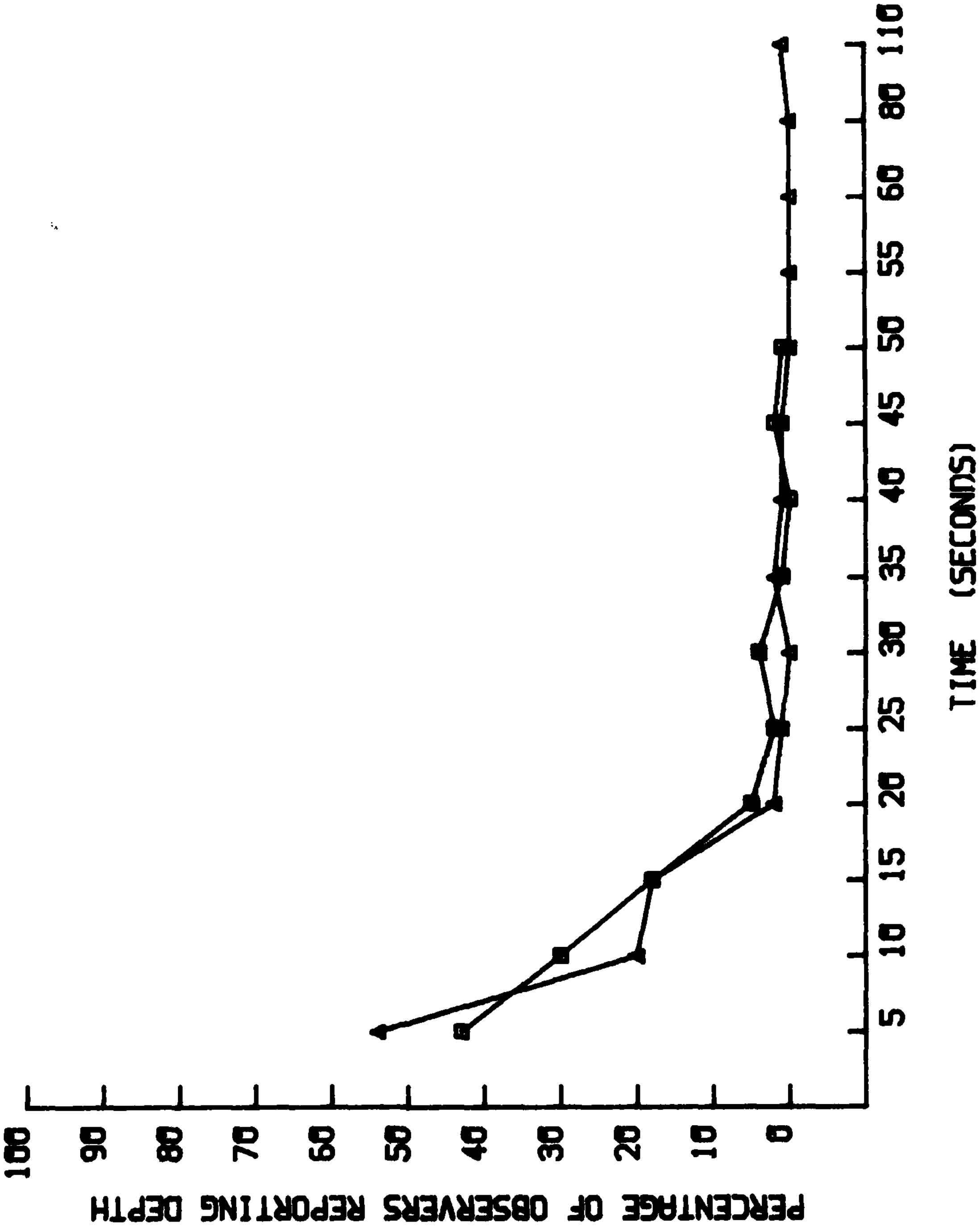
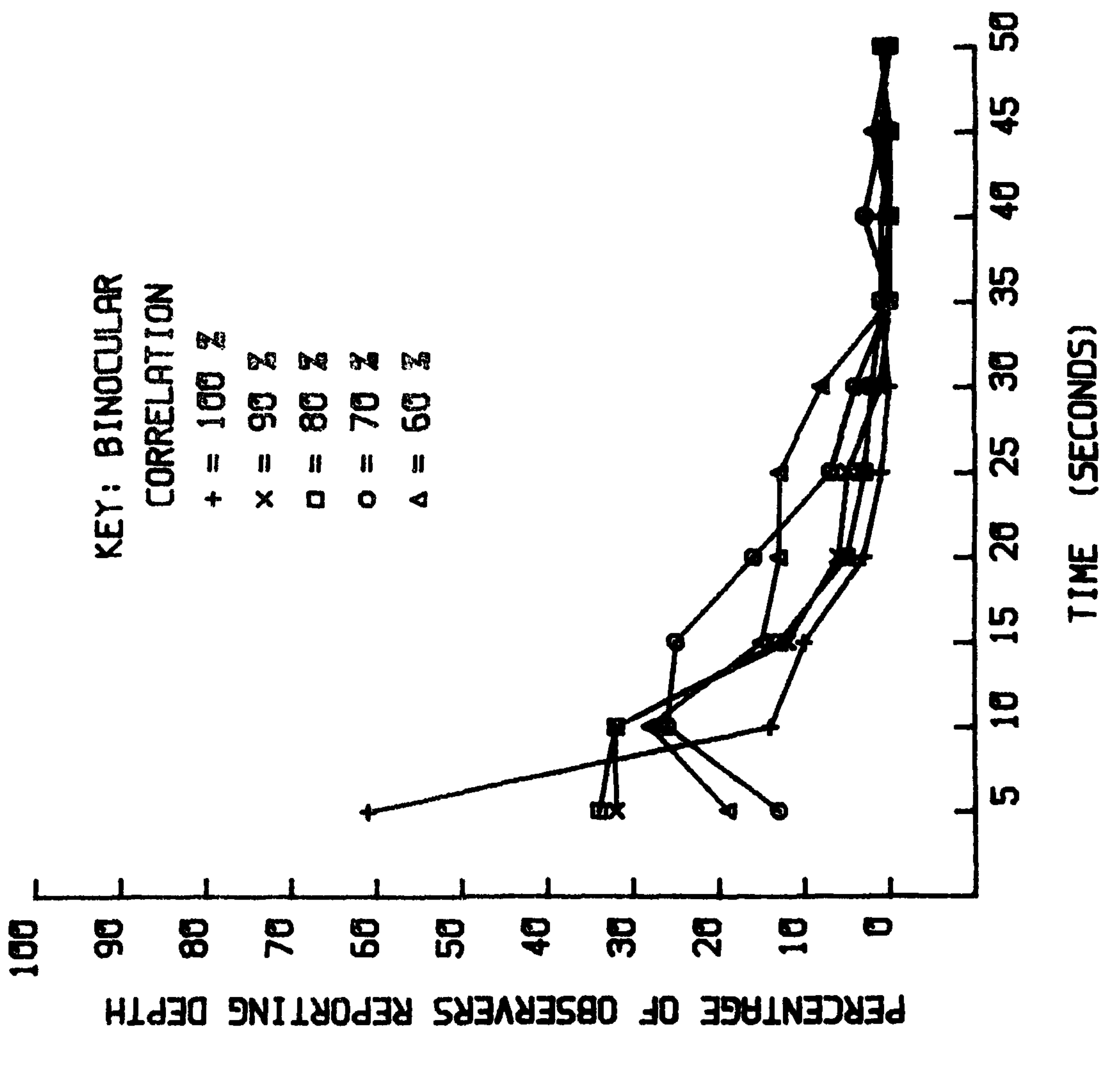

PERCENTAGE OF OBSERVERS REPORTING DEPTH
100
90
80
70
60
50
40
30
20
10
0
100
100
100
90
80
70
60
50
40
ANAGLYPH PATTERNS
(% BINOCULAR CORRELATION)

FIGURE 2



PERCENTAGE OF OBSERVERS REPORTING DEPTH
100
90
80
70
60
50
40
30
20
10
0
TIME (SECONDS)
5
10
15
20
25
30
35
40
45
50
55
60
80
110

FIGURE 3


KEY: BINOCULAR
CORRELATION
+ = 100 %
x = 90 %
□ = 80 %
o = 70 %
Δ = 60 %
TIME (SECONDS)
5 10 15 20 25 30 35 40 45 50
PERCENTAGE OF OBSERVERS REPORTING DEPTH
0 10 20 30 40 50 60 70 80 90 100

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