ADA029542

(12)

(14) USAARL [redacted]-76-25

(6)

DEPTH PERCEPTION WITH THE AN/PVS-5 NIGHT VISION GOGGLE.

(10) By

MAJ Roger W. Wiley, O.D., Ph.D.
MAJ David D. Glick, O.D.
SP5 Carol T. Bucha, B.S.
SP5 Chun K. Park, B.S.

(12) 22p.

(11) Jul[redacted]976

(9) Final Report,

US Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36362

(16) DA-1498,
DA-3-A-Φ62110-A-819

1473
404578
LB

NOTICE

Qualified requesters may obtain copies from the Defense Documentation Center (DDC), Cameron Station, Alexandria, Virginia. Orders will be expedited if placed through the librarian or other person designated to request documents from DDC (Formerly ASTIA).

Change of Address

Organization receiving reports from the US Army Aeromedical Research Laboratory on automatic mailing lists should confirm correct address when corresponding about laboratory reports.

Disposition

Destroy this report when it is no longer needed. Do not return it to the originator.

Disclaimer

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER USAARL Report	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) DEPTH PERCEPTION WITH THE AN/PVS-5 NIGHT VISION GOGGLE		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) MAJ Roger W. Wiley, O.D.,Ph.,D. MAJ David D. Glick, O.D. SP5 Carol T. Bucha, B.S. SP5 Chun K. Park, B.S.		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Bio-Optics Division (SGRD-UAO) US Army Aeromedical Research Laboratory Fort Rucker, AL 36362		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS DA 1498
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Aeromedical Research Laboratory SGRD-UAC Fort Rucker, AL 36362		12. REPORT DATE July 1976
		13. NUMBER OF PAGES 17
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) US Army Medical R & D Command Washington, D.C.		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

This document has been approved for public release and sale; its distribution is 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)

AN/PVS-5 Night Vision Goggle
Relative Depth Perception
Stereopsis

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

Laboratory measures of stereopsis and field measures of relative depth discrimination while using the AN/PVS-5 Night Vision Goggle were determined and compared with data of unaided eye performance. Using a modified Howard-Dolman apparatus, the stereoscopic threshold was found to be considerably degraded with the man-goggle system when compared to photopic unaided eye performance. Field measurements of relative depth discrimination using all available visual cues showed that performance of the man-goggle system was statistically equivalent only at intermediate distances of 500 feet or less.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

However, performance was inferior to unaided viewing at distance greater than 500 feet. These results are attributed primarily to the loss in resolution with the man-goggle system and thus a failure to appreciate subtle visual cues normally available for depth discrimination.

ACKNOWLEDGMENT

The authors wish to express their sincere appreciation to Mr. Lynn A. Alford and Mr. Paul L. Burns of the Laboratory Crafts Branch for the fabrication of the targets used in the field experiment.

SUMMARY

Laboratory measures of stereopsis and field measures of relative depth discrimination while using the AN/PVS-5 Night Vision Goggle were determined and compared with data of unaided eye performance. Using a modified Howard-Dolman apparatus, the stereoscopic threshold was found to be considerably degraded with the man-goggle system when compared to photopic unaided eye performance. Field measurements of relative depth discrimination using all available visual cues showed that performance of the man-goggle system was statistically equivalent only at intermediate distances of 500 feet or less. However, performance was inferior to unaided viewing at distance greater than 500 feet. These results are attributed primarily to the loss in resolution with the man-goggle system and thus a failure to appreciate subtle visual cues normally available for depth discrimination.

ROBERT W. BAILEY
COL, MSC
Commanding

TABLE OF CONTENTS

INTRODUCTION

Recent military experiences and modern tactical considerations have dictated the requirement for placing emphasis on sustained operations with future military deployment. Such sustained operations imply continuous activity by military units during periods of darkness as well as daylight. The requirement for operating during periods of reduced illumination will place new perceptual demands upon the individual soldier. Since vision is the principal sensory modality with which man gathers information from the external world about him in order to function effectively, major military operations historically have been conducted during periods of good illumination when the human visual system is most efficient.

The eye and related neural structures comprise an extremely effective information processing system. The visual system has a total dynamic range in response to light stimulation much greater than any other known photodetection system. In order to achieve this large dynamic range, several physiological adaptations and compromises have been accomplished. The duplicity arrangement of the retina represents one of the most effective adaptations. At moderate to high light levels, the cone or photopic system is operational and processes visual information with remarkable resolution along several dimensions (color, spatial, temporal). At lower light levels, down to the order of several photons, the rod or scotopic system is operational. In order to be capable of functioning at low light levels, some severe visual compromises have been made. For example, the scotopic system integrates light over relatively large retinal areas so spatial resolution is considerably reduced. No color information is processed, and temporal processing is reduced. The limited information provided by the scotopic visual system restricts the capability of the soldier to effectively perform his military duty.

In recognition of the requirement for sustained military operations, two avenues have been pursued to reduce the impact of the basic limitations of the scotopic visual system on military operations during periods of darkness. The first approach has been to increase the amount of time devoted to operational training at night. It is felt that this will reduce the stress and increase the perceptual proficiency of individuals during night military operations. However, the anatomy and physiology of the human visual system are relatively immutable and certain tasks, such as nap-of-the-earth (NOE) rotary wing flight, require more visual information than the scotopic system can provide, regardless of the type and quantity of training. To fulfill this need for low light level visual information, major technological advances in light amplification and infra-red systems have been developed in recent years.

The AN/PVS-5 Night Vision Goggle (NVG), developed by the U.S. Army Night Vision Laboratory, is considered an effective interim solution to allow U.S. Army aviators to conduct limited rotary wing operations at night. While the NVG performs commendably in light amplification, use of the NVG has presented new problems and questions for those of us concerned with the human in this man-machine system. For the past several years, personnel at the U.S. Army Aeromedical Research Laboratory have been conducting experiments designed to determine the present and potential impact of the NVG on aviators during rotary wing flight.

Previous USAARL reports have detailed the results from studies involving the NVG and color afterimages[1], dark adaptation[2], navigational maps[3], and aviator performance with goggles having various fields of view[4]. This report presents results from experiments designed to determine the effects of the goggle on a user's ability to make relative depth discriminations under both field and laboratory conditions. This depth discrimination data becomes important when consideration is given to altering the present binocular goggle design to a bi-ocular or single tube design to gain potential savings in weight and cost.

METHODS AND RESULTS

1. Laboratory Measures of Relative Depth Discrimination

A modified Howard-Dolman apparatus was used for the laboratory measures of relative depth discrimination. Modifications to the basic instrument consisted of driving the variable vertical rod by a motor which was controlled by a radiofrequency receiver. The observers held a transmitter and moved a toggle switch in a fore and aft direction to elicit rod movement and effect alignment with the fixed comparison rod. When an observer indicated alignment of the two rods, displacement readings to the nearest 0.1 mm were taken with a digital voltmeter which read the voltage across a linear potentiometer attached to the variable rod. Except for a 0.75° x 1.75° viewing window in the front of the instrument, the apparatus was completely enclosed and illuminated with electroluminescent panels lining the sides and top of the case. The luminance levels used were 6.70 footlamberts for the naked eye observations and 0.012 footlambert for the observations using the NVG.

Six experienced aviators were used as observers. A modified method of adjustment was used and during each testing period, an observer would make 10 readings under each of four different viewing conditions: unaided monocular, unaided binocular, monocular with NVG, binocular with NVG. To eliminate an order effect, the viewing conditions were alternated after each observation, and between each observation, the variable rod was moved to either the front or back strap of the apparatus. All observations were made at a viewing distance of 6 meters from the fixed rod.

Hirsch and Weymouth[5] first discussed the theoretical implications of measures of depth discrimination thresholds, and their suggestion of using the standard deviation of the linear displacement scores has been adopted by other investigators in subsequent reports. Accordingly, our threshold measure was the standard deviation of the displacement scores from the 10 observations made by each observer under the different viewing conditions. Table 1 shows the average threshold obtained from the six observers with the four viewing conditions. It can be seen in this table that unaided binocular viewing yielded results superior to

Table 1. Relative Depth Threshold with Howard-Dolman Apparatus

	Linear Threshold (Centimeters)	Angular Threshold (Seconds of Arc)
Binocular	1.34	5.0
Monocular	5.19	19.3
Binocular/NVG	4.80	17.9
Monocular/NVG	7.04	26.2

any of the remaining three conditions. Binocular viewing with the NVG was slightly better than unaided monocular viewing, while monocular viewing with the NVG gave the poorest performance. Scheffe's S multiple comparsion method was used to statistically evaluate these data. There was a significant difference ($p<.01$) between the results obtained with unaided binocular viewing and those found with the other three viewing conditions. However, no statistically significant difference ($p<.01$) was indicated between the thresholds with unaided monocular viewing, binocular-NVG viewing, and monocular-NVG viewing.

Thresholds in terms of angular disparities are also shown in Table 1. These were determined using the following equation[5].

$$\eta = \frac{a\ (\Delta d)}{d^2} \cdot 206{,}280$$

where

η = angular threshold in seconds of arc
a = interpupillary distance
Δd = linear displacement of the variable rod from the fixed rod
d = observation distance

A binocular threshold of approximately 5 seconds of arc is of the same order of magnitude as those which have been presented in previous investigations[5,6].

2. Field Measures of Relative Depth Dsicrimination

The six observers used in the laboratory study were also used for the field measures of relative depth discrimination. Again, a modified method of adjustment was used and the observer's task was to indicate when two targets, one fixed and one variable, were judged to be at the same distance from him. However, several procedural changes were made. Only three viewing conditions were used: monocular viewing during the day, binocular viewing during the day, binocular viewing with the NVG at night. Only one viewing condition was tested during each observation period, and two aviators, alternately responding, were tested during the same period. Full moon, no overcast conditions prevailed during the night testing periods with photometric measures (taken at the beginning and end of each night testing period) averaging 1.7×10^{-2} foot candles.

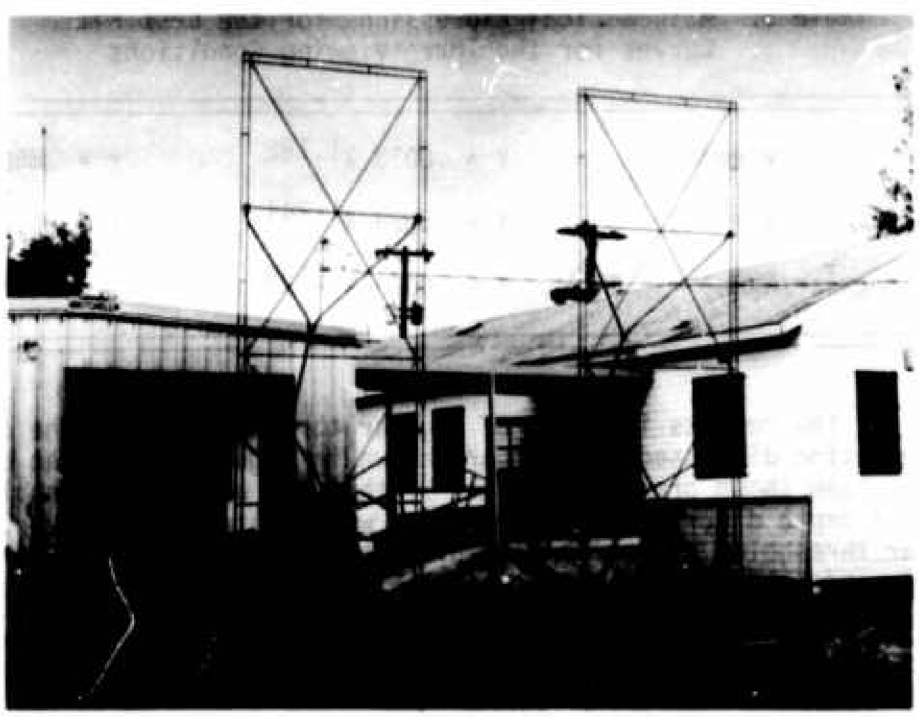
The aviator subjects were seated in the cockpit of a UH-1H helicopter and viewed target pairs (one fixed and one variable) placed at distances ranging from 200 feet to 2000 feet from the helicopter along an inactive runway at Shell Army Airfield, Fort Rucker, Alabama (Figure 1.A).

The targets consisted of white cloth stretched over metal framework (Figure 1.B). The larger variable targets were mounted on wheels to allow easier movement and pulled by a small tractor which was behind the targets to be completely hidden from view from the observers. The targets were moved along a white reference tape to insure a constant angular separation of the fixed and variable target. The actual sizes of the targets, as shown in Table 2, were established so that each of the five target pairs would subtend a visual angle of 10' x 30' at their respective testing distances. Lateral angular separation between the two targets of each pair was maintained at 1.5° for all testing distances.

Table 2. Actual Size of the Target Pairs

Testing Distance (Feet)	Target Size (Feet)
200	0.58 x 1.75
500	1.46 x 4.37
1000	2.91 x 8.73
1500	4.37 x 13.09
2000	5.82 x 17.46

A



B

FIGURE 1
(A) SUBJECT'S VIEW OF A TARGET PAIR FROM THE UH-1H
(B) CONSTRUCTION OF THE METAL FRAME OF THE T .GETS USED AT 2000 FEET.

Figure 2 shows the resultant thresholds for the three viewing conditions at all testing distances. As with the laboratory study, the measure of threshold was the standard deviation of 10 observations at each distance for all conditions. The average thresholds for all six observers at each distance are shown in Figure 2. It can be seen that while the unaided monocular and binocular results were similar, the depth discrimination performance with the night vision goggle was clearly inferior at most of the testing distances. Again, Scheffe's S multiple comparison method was used to statistically evaluate these data. Results indicate that there is a statistically significant difference ($p<.01$) between the unaided daylight monocular and binocular thresholds only at the 2000 feet testing distance. However, NVG performance was significantly different from monocular performance at all distances except 200 feet, and goggle performance was significantly different from binocular performance at all distances except 200 feet and 500 feet.

In order to determine the mathematical expression best describing the results, the data from each of the three viewing conditions were analyzed by the least squares technique to six different functions (linear, exponential, power, and three hyperbolic functions). The correlation coefficients were highest, indicating the best mathematical description, for all three viewing conditions when the data were fit to a power function. These functions for each of the viewing conditions are shown in Table 3.

Table 3. Mathematical Expressions for the Best Fit Curves for the Three Viewing Conditions

Monocular Viewing	$Y = .0038\ X^{1.182}$	$r = .859$
Binocular Viewing	$Y = .0029\ X^{1.241}$	$r = .914$
Binocular/NVG	$Y = .0068\ X^{1.158}$	$r = .810$

The results in terms of angular thresholds using the conversion equation discussed earlier are shown in Figure 3. It can be seen, and has been shown previously[7,8,9,10], that the angular threshold for relative depth discrimination decreases with distance. However, these angular thresholds cannot be viewed as stereoscopic disparity thresholds. Clearly, additional monocular cues such as size constancy are operational for these depth discriminations made under field conditions at all of the testing distances.

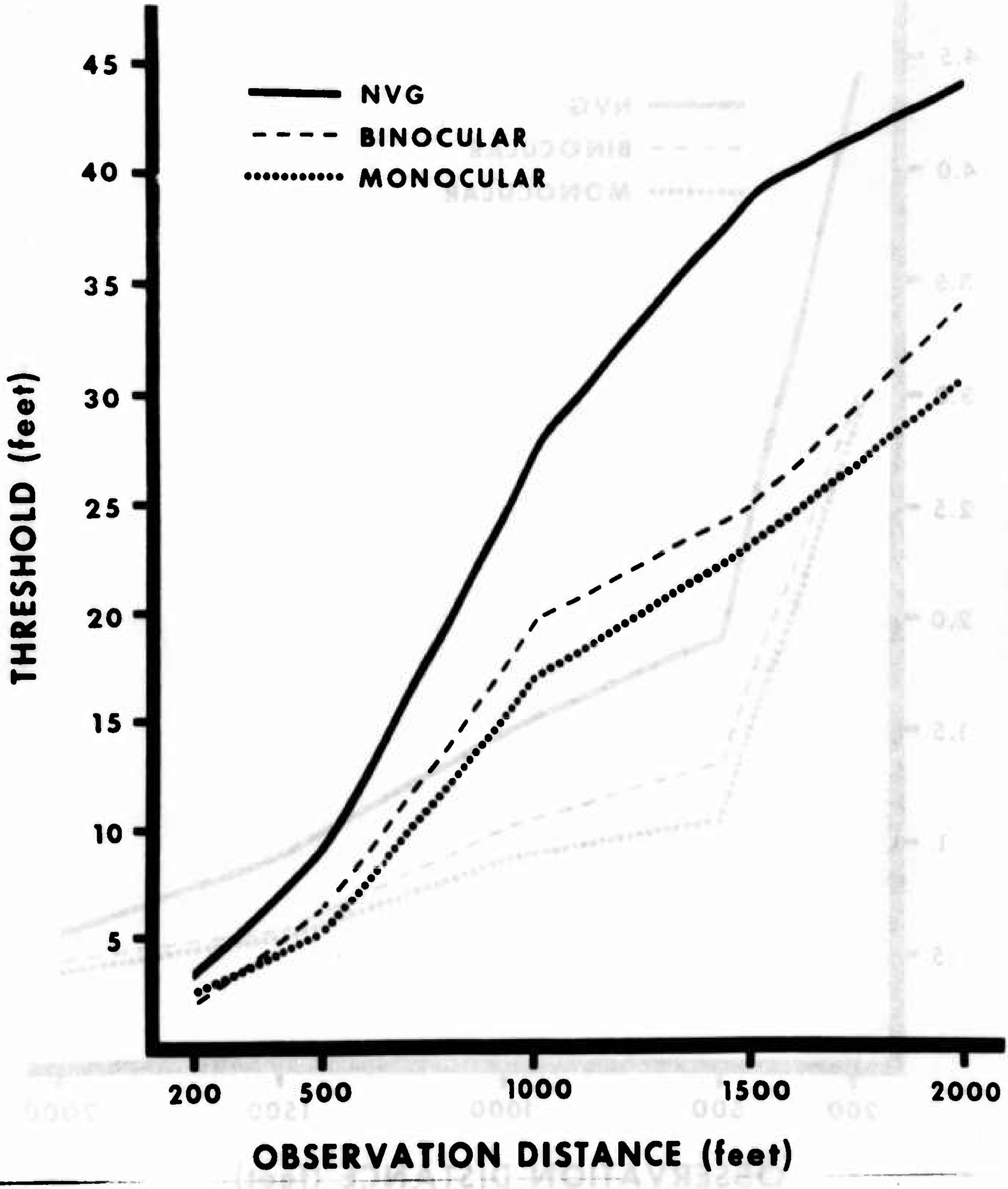


FIGURE 2. LINEAR THRESHOLDS FOR RELATIVE DISTANCE DISCRIMINATION UNDER THREE VIEWING CONDITIONS. DATA POINTS ARE THE AVERAGE FROM SIX OBSERVERS.

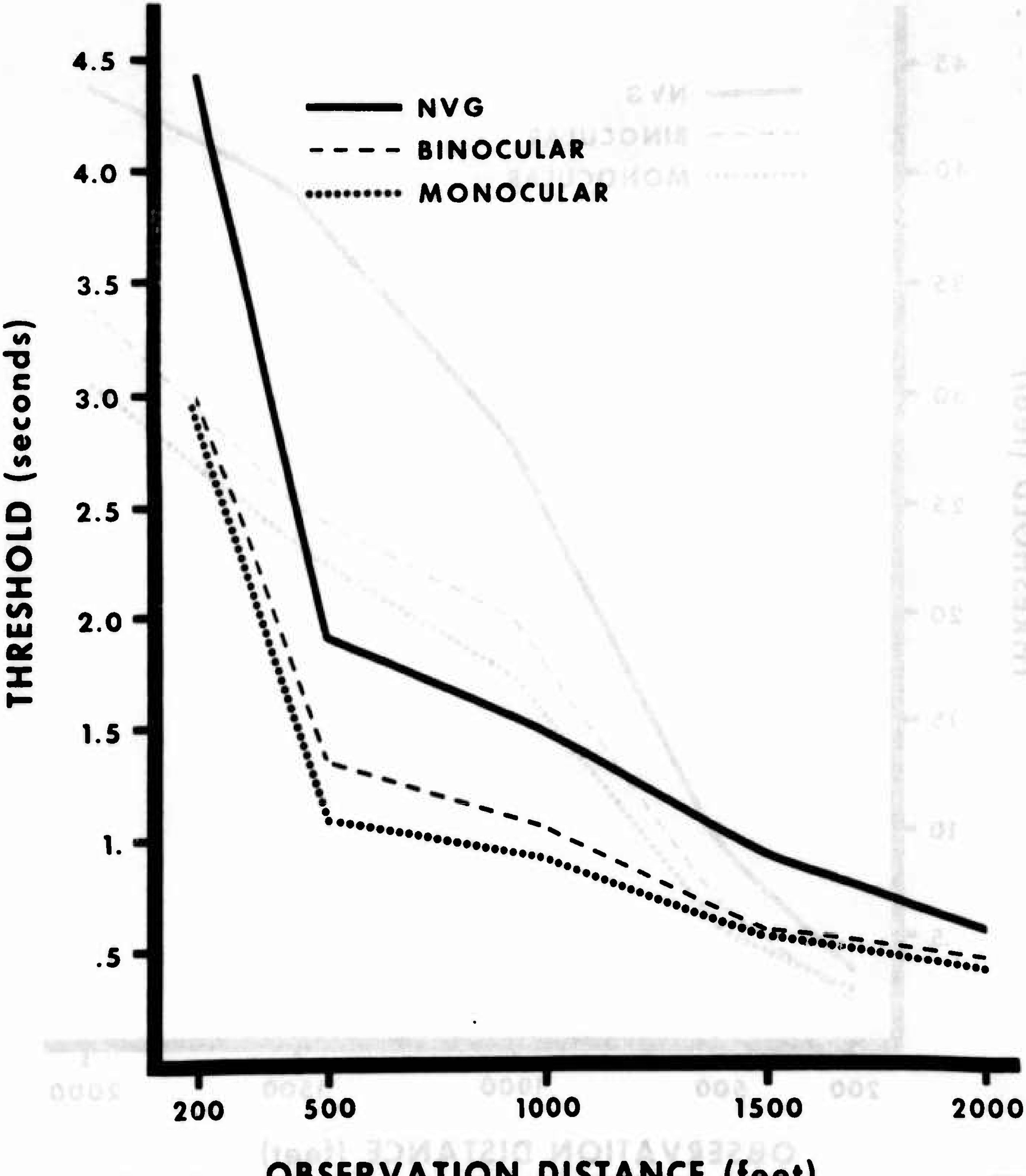


FIGURE 3. ANGULAR THRESHOLDS FOR RELATIVE DISTANCE DISCRIMINATION.

DISCUSSION

The reduced resolution capability with the NVG has probably significantly influenced the results obtained in the depth discrimination experiments. A report now in preparation[11] will present data showing that the best acuity measured clinically with the NVG is approximately 20/70 Snellen acuity and that this value agrees very closely with data obtained using a modulation transfer function technique.

As shown in Table 1, the results obtained with the Howard-Dolman apparatus indicate that the depth discrimination thresholds with unaided binocular vision were superior to those obtained with the remaining three viewing conditions. On a rank order basis, the thresholds with binocular viewing with the night vision goggle were slightly better than unaided monocular viewing thresholds, while thresholds obtained with the NVG and monocular viewing were the poorest. Statistical evaluation indicated that while there was a statistically significant difference ($p<.01$) between the thresholds of binocular viewing and the remaining viewing conditions, there was no significant difference between unaided monocular, binocular-NVG, and monocular-NVG viewing conditions. However, our own observations and comments from every subject used in these experiments indicate that there is a perceptually significant difference between binocular viewing with the NVG and the two monocular viewing conditions. That is, even though the targets are not as clear, depth judgments using binocular viewing with the NVG are more easily made than those using unaided or aided monocular viewing.

An upright image is achieved with the NVG by means of a fiber optics twist contained within the optics of the tube. The fact that adequate spatial information is retained after the fiber optics twist is shown by the readily fused images presented to the eyes by the two tubes in the NVG. One might reasonably expect disparity information to be retained also. Therefore, the decrement in performance while using the goggle from that of unaided binocualr viewing is mainly ascribed to the loss in resolution.

The loss of resolution resulting in larger depth discrimination thresholds can also be seen in a comparison between the unaided and aided monocular performances (Table 1). The Howard-Dolman apparatus is usually considered to yield measures of central stereopsis. Relative depth judgments with this instrument are supposedly based upon disparity of the retinal images of the two eyes. However, cues for depth judgment other than image disparity are available to the observer with the Howard-Dolman instrument, especially when the fixed and comparison rods are of the same size. One cue, proximal image size, was purposely left available for our subjects. Size was probably the major cue used to make the displacement settings when the targets were viewed monocularly. Although the cues available to the observer when viewing the apparatus monocularly with and without the NVG were the same, the degraded image of the targets with the goggle resulted in a threshold which was much greater than that found with unaided monocular viewing.

The field experiment was designed to measure relative depth discrimination thresholds using the goggle and to compare that performance with depth thresholds of daylight unaided vision. With the preponderance of monocular cues, the cue of retinal image disparity was relatively minor, and little difference between monocular and binocular performance was expected. This supposition was supported as shown in Figure 2 in which the monocular and binocular thresholds are statistically equivalent at all testing distances. However, for distances of 500 feet or greater, Figure 2 also shows that depth discrimination performance with the night vision goggle is significantly poorer. As with the results of the laboratory study, the larger thresholds obtained while the observers viewed with the NVG are probably the result of the reduced resolution. That is, while information similar to that used by the observers when viewing the targets during daylight was also available to them when they used the night vision goggle, most of the cues, such as texture, gradients, lighting and shading, and linear perspective, had become sufficiently subtle to result in larger thresholds.

Our results have shown that stereopsis, the appreciation of depth by means of the disparity of the retinal images, is significantly reduced when wearing the night vision goggle. Also, when many monocular cues are available, the field experiments have shown that relative depth discrimination is poorer with the NVG for distances of 500 feet or greater. For lesser distances, performance was statistically equivalent to unaided daylight performance. It should be noted that our results only reflect accuracy and not other qualities such as speed or comfort. The relative advantages of stereopsis in aviation are still somewhat equivocal. Two recent reports[12,13] have shown that landing performances of pilots deprived of vision in one eye were as accurate as their landings while using both eyes. However, these reports were based on data obtained in fixed wing aircraft. The visual demands of rotary wing flight are most probably considerably different. Certainly, military flight profiles involving hovering and flight into and out from unprepared areas without benefit of approach and landing aids might reasonably be expected to place greater demand on an aviator's ability to perceive depth, especially at distances of less than 100 feet. The reduced depth discrimination with the goggle should be recognized so that aviators can be properly trained in preparation for flight with the night vision goggle.

CONCLUSIONS

1. Stereopsis, which is based upon retinal image disparities, is degraded with the goggle from that performance measured with binocular photopic (daylight) performance.

2. Relative depth discrimination with the man-goggle system is statistically equivalent to unaided photopic viewing for intermediate distances when measured in a visually-rich environment. However, performance with the man-goggle system is inferior at viewing distances of 500 feet or greater.

3. The reduced depth perception performance is most probably directly related to the loss in resolution capability with the man-goggle system.

REFERENCES

1. Glcik, D.D. and Moser, C.E. "Afterimages associated with using the AN/PVS-5 Night Vision Goggle, USAARL Letter Report-75-1-7-1, August 1974.

2. Glick, D.D.; Wiley, R.W.; Moser, C.E. and Park, C.K. "Dark Adaptation Changes Associated with Use of the AN/PVS-5, Night Vision Goggle," USAARL Letter Report-75-2-7-2, August 1974.

3. Glick, D.D. and Wiley, R.W. "A Visual Comparsion of Standard and Experimental Maps Using the AN/PVS-5, Night Vision Goggle," USAARL Letter Report-75-26-7-6, March 1975.

4. Sanders, M.G.; Kimball, K.A.; Frezell, T.L. and Hofmann, M.A. "Aviator Performance Measurements During Low Altitude Rotary Wing Flight with the AN/PVS-5 Night Vision Goggles," USAARL Report 76-10, December 1975.

5. Hirsch, M.J. and Weymouth, F.W. "Distance Discrimination. I. Theoretic Considerations," 1948, Archives of Ophthalmology, 39: 210-223.

6. Sloan, L.L. and Altman, A. "Factors Involved in Several Tests of Binocular Depth Perception," 1954, Archives of Ophthalmology, 52: 524-544.

7. Hirsch, M.J. and Weymouth, F.W. "Distance Discrimination. V. Effect of Motion and Distance of Targets on Monocular and Binocular Distance Discrimination," 1947, Journal of Aviation Medicine, 18: 594-600.

8. Teichner, W.H; Kobrick, J.L. and Wehrkamp, R.F. "Effects of terrain and Observation Distance on Depth Discrimination," May 1954, Environmental Protection Division, U.S. Army Quartermaster Research and Development Center, Natick, Massachusetts, Report No. 228.

9. Teichner, W.H.; Kobrick, J.L. and Wehrkamp, R.F. "The Effects of Terrain and Observation Distance on Relative Depth Discrimination," 1955, American Journal of Psychology, 68: 193-208.

10. Teichner, W.H.; Kobrick, J.L. and Dusek, E.R. "Commonplace Viewing and Depth Discrimination," 1955, Journal of the Optical Society of America, 57: 401-406.

11. Holly, Franklin F. "Modulation Transfer Functions of A Man-Goggle System Using the AN/PVS-5 Night Vision Goggle, USAARL, 1976, (In preparation).

12. Lewis, E.E., Jr. and Krier, G.E. "Flight Research Program XVI: Landing Performance in Jet Aircraft After the Loss of Binocular Vision," 1969, Aerospace Medicine, 40: 9-11.

13. Lewis, E.E., Jr.; Blakeley, W.R.; Swaroop, R.; Masters, R.L. and McMurty, T.C. "Landing Performance by Low-time Private Pilots After the Sudden Loss of Binocular Vision - Cyclops II," 1973, Aerospace Medicine, 44: 1241-1245

DISTRIBUTION LIST OF USAARL REPORTS

Project No. 3A161102B71P-03
Basic Research of Military Medicine Human Ecology

No. of Copies	
5	US Army Medical Research and Development Command Washington, D.C. 20315
12	Defense Documentation Center Alexandria, Virginia 22314
1	US Army Combat Developments Command Medical Department Agency, BAMC Fort Sam Houston, Texas 78234

ARL | AD
US Army Aeromedical Research Laboratory, Fort Rucker, Alabama | UNCLASSIFIED

DEPTH PERCEPTION WITH THE AN/PVS-5 NIGHT VISION GOGGLE by MAJ Roger W. Wiley, O.D., Ph.D.; MAJ David D. Glick, O.D.; SP5 Carol T. Bucha, B.S.; and SP5 Chun K. Park, B.S.; 17 pp, DA Project 3A062110A819, Bio-Optics Division.

1. AN/PVS-5 Night Vision Goggle
2. Relative Depth Perception
3. Stereopsis

Laboratory measures of stereopsis and field measures of relative depth discrimination while using the AN/PVS-5 Night Vision Goggle were determined and compared with data of unaided eye performance. Using a modified Howard-Dolman apparatus, the stereoscopic threshold was found to be considerably degraded with the man-goggle system when compared to photopic unaided eye performance. Field measurements of relative depth discrimination using all available visual cues showed that performance of the man-goggle system was statistically equivalent only at intermediate distances of 500 feet or less. However, performance was inferior to unaided viewing at distance greater than 500 feet. These results are attributed primarily to the loss in resolution with the man-goggle system and thus a failure to appreciate subtle visual cues normally available for depth discrimination.

ARL | AD
US Army Aeromedical Research Laboratory, Fort Rucker, Alabama | UNCLASSIFIED

DEPTH PERCEPTION WITH THE AN/PVS-5 NIGHT VISION GOGGLE by MAJ Roger W. Wiley, O.D., Ph.D.; MAJ David D. Glick, O.D.; SP5 Carol T. Bucha, B.S.; and SP5 Chun K. Park, B.S.; 17 pp, DA Project 3A062110A819, Bio-Optics Division.

1. AN/PVS-5 Night Vision Goggle
2. Relative Depth Perception
3. Stereopsis

Laboratory measures of stereopsis and field measures of relative depth discrimination while using the AN/PVS-5 Night Vision Goggle were determined and compared with data of unaided eye performance. Using a modified Howard-Dolman apparatus, the stereoscopic threshold was found to be considerably degraded with the man-goggle system when compared to photopic unaided eye performance. Field measurements of relative depth discrimination using all available visual cues showed that performance of the man-goggle system was statistically equivalent only at intermediate distances of 500 feet or less. However, performance was inferior to unaided viewing at distance greater than 500 feet. These results are attributed primarily to the loss in resolution with the man-goggle system and thus a failure to appreciate subtle visual cues normally available for depth discrimination.

ARL | AD
US Army Aeromedical Research Laboratory, Fort Rucker, Alabama | UNCLASSIFIED

DEPTH PERCEPTION WITH THE AN/PVS-5 NIGHT VISION GOGGLE by MAJ Roger W. Wiley, O.D., Ph.D.; MAJ David D. Glick, O.D.; SP5 Carol T. Bucha, B.S.; and SP5 Chun K. Park, B.S.; 17 pp, DA Project 3A062110A819, Bio-Optics Division.

1. AN/PVS-5 Night Vision Goggle
2. Relative Depth Perception
3. Stereopsis

Laboratory measures of stereopsis and field measures of relative depth discrimination while using the AN/PVS-5 Night Vision Goggle were determined and compared with data of unaided eye performance. Using a modified Howard-Dolman apparatus, the stereoscopic threshold was found to be considerably degraded with the man-goggle system when compared to photopic unaided eye performance. Field measurements of relative depth discrimination using all available visual cues showed that performance of the man-goggle system was statistically equivalent only at intermediate distances of 500 feet or less. However, performance was inferior to unaided viewing at distance greater than 500 feet. These results are attributed primarily to the loss in resolution with the man-goggle system and thus a failure to appreciate subtle visual cues normally available for depth discrimination.

ARL | AD
US Army Aeromedical Research Laboratory, Fort Rucker, Alabama | UNCLASSIFIED

DEPTH PERCEPTION WITH THE AN/PVS-5 NIGHT VISION GOGGLE by MAJ Roger W. Wiley, O.D., Ph.D.; MAJ David D. Glick, O.D.; SP5 Carol T. Bucha, B.S.; and SP5 Chun K. Park, B.S.; 17 pp, DA Project 3A062110A819, Bio-Optics Division.

1. AN/PVS-5 Night Vision Goggle
2. Relative Depth Perception
3. Stereopsis

Laboratory measures of stereopsis and field measures of relative depth discrimination while using the AN/PVS-5 Night Vision Goggle were determined and compared with data of unaided eye performance. Using a modified Howard-Dolman apparatus, the stereoscopic threshold was found to be considerably degraded with the man-goggle system when compared to photopic unaided eye performance. Field measurements of relative depth discrimination using all available visual cues showed that performance of the man-goggle system was statistically equivalent only at intermediate distances of 500 feet or less. However, performance was inferior to unaided viewing at distance greater than 500 feet. These results are attributed primarily to the loss in resolution with the man-goggle system and thus a failure to appreciate subtle visual cues normally available for depth discrimination.