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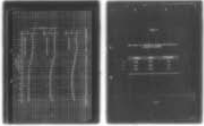
NAVAL MEDICAL FIELD RESEARCH LAB CAMP LEJEUNE N C  
STUDY OF THE EFFECTIVENESS OF GLASSES, SUN, N-1, CONTRACT NUMBE--ETC(U)  
MAY 46 S ROSS, C G MUELLER, P RICHMOND

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MEDICAL FIELD RESEARCH LABORATORY  
CAMP LEJEUNE, NORTH CAROLINA

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STUDY OF THE EFFECTIVENESS OF GLASSES,  
SUN, N-1, CONTRACT ~~12~~ NXsX 66844  
and  
M & S Research Project ~~12~~ X-542 (Av-282-p),

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OBJECT

To study the effectiveness of sunglasses, N-1, Contract No. NXSx 66844 in eliminating the cumulative effects on light threshold of intense exposure to sunlight.

SUMMARY

Thirty-two subjects were given training on the Hecht-Shlaer Adaptometer for one week and, on the basis of average threshold, divided into three groups. For the next three weeks, all subjects were tested each morning and then transported to Onslow Beach. During this period, one group had maximum protection from the sun by wearing dark-adaptor goggles; another group was issued sunglasses, N-1; the third group had no protection for their eyes. Average thresholds for each group were computed and compared.

No significant differences were found between any of the groups. Possible reasons for the apparent discrepancy between these results and those of other investigators are outlined.

BACKGROUND

Hecht, et al., investigated the effect of extended

exposure to sunlight on the threshold of the dark-adapted eye (1). They confirmed previous work showing that the rate of adaptation and the final threshold after forty-five minutes in the dark were affected by the intensity of light in the period preceding dark adaptation. They also concluded that there was a cumulative effect, such that, over an extended period of exposure, e.g., 10-15 days in the bright sun, the threshold gradually increased and did not return to normal for several days after intense exposure was discontinued. The military significance of such results is immediately apparent when one considers the possibility that a man who performs night lookout duty might be exposed to intense sunlight during the day. Not only would it take him longer to completely adapt to the darkness the following night, but, over a period of several weeks of such a routine, his eyes would gradually become less and less sensitive to minute changes in light. Sunglasses were developed to protect the eyes from exposure to such high intensities of light. These sunglasses, N-1, Contract No. NxSx 66844, have neutral tint, plastic lenses with a transmission of about twelve per cent. The present experiment was designed to test whether these glasses offer sufficient protection to eliminate cumulative effects of exposure on subsequent threshold values.

### APPARATUS AND PROCEDURE

All threshold determinations were made with the Hecht-Shlaer Adaptometer which has been described in a previous report (1). The psycho-physical method used was the method of limits. The procedure for determining the threshold of each subject included the following steps:

(1) Several settings of the Hecht-Shlaer Adaptometer were used to establish the approximate range of the threshold.

(2) The intensity was set considerably below this approximate threshold and was increased in steps of 0.1 log units until the subject reported seeing the stimulus on two successive steps.

(3) The intensity was then set considerably above the approximate threshold and was successively reduced in 0.1 log unit steps until, on two consecutive exposures, the subject reported that he saw nothing.

(4) Steps 2 and 3 were repeated. The four values obtained were averaged, and this average was taken as the threshold for that test period.

Thirty enlisted Marine Corps personnel were used as subjects. For one week prior to the experiment, these subjects were tested twice a day on the Hecht-Shlaer Adaptometer. During this week, all subjects wore standard Navy

dark-adaptor goggles which provided a control over pre-experimental differences in exposure to sunlight. This period not only gave training on the Adaptometer but yielded a fairly well determined pre-experimental threshold.

At the end of this pre-experimental period, the subjects were divided into three groups: the "sun (X) group", which was to have no protection from the sun; the "control (C) group", which was to have maximum protection by wearing the dark-adaptor goggles throughout the experiment; and the "sunglass (S) group", which was to have the protection of the sunglasses. These groups were approximately equated as to mean threshold on the basis of their average threshold in the pre-experimental week.

Since primary interest was in the cumulative effect, all testing was done in the morning between 0700 and 0900. This eliminated as much as possible the immediate effects of the previous day's exposure. At 0900 all subjects were transported to the beach. Except for about thirty to forty minutes at noon, all subjects remained at the beach until about 1600 when they were transported back to camp. This routine was continued for nineteen days.

Brightness measurements were made each day with the Macbeth Illuminometer. The average brightness of the beach was about 4000 millilamberts (ml.), that of the water

about 2000 ml. Of the nineteen days in the experimental period, there were three days in which the subjects did not go to the beach. Of the remaining days, three were dull and overcast. In general, the brightness of the area was below that which has been available to other investigators, and to that extent, this area was an unfortunate choice as a locale for this study.

Several subjects were unable to complete the experiment because of emergency leave, reporting to sick bay, etc. Only those subjects were used in this analysis who completed the experiment with not more than two days in which thresholds were not taken.

#### RESULTS

Table I records the threshold for each subject for each day. The mean scores for each group for each day were computed, and these values are plotted in figure 1. The line was drawn through the data in each group by visual inspection. Inspection of the curves representing the three groups in this experiment reveals no striking differences between the groups. The curves for the control and sun groups are almost identical, except for a small constant difference due to failure to exactly equate the two groups with respect to pre-experimental threshold. The average threshold for the sunglass group shows less of a tendency to decrease, but this difference can probably be attributed

to the inaccuracies of the method of fitting the line to the data and to the large variability of the thresholds.

In an attempt to get an over-all statement of the amount of the effect of exposure to sunlight, the mean threshold for each group for the week preceding exposure and for the three weeks during exposure were computed. These values are shown in Table II. The small differences between the groups again assign the greatest decrease in threshold to the control group. In accordance with figure 1, the sunglass group (S) exhibits the least decrease in threshold. As in the previous method of analysis, the diminutive nature of the differences must be emphasized.

#### DISCUSSION

It is impossible to evaluate the effectiveness of sunglasses, N-1, from the present results. This may be attributed to two factors:

- (1) Great variability of threshold determinations on untrained subjects, which tends to obscure minute changes in threshold.
- (2) Lack of concrete evidence for the original phenomenon, i.e., the existence of a cumulative effect of exposure.

An indication of the magnitude of the variability can

be obtained from Table I. The variability of such a relatively stable statistic as the group mean can be observed in figure 1 and in Table I.

Some doubt as to the existence of a cumulative effect has arisen as a result of the work of Clark, Johnson, and Dreher (2) who found an increase in threshold (following exposure) which persisted overnight to some extent but which "returned to normal after one day's complete protection from light". Before additional research is designed to evaluate these sunglasses re: the protection offered against the cumulative effect of exposure to intense sunlight, it is recommended that another project be set up to analyze and reaffirm this "effect".

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TABLE I

THRESHOLD DETERMINATIONS FOR EACH SUBJECT FOR EACH DAY AS MEASURED BY HECHT-SHLAER ADAPTOMETER

GROUP	SUBJECT	DAYS												
		1	2	3	4	5	6	7	8	9	10	11	12	
I	1	2.50	2.30	2.33	2.38	2.28	2.50	2.28	2.50	2.30	2.35	2.28	2.28	2.28
	2	2.60	2.50	2.68	2.65	2.60	2.60	2.68	2.70	2.58	2.55	2.60	2.60	2.40
	3	2.03	2.08	2.13	2.05	2.18	2.13	2.10	2.00	2.08	2.00	2.05	2.05	1.95
	4	2.47	2.43	2.48	2.53	2.55	2.58	2.80	2.50	2.52	2.45	2.38	2.38	2.40
	5	2.45	2.48	2.43	2.40	2.45	2.55	2.28	2.43	2.40	2.25	2.40	2.40	2.46
	6	2.32	2.35	2.40	2.53	2.48	2.43	2.58	2.40	2.30	2.65	2.53	2.53	2.43
	7	2.25	2.35	2.25	2.40	2.33	2.35	2.30	2.28	2.58	2.28	2.23	2.23	2.20
	8	2.38	2.23	2.18	2.30	2.50	2.20	2.33	2.13	2.10	2.13	2.08	2.08	1.98
	9	2.53	2.43	2.65	2.50	2.58	2.43	2.55	2.35	2.50	2.40	2.55	2.55	2.48
	10	2.45	2.25	2.28	2.20	2.23	2.35	2.35	2.28	2.23	2.25	2.10	2.10	2.48
Average		2.40	2.34	2.38	2.39	2.42	2.41	2.43	2.36	2.36	2.33	2.32	2.31	
G	1	2.53	2.35	2.28	2.35	2.28	2.28	2.30	2.38	2.28	1.83	2.25	2.23	
	2	2.28	2.43	2.18	2.20	2.20	2.28	2.48	2.28	2.32	2.20	2.35	1.93	
	3	2.68	2.63	2.60	2.70	2.80	2.73	2.68	2.70	2.63	2.75	2.58	2.40	
	4	2.33	2.38	2.30	2.35	2.35	2.18	2.25	2.25	2.43	2.13	2.30	2.40	
	5		2.38	2.50	2.58	2.35	2.43	2.60	2.63	2.48	2.45	2.43	2.50	
	6	2.35	2.20	2.40	2.30	2.38	2.48	2.38	2.38	2.33	2.18	2.28	2.13	
Average		2.43	2.40	2.38	2.41	2.40	2.40	2.45	2.44	2.41	2.26	2.37	2.27	
S	1	2.48	2.65	2.50	2.48	2.50	2.53	2.23	2.40	2.35	2.30	2.43	2.55	
	2	2.33	2.38	2.25	2.28	2.30	2.38	2.20	2.28	2.23	2.03	2.28	2.23	
	3	2.28	2.30	2.45	2.58	2.65	2.50	2.75	2.53	2.53	2.53	2.48	2.38	
	4	2.40	2.50	2.43	2.40	2.35	2.30	2.43	2.53	2.32	2.10	2.13	2.08	
	5	2.18	2.20	2.35	2.28	2.43	2.15	2.23	2.23	2.20	2.12	1.98	2.18	
	6	2.23	2.35	2.35	2.43	2.30	2.20	2.35	2.33	2.40	2.30	2.18	2.20	
	7	2.40	2.30	2.53	2.28	2.53	2.45	2.50	2.33	2.43	2.20	2.38	2.35	
	8	2.40	2.48	2.50	2.48	2.53	2.53	2.45	2.38	2.52	2.33	2.48	2.38	
	9	2.15	2.20	2.10	2.30	2.25	2.25	2.38	2.20	2.22	2.20	2.25	1.95	
	10	2.75	2.45	2.58	2.63	2.55	2.53	2.75	2.43	2.55	2.38	2.65	2.48	
Average		2.36	2.38	2.40	2.41	2.44	2.43	2.36	2.38	2.25	2.32	2.28		

TABLE I (cont'd)

THRESHOLD DETERMINATIONS FOR EACH SUBJECT FOR EACH DAY AS MEASURED BY WECHE-SHILVER ADAPTOMETER

GROUP	SUBJECT	DAYS																							
		13	14	15	16	17	18	19	20	21	22	23	24	13	14	15	16	17	18	19	20	21	22	23	24
X	1	2.20	2.13	2.30	2.05	2.35	2.23	2.28	2.10	2.38	2.13	2.33	2.20	2.20	2.13	2.30	2.05	2.35	2.23	2.28	2.10	2.38	2.13	2.33	2.20
	2	2.35	2.25	2.33	2.45	2.25	2.35	2.23	2.35	2.45	2.38	2.50	2.63	2.35	2.25	2.33	2.45	2.25	2.35	2.23	2.35	2.45	2.38	2.50	2.63
	3	2.02	2.03	1.98	1.83	1.95	2.10	2.13	2.02	2.15	2.03	2.18	2.18	2.02	2.03	1.98	1.83	1.95	2.10	2.13	2.02	2.15	2.03	2.18	2.18
	4	2.45	2.25	2.30	2.48	2.30	2.40	2.40	2.12	2.25	2.28	2.55	2.40	2.45	2.25	2.30	2.48	2.30	2.40	2.12	2.25	2.28	2.55	2.40	
	5	2.28	2.18	2.18	2.38	2.23	2.20	2.23	2.15	2.38	2.13	2.25	2.33	2.28	2.18	2.18	2.38	2.23	2.20	2.23	2.15	2.38	2.13	2.25	2.33
	6	2.35	2.42	2.43	2.38	2.50	2.38	2.33	2.51	2.43	2.50	2.28	2.43	2.35	2.42	2.43	2.38	2.50	2.38	2.33	2.51	2.43	2.50	2.28	2.43
	7	2.08	2.20	2.30	2.15	2.15	2.18	2.05	2.05	2.30	2.18	2.18	2.08	2.08	2.20	2.30	2.15	2.15	2.18	2.05	2.05	2.30	2.18	2.18	2.08
	8	2.10	1.97	2.05	2.10	2.08	2.05	2.00	1.95	2.50	2.18	2.18	2.15	2.10	1.97	2.05	2.10	2.08	2.05	2.00	1.95	2.50	2.18	2.18	2.15
	9	2.28	2.35	2.40	2.30	2.35	2.40	2.25	2.37	2.25	2.25	2.25	2.35	2.28	2.35	2.40	2.30	2.35	2.40	2.25	2.37	2.25	2.25	2.35	
	10	2.35	2.28	2.28	2.18	2.23	2.25	2.13	2.40	2.33	2.33	2.28	2.18	2.35	2.28	2.28	2.18	2.23	2.25	2.13	2.40	2.33	2.28	2.18	
Average		2.25	2.21	2.23	2.22	2.24	2.25	2.20	2.23	2.32	2.23	2.30	2.31	2.25	2.21	2.23	2.22	2.24	2.25	2.20	2.23	2.32	2.23	2.30	2.31
G	1	2.33	2.23	2.15	2.08	2.25	2.18	1.83	2.33	2.18	2.23	2.03	2.20	2.33	2.23	2.15	2.08	2.25	2.18	1.83	2.33	2.18	2.23	2.03	2.20
	2	2.13	2.00	2.15	2.08	2.20	2.10	1.98	2.12	2.13	2.00	1.95	2.30	2.13	2.00	2.15	2.08	2.20	2.10	1.98	2.12	2.13	2.00	1.95	2.30
	3	2.48	2.35	2.33	2.43	2.33	2.35	2.33	2.40	2.35	2.40	2.53	2.60	2.48	2.35	2.33	2.43	2.33	2.40	2.35	2.40	2.35	2.40	2.53	2.60
	4	2.15	2.23	2.20	2.25	2.15	2.10	2.00	2.20	2.35	2.35	1.95	2.18	2.15	2.23	2.20	2.25	2.15	2.10	2.00	2.20	2.35	2.35	1.95	2.18
	5	2.50	2.50	2.40	2.25	2.40	2.40	2.48	2.35	2.43	2.43	2.73	2.58	2.50	2.50	2.40	2.25	2.40	2.40	2.48	2.35	2.43	2.43	2.73	2.58
	6	2.33	2.10	2.35	2.10	2.28	2.18	2.10	2.20	2.23	2.13	2.10	2.05	2.33	2.10	2.35	2.10	2.28	2.18	2.10	2.20	2.23	2.13	2.10	2.05
Average		2.32	2.24	2.26	2.20	2.27	2.22	2.12	2.27	2.28	2.23	2.22	2.32	2.32	2.24	2.26	2.20	2.27	2.22	2.12	2.27	2.28	2.23	2.22	2.32
S	1	2.60	2.45	2.43	2.33	2.35	2.25	2.10	2.35	2.28	2.33	2.23	2.15	2.60	2.45	2.43	2.33	2.35	2.25	2.10	2.35	2.28	2.33	2.23	2.15
	2	2.33	2.30	2.13	2.20	2.30	2.13	2.00	2.15	2.05	2.08	2.10	2.15	2.33	2.30	2.13	2.20	2.30	2.13	2.00	2.15	2.05	2.08	2.10	2.15
	3	2.40	2.25	2.40	2.20	2.45	2.40	2.33	2.38	2.38	2.38	2.43	2.55	2.40	2.25	2.40	2.20	2.45	2.40	2.33	2.38	2.38	2.38	2.43	2.55
	4	2.13	2.60	2.08	2.25	2.20	2.28	2.08	2.35	2.35	2.45	2.20	2.30	2.13	2.60	2.08	2.25	2.20	2.28	2.08	2.35	2.35	2.45	2.20	2.30
	5	2.30	2.15	2.23	2.25	2.20	2.28	2.10	2.28	2.20	2.25	1.98	2.28	2.30	2.15	2.23	2.25	2.20	2.28	2.10	2.28	2.20	2.25	1.98	2.28
	6	2.07	2.20	2.20	2.33	2.10	2.23	2.25	2.10	2.20	2.20	2.33	2.35	2.07	2.20	2.20	2.33	2.10	2.23	2.25	2.10	2.20	2.20	2.33	2.35
	7	2.38	2.43	2.28	2.38	2.35	2.25	2.08	2.35	2.18	2.20	2.05	2.25	2.38	2.43	2.28	2.38	2.35	2.25	2.08	2.35	2.18	2.20	2.05	2.25
	8	2.45	2.40	2.40	2.53	2.50	2.40	2.20	2.50	2.50	2.50	2.33	2.43	2.45	2.40	2.40	2.53	2.50	2.40	2.20	2.50	2.50	2.33	2.43	
	9	2.08	2.20	2.13	2.18	2.18	2.00	2.00	2.07	2.03	2.10	2.40	2.35	2.08	2.20	2.13	2.18	2.18	2.00	2.00	2.07	2.03	2.10	2.40	2.35
	10	2.53	2.45	2.43	2.15	2.35	2.33	2.00	2.00	2.38	2.40	2.20	2.08	2.53	2.45	2.43	2.15	2.35	2.33	2.00	2.00	2.38	2.40	2.20	2.08
Average		2.33	2.34	2.27	2.28	2.29	2.26	2.11	2.29	2.26	2.29	2.23	2.29	2.33	2.34	2.27	2.28	2.29	2.26	2.11	2.29	2.26	2.29	2.23	2.29

AVERAGE DAILY LIGHT THRESHOLD FOR EACH EXPERIMENTAL GROUP

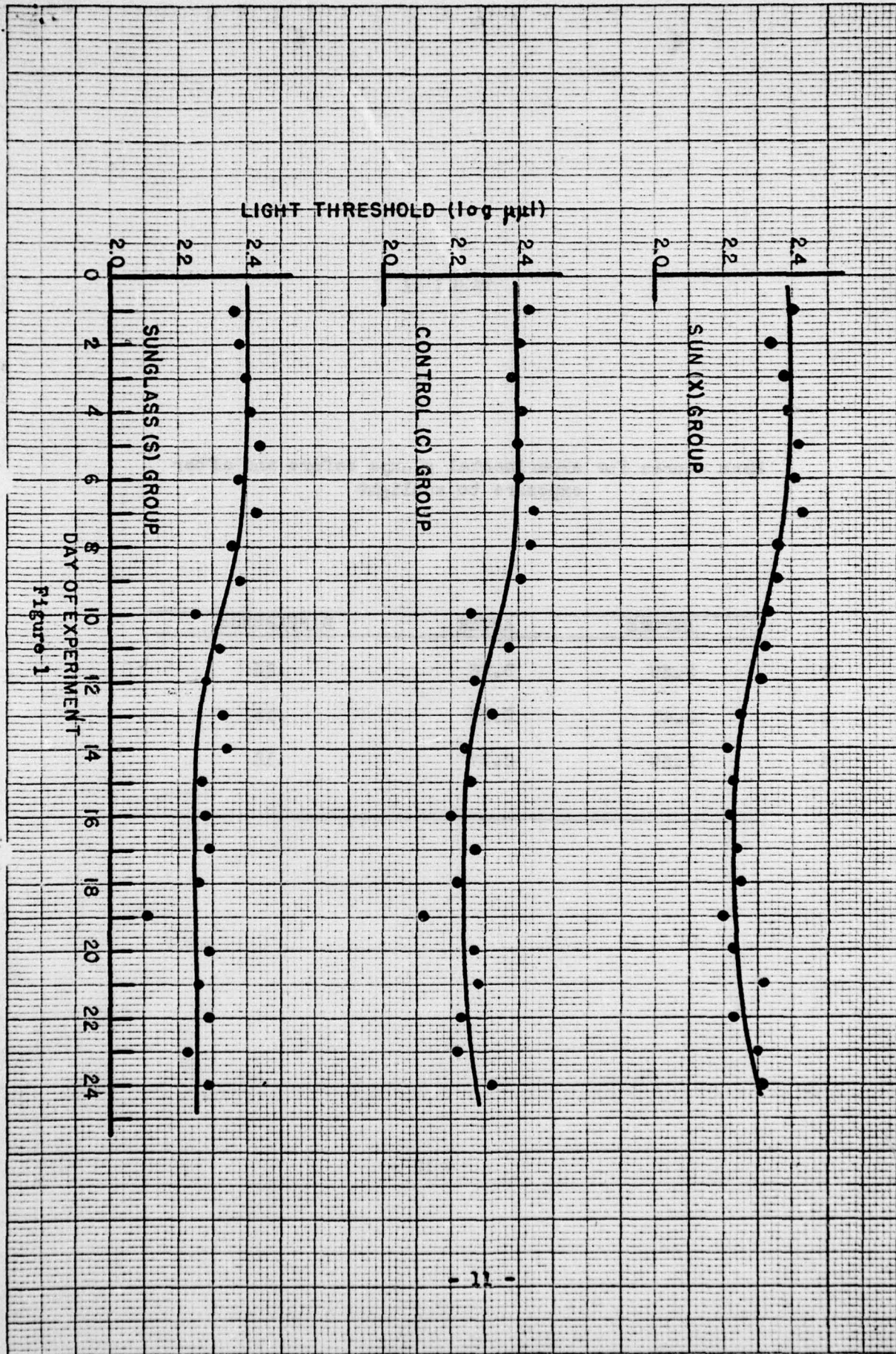


Figure 1

TABLE II

Mean scores for experimental groups before and after exposure to sunlight

	BEFORE	AFTER	DIFFERENCE
X	2.39	2.26	.13
C	2.41	2.26	.15
S	2.39	2.27	.12