THE EFFECTS OF SODIUM AMYLOBARBITONE AND DEXAMPHETAMINE SULPHATE ON THE PERIPHERAL VISUAL FIELD

By

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In an earlier investigation (Holland, 1960) the peripheral visual field was examined under three treatment conditions, namely meprobamate (2-methyl-2-n-propyl-1, 3 propanediol dicarbamate), Doriden (glutethimide), and no drug. Results from 24 subjects, each tested three times, indicated that there were significant differences, attributable to the treatments, in both the inner and outer discrimination thresholds and also in the magnitude of the interval of uncertainty between thresholds. In the present experiment it has been thought worth while to examine the visual field for the effects of two other compounds, a stimulant dexamphetamine sulphate (Dexedrine), and a depressant sodium amylobarbitone (Amytal).

The Present Investigation

When plotting the extent and sensitivity of the visual field by delineating intensity isopters, the problem for the subject is one of brightness discrimination. The discrimination threshold for the inner threshold is the point at which a judgment of "different" between target and background brightnesses can be made, and the outer threshold is the point at which an existing difference can no longer be resolved (Sharples, 1946; Mann, 1946). The present investigation can therefore be viewed in two ways: (*a*) the extent of the visual field; and (*b*) brightness discrimination changes; due to the action of the drugs used.

The number of meridians examined in the present investigation has been reduced from the earlier study. The nasal visual field has been ignored because of "nose plotting" and the upper and lower temporal field disregarded because of individual differences in lid, brow and cheek positions. In all other respects the present procedure is comparable with previous work.

Subjects

There were 6 subjects, each seen on three separate occasions. They were all female, aged between 19 and 24 years. Not less than one and not more than four hours elapsed between taking the drug and being tested.

The Drugs

There were three treatments comprising two drugs and a placebo. All the capsules were identical in appearance and contained either dexamphetamine sulphate 10 mg., sodium amylobarbitone 3 grains (approximately 200 mg.), and a placebo. The treatments were administered according to a double latin square design, randomizing the orders in which they could occur and thus equating for differential practice effects.

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The Instrument

The perimeter employed was a commercially available Goldman projection perimeter,* which was modified to allow accuracy of direction while keeping the eye under continuous scrutiny. As normally supplied, accuracy of direction along the meridians is impaired unless some sacrifice is made of the continuous observation of the eye, or *vice versa*. By a small modification which involves the construction of a plastic channel, pivoted at a point near the centre, a specific spot along any meridian can be repeated while observation of the eye is maintained. The modification is useful in increasing the reliability for research purposes, it may not be necessary for ordinary ophthalmic uses.

Procedure

The subject was seated at the apparatus and gross adjustments made. The head was strapped to the combined chin and head rest and depth of penetration of the face adjusted. Owing to differential face reflection the bowl illumination was set before each examination by use of filter and photometer screen. From the time that all adjustments had been made, a period of 4 minutes was allowed for light adaptation to the bowl level before testing began.

The subject reported the appearance or disappearance of the target light ($\cdot 25$ mm^2, relative intensity = $\cdot 310$) by depressing a morse key with her right hand, which in turn illuminated a small bulb in front of the experimenter.† Practice trials were given on the first day until the subject was thoroughly conversant with the procedure, after which the incoming trials were plotted first, in random order, followed by the outgoing trials. In all, ten meridians of the left temporal field were tested, i.e. every $7 \cdot 5°$ between 210° and 135° inclusive, with the exception of the 180° meridian which was omitted for mechanical reasons.

Results

The results of testing are presented in Tables I–III. Table I presents the means of the inner and outer threshold scores for the ten meridians measured. An examination of the scores by analyses of variance showed that there are no significant differences between drugs in the *inner threshold*, i.e. means = Placebo $65 \cdot 5$, Dexedrine $65 \cdot 3$, Amytal $65 \cdot 5$, F = $\cdot 0644$, but that there are highly significant differences due to drugs in the *outer threshold* scores. The outline of the analysis of outer threshold scores is presented in Table II. Three significant variances emerged, namely, those for people, treatments and trials, the first being individual differences in field size, the second defining the drug effect, and the third outlining the differential sensitivity of the meridians explored. When the total drug variance was broken down for paired comparisons only Placebo/Amytal and Dexedrine/Amytal could be discriminated with the required degree of confidence.

An analysis of the *interval of uncertainty* scores is presented in Table III. This score is derived by subtracting the inner threshold from the outer, along each of the ten meridians. In this analysis only two significant F ratios appear, those for *people and treatments*, both achieving the 1 per cent. level of confidence. The trial means for the interval of uncertainty were Placebo = $7 \cdot 283°$,

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† This method of reporting obviated the head movement which occurs when the head is strapped to the chin-rest and a verbal response is required.

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TABLE I

Perimetry

Trial Means

Inner Threshold

Subjects	Placebo	Dexedrine	Amytal
1	71·7	71·8	71·2
2	66·9	66·4	64·8
3	65·5	67·4	68·1
4	68·5	68·4	67·8
5	66·6	65·2	67·4
6	53·9	52·8	53·8
Means	65·5	65·3	65·5

Outer Threshold

Subjects	Placebo	Dexedrine	Amytal
1	77·3	76·5	78·9
2	71·3	69·7	73·0
3	73·8	73·9	77·3
4	78·0	79·2	80·9
5	72·9	71·9	76·4
6	63·2	60·8	65·2
Means	72·8	72·0	75·3

TABLE II

Perimetry

Outline of analysis of variance of *outer threshold* scores

Source	D.f.	M.S.V.	F.	P.
Between people	5	999·98	80·98	1%
Between treatments	2	177·61	14·38	1%
Between trials	9	825·08	66·81	1%
Between orders	2	2·27	0·18	—
Residual	161	12·349		
Total	179			

t, Placebo-Dexedrine = 1·168; N.S.
t, Placebo-Amytal = 3·940; 1%
t, Dexedrine-Amytal = 5·108; 1%

TABLE III

Perimetry

Outline of analysis of variance of *interval of uncertainty* scores

Source	D.f.	M.S.V.	F.	P.
Between people	5	141·94	26·49	1%
Between treatments	2	160·34	29·92	1%
Between trials	9	3·63	0·68	N.S.
Between orders	2	8·34	1·56	N.S.
Residual	161	5·359		
Total	179			

t, Placebo-Dexedrine = 1·418; N.S.
t, Placebo-Amytal = 5·871; 1%
t, Dexedrine-Amytal = 7·289; 1%

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Dexedrine = 6·683°, and Amytal = 9·767°, t tests between them again indicating that although Placebo/Amytal and Dexdrine/Amytal differences were highly significant there was no difference between Placebo/Dexedrine.

Finally, as a check on whether there is a consistent change in the *interval of uncertainty* with a change in the target intensity, which is also effected by drugs, inner and outer thresholds were determined along a single meridian (187·5°) at three relative intensities (·030, ·096, ·310). The means for the three intensities independent of drug were: intensity 1 = 16·388°; intensity 2 = 9·555°; intensity 3 = 7·555°. When the three means are averaged for the drug conditions they result as follows: Placebo 11·111°; Dexedrine 9·388°; and Amytal 13·000°.

An outline of the analysis of variance of the scores is presented in Table IV. The main significant variance is again attributable to the drug effect, this time, however, only a t test between Dexedrine/Amytal gives a difference which is significant.

TABLE IV

Perimetry

Outline of analysis of variance of *intensity isopter interval of uncertainty* scores

Source	D.f.	M.S.V.	F.	P.
Between people	5	10·12	0·92	N.S.
Between treatments	2	58·72	5·32	1%
Between trials	2	386·17	34·98	1%
Between orders	2	10·72	0·97	N.S.
Residual	42	11·04		
Total	53			

t, Placebo-Dexedrine = 1·555; N.S.
t, Placebo-Amytal = 1·705; N.S.
t, Dexedrine-Amytal = 3·260; 1%

SUMMARY AND CONCLUSIONS

The results of the present investigation differ slightly from the findings of the earlier study. In the earlier investigation both the ataractic, meprobamate, and the hypnotic, glutethimide, reduced the extent of the inner threshold of the visual field compared with the control, no-drug, condition. In this present study neither of the drug treatments changed the inner threshold sufficiently to produce a reliable difference. The outer threshold changes, on the other hand, are consistent with earlier findings, namely, the depressant drug Amytal has extended the visual field compared to the Placebo treatment. Again, as in the earlier study, the difference between the inner and outer threshold (the interval of uncertainty) demonstrates a profound change, attributable to the drugs. Finally, when the increase in the interval between thresholds is examined in relation to increasing target intensity, drug effects also emerge which indicate that Amytal enlarges the interval whereas Dexedrine narrows it.

The finding of an interval of uncertainty drug effect implies one of two possible explanations: (*a*) a slowing of motor response in reacting to decreases in stimulus intensity; or (*b*) some change in the sensory scale of discrimination of brightness differences; both explanations being based upon the central action of the drugs. The first of these explanations was considered after the first study but rejected owing to its incompatibility with other test findings

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which required rapid responses. However, other authors who have been concerned with visual field reductions, under conditions of anoxia (Ikui, 1947), do not reject the possibility of general response slowing. The second explanation would involve an investigation of the psychological changes which may follow drug ingestion. Both explanations are, of course, questioned due to the finding that the drug effects only appear to manifest themselves to a decreasing intensity, i.e. an outgoing stimulus.

Finally, the present method of measurement does not permit discrimination between explanations as, clearly, the two factors of discrimination and response are confounded. An alternative method is called for in which brightness discrimination is not influenced by speed of response. Such measurements are available in the constant methods and future experiments will be attempted by their use. If drug effects can be demonstrated as inducing changes in psychosensory continua, integration into general psychological theory seems possible.

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