D-AMPHETAMINE AND AMYTAL: I. EFFECTS ON MEMORY AND EXPRESSIVE MOVEMENT

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INTRODUCTION

"WE would predict that any test which has been shown to differentiate reliably and validly between introverts and extraverts will, when applied to subjects who have been administered an excitant (or depressant) drug, show shifts in scores in the direction characteristic of greater introversion (or extraversion)." ". . . the effects of depressant drugs are similar to those of brain damage as far as objective psychological tests are concerned. Conversely, the effects of excitant drugs are opposite to those of brain damage." These predictions by Eysenck (7) were tested using measures of immediate memory and expressive movement which had previously been validated against extraversion and brain damage. The measures discussed are derived from the Figure Reconstruction Test (immediate recall version).

Using Eysenck's equation of hysteria and brain damage with drug sedation the following predictions may be derived. Firstly, brain damage is known to be associated with *memory* defect. As far as the FRT is concerned, this has been demonstrated in that subjects with a known history of brain damage made considerably more errors than neurotics and non-neurotics (Bartholomew, 1). Furthermore, electroshock treatment significantly impaired memory (Brengelmann, 2). Persons to whom *amytal* is administered should therefore score *higher on error* than drug-stimulated persons.

On the other hand, it has been shown that, although not significantly so, a number of groups of extraverted subjects scored consistently lower on error than the introverts, using the learning version of the FRT (Brengelmann, 3). Secondly, employing the immediate recall version of the FRT, as used in the present experiment, extraverted male and female neurotics scored considerably lower on error than the introverts (Brengelmann, 6), provided a short exposure time was used. From this the prediction is made that *amytal decreases error*. These two opposing predictions show forcefully that Eysenck's theory on drug action is over-simplified.

Turning to *expressive movement*, as spontaneous or other acts accompanying involuntary movements, one would naturally expect sedatives to exert a calming effect. When referring to the literature, it has been pointed out that sedatives probably decrease movement variability and improve steadiness (Brengelmann, 5). As far as the presently used FRT is concerned it was found that hysterics, or "extraverted" neurotics, were significantly and consistently more variable in drawing than the dysthymics, or "introverted" neurotics (Brengelmann, 4). Furthermore, the present author has found that the application of electroshock leads to a considerable increase in variability on the FRT. These results are being prepared for publication. Consequently, Eysenck's association of hysteria with brain damage remains, in this respect, tenable.

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The prediction to be made is that subjects should become more variable as the result of sedation.

Reference must be made at this point to one further test score, used in the present study, called *spread*, or the scatter of test items in drawings. Although logically similar to variability, this score is listed separately for various empirical reasons. It was previously shown that spread was consistently larger in hysterics, as compared with dysthymics (4). The prediction, correspondingly, would be that spread is highest for amytal.

Summarizing the predictions made from Eysenck's theory, disregarding the factual evidence, the following statement may be made. *As a result of the administration of amytal, memory error, expressive movement variability, and spread scores will be significantly higher than after the administration of d-amphetamine.*

METHOD

1. *The Figure Reconstruction Test (immediate recall version)*

As the principles of this technique have already been described, a short reference will suffice here (3, 4, 5). Five simple geometric shapes, distributed around a central circle, are exposed and drawn from memory (Fig. 1). *All* shapes must be reproduced. One test set consists of ten stimuli. Most of the scores are obtained with the help of the central ring, printed on the response sheets.

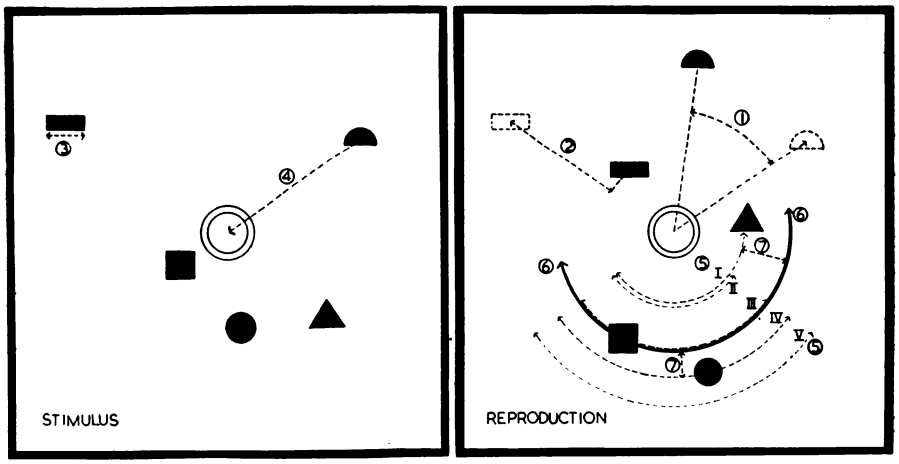


FIG. 1.—Example of stimulus card and moderately distorted reproduction. *Error scores:* 1. Rotation error. 2. Distance error. *Expressive movement scores:* 3. Size. 4. Distance. 5. Distance ranges I–V. 6. Mean distance (pattern mean). 7. Spread. Shapes drawn in dotted line in the reproduction indicate stimulus position.

In the present experiment a constant exposure time of one second was used, controlled by a compur shutter. The test cards were shown against a black background. A short exposure time was chosen in order to achieve a reasonable amount of error in the reproductions. Additionally, it is now known that an exposure time of this order favours the occurrence of differences between extraverts and introverts, whereas long exposure fails to do so (6). Unfortunately, some of the expressive movement characteristics, to be investigated, emerge more clearly under different exposure conditions. Variability scores appear to be favoured by very short and spread by long exposure time (5). As the same

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subjects were tested by other experimenters there was not sufficient time to vary exposure duration. Nevertheless, results will show that a conclusion could be drawn despite adverse conditions.

2. *Scores*

Scores hitherto derived from the FRT are described in Figure 1 and the following:

Rotation error: mean axial displacement of the individual stimulus elements, measured in degrees (No. 1 in Fig. 1).

Distance error: radial, either centrifugal or centripetal displacement, measured in mms. (2).

Size: mean base length of reproduced shapes in mms. (3).

Size variability within shapes (*SV within*)*:* mean variability of size between successive trials, scored separately for each category of shape (triangle, cross, etc.), in 1/10 mms.

Size variability between shapes (*SV between*)*:* mean size deviations of the ten shapes from their mean, in 1/10 mms.

Distance: mean distance of shapes per trial from the centre of the reproduction sheet (6).

Distance variability between patterns (*DV pattern*)*:* between trials variability of distance (6) in 1/10 mms. or, the mean deviation of a given number of distance scores from their mean.

Distance variability within ranges (*DV ranges*)*:* identical with the preceding score, except for measuring separately at each of the five distances, or ranges (5, ranges I–V), at which S's choose to draw on the response sheet.

Distance spread: mean deviation of shapes from the mean distance within trials, as measured in mms. (7).

In addition to rotation and distance error, two more error scores were used. These are "*rotation proportion*", or the mean axial deviation in degrees of each reproduced shape from the *nearest* stimulus shape. (Rotation error, in contrast, measures same deviation of each reproduced shape from the *identical* stimulus shape.) Similarly, "*distance proportion*" measures the mean radial deviation in mms. of each reproduced shape from the *nearest* instead of identical stimulus shape.

Variability measures were used as ratios, as follows: SV within/size, SV between/size, DV pattern/distance and DV ranges/distance. Similarly, the distance error scores were, for each subject, divided by distance. It is obvious that the former depends heavily on the latter.

3. *Subjects*

There were six normal subjects, five men and one woman, all, with the exception of one technician, psychologists. The age range was 25 to 39, with a mean of about 30.

4. *Design*

The experiment was conducted concurrently with those reported by Eysenck and his co-workers (8, 9, 10, 11), using identical subjects and conditions. Drugs were given orally and consisted of 10 mg. d-amphetamine, 4½ grains sodium amytal and a placebo. Tests took place on three different days using a balanced randomized block design to control for sequence effects. For greater detail the writer may refer to the above papers.

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Before beginning the experiment, subjects were given three sets of tests in order to familiarize them with the task and to reduce practice effects. With three practice and three experimental tests a total of six parallel test sets had to be constructed. The experimental tests were systematically varied so as to avoid sequence effects.

RESULTS

1. *Immediate memory.* The mean scores were as follows:

	Amphetamine	Amytal	Placebo
Rotation error	37·4	41·2	39·7
Distance error	14·6	14·0	14·3
Rotation proportion	17·2	19·3	20·5
Distance proportion	7·4	6·8	7·1

As can be seen, means vary at random with treatments. Applying independent t-tests of related measures, the largest t-ratio between any pair of drugs was 0·790 (5 d.f.), which is not significant. It may be concluded that no significant differences were obtained relating systematically to drug treatments.

2. *Movement variabilities.* Results are shown in Figure 2, with the group means added in Table I.

TABLE I

Group Means Belonging to Figure 2

	D-amphetamine	Amytal	Placebo
Size variability (between)	4·43	3·78	4·13
Size variability (within)	2·43	2·45	2·57
Distance variability (pattern) ..	16·33	11·83	15·33
Distance variability (ranges) ..	11·83	10·83	11·67

Analysis of variance was used for all test scores. The between persons and between drugs variances were tested against the residual, as shown in Table II for distance variability (pattern).

TABLE II

Analysis of Variance of Distance Variability (Pattern) Score

Distance Variability (Pattern)	d.f.	s.sq.	m.sq.	F-ratio	Significant (Per cent.)
Drugs	2	67·000	33·500	4·855	5
Persons	5	132·500	26·500	3·841	5
Residual	10	69·000	6·900		
Total	17	268·500			

Total results of the analysis of variance are presented in Table III.

TABLE III

Results of Analysis of Variance Pertaining to Figure 2

F-ratio	Drugs	Persons
Size variability (between)	4·922 (5%)	153·713 (0·1%)
Size variability (within)	NS	18·021 (0·1%)
Distance variability (pattern)	4·855 (5%)	3·841 (5%)
Distance variability (ranges)	2·627 (NS)	5·017 (5%)

D.f.: drugs 2/10, persons 5/10.

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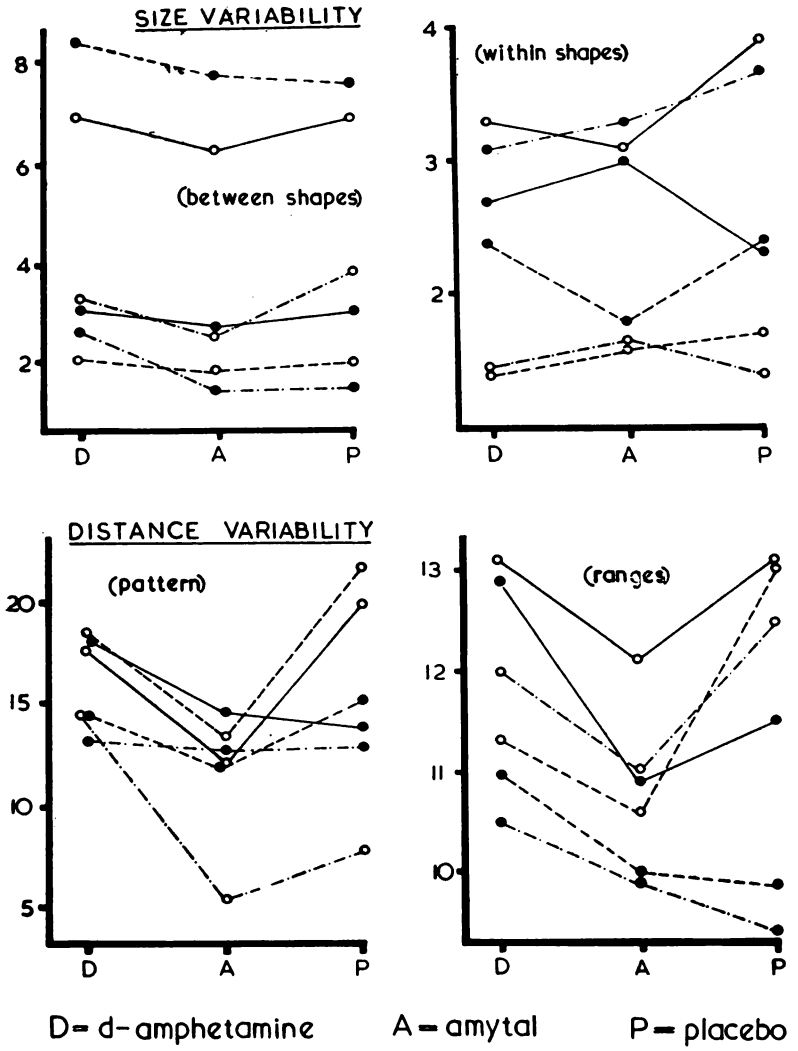


FIG. 2.—Four variability scores as related to drugs. Curves represent individual subjects.

As can be seen from Figure 2, all subjects scored higher with d-amphetamine than with amytal on three test scores, the remaining one being inconsistent in this respect. t-test analysis of the significant scores revealed differences between amphetamine and amytal to be significant at the 2 per cent level of confidence. The conclusion is drawn that amytal significantly decreased involuntary movement variability, as measured by the FRT. Additionally, it should be noted that the mean variability scores, with the exception of the least significant score, increased in the order amytal-placebo-amphetamine, indicating that opposing drug actions are indeed measured.

3. *Spread.* With an F-ratio of 6·066 (d.f. 5/10) differences between persons were significant (1 per cent.). As to drugs, the mean variance for the residual was higher than for drugs. The conclusion is that no significant differences

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were found due to drugs. The mean scores were 22·8 (amphetamine), 24·3 (amytal) and 24·7 (placebo).

Discussion

The results on *memory* do not support the predictions made from Eysenck's theory, although an exposure time favourable to the production of differences between extraverts and introverts was chosen. As LSD was previously shown to produce considerably higher rotation error than amytal (5), a comparison with the presently used stimulant may be of interest. The suggestion may be derived that differences in drug action between LSD and d-amphetamine may be measured with a memory test. Results regarding *variability* were, in agreement with the literature, found to be contradictory to Eysenck's theory. As to *spread*, again, no support can be drawn for the prediction made. In this case it may be argued that a longer exposure time was needed for significant differences to occur.

The criticism may be made that predictions for the test scores used cannot be derived from Eysenck's theory of extraversion. This, however, is of little importance as predictions could be made on the basis of empirical results, which is obviously superior to speculation.

A joint consideration of the experiments performed by Eysenck and his co-workers (8, 9, 10, 11) and of those by the present author suggests that, at present, the results obtained with amytal and amphetamine are better understood on the basis of the implied pharmacological actions than from personality theory point of view. Eysenck, in his introductory paper on methodology on drug research (7) has apparently relied too heavily on Shagass' (12) reports that "sedation threshold" discriminates neurotic categories as expected from Eysenck's theory of extraversion. The high reliability, quoted by Shagass, appears suspect in view of a recent study directed to this point. Thorpe and Barker (13), copying Shagass' technique, asked 16 psychiatrists to note the point, in tape records, at which slurred speech definitely occurred. The conclusion was that "speech slurring is too subjective to be of general use, and that some doubt is thrown on the objectivity of the Sedation Threshold".

Summary

Eysenck's theory that the effects of drug sedation are those of increased extraversion, whereas stimulant drugs decrease scores related to this factor, was tested using memory and expressive movement scores of relevant validity. On memory scores, neither significant nor consistent differences were found between amytal and amphetamine. Movement variability was reliably higher with amphetamine than with amytal. Findings were interpreted as either not supporting or as contradictory to Eysenck's theory of drug action.

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