DRUGS AND PERSONALITY

IX. THE EFFECTS OF STIMULANT AND DEPRESSANT DRUGS UPON VISUAL FIGURAL AFTER-EFFECTS*

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1. INTRODUCTION

FIGURAL after-effects are the observable results of a hypothetical process of satiation or inhibition which accompanies and follows the passage of neural currents consequent upon stimulation. Most of the work in this field has been on figural after-effects affecting contours. In this work an inspection figure is fixated for a fairly lengthy period of time; this is then withdrawn and two test figures are substituted. One of these test figures falls within the same area as the inspection figure while the other is well removed from this area. Differences in size between the two figures which are objectively equal are usually observed and are supposed to be a consequence of satiation set up by the inspection figure (McEwen, 1958).

Other effects also may be observed and made the basis of measurement. Thus when a bright inspection figure is fixated for any length of time and is then withdrawn, then a test figure exhibited in the same region should look rather darker, as a consequence of satiation, than an equally bright test figure exhibited elsewhere. In this experiment we have used both of these phenomena, i.e. size effects and brightness effects, for the measurement of satiation.

Satiation phenomena have been brought into connection with personality in terms of a general hypothesis identifying satiation with the more general concept of reactive inhibition (Eysenck, 1957); it follows from this identification that extraverts under conditions of equal stimulation should show greater figural after-effects than introverts. This hypothesis has proved difficult to test because of difficulties encountered in ensuring equal stimulation. Experiments of this kind require visual fixation for several minutes, and the structures involved in maintaining fixation are also subject to inhibition. As this inhibition is again supposed to be greater in extraverts, these would tend to be poorer at fixating than introverts and would consequently receive less stimulation during equal periods of time, thus leading to the prediction that because of the lower degree of stimulation thus received, extraverts would show weaker figural after-effects. It is also possible that extraverts would receive less stimulation because satiation would soon block the perceptual pathways, thus reducing the amount of stimulation received by them as compared with introverts.

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Fortunately these contradictory predictions can be reconciled by realizing that the satiation which gives rise to figural after-effects sets in rather quickly, possibly within a matter of milliseconds, while reactive inhibition sets in rather slowly, possibly in a matter of minutes. The prediction would seem to follow that when inspection periods are short, extraverts would show greater figural after-effects. When inspection periods are long, introverts would be expected to show greater figural after-effects. With intermediate periods no great difference would be expected (short in this connection means 30 seconds or less; long means 3 to 4 minutes). The evidence on these predictions has been reviewed elsewhere (Eysenck, 1960) and appears to support the hypothesis. Unfortunately different types of subjects and different experimental regimes were used in the different studies so that it is impossible to be certain at the moment whether or not the data do in fact prove the hypothesis.

Similar considerations affect the predictions which may be made about drug effects in relation to satiation. Depressant drugs would be expected to increase the size of figural after-effects, while stimulant drugs would be expected to decrease them. Again we would expect complications to arise from the fact that fixation too would presumably be affected by the drugs in a compensatory manner, and further complications may arise from the fact demonstrated in a previous paper that iris size is also affected by the drug, thus changing the amount of light admitted by the eye (Eysenck and Easterbrook, 1960). In these circumstances no very confident prediction can be made but clearly an exploration of the field may serve to set the stage for further experiments.

2. The Experiment

Details of drugs, experimental design and subjects have been given in a previous paper (Eysenck and Easterbrook, 1960). Eight subjects in all were tested under four drug conditions (d-amphetamine sulphate, sodium amylobarbitone, meprobamate, and a placebo), under an experimental design which ensured that each drug would be given once after each other drug and in each serial position. The experimental design, a balanced incomplete block, was completed twice, once for the subjects seen in the morning and once for those seen in the afternoon. The test under discussion here was only one of several applied to the same group of subjects under the same conditions.

(a) *Brightness matching* was carried out in a manner designed to evoke satiation effects (Eysenck and Holland, 1958). The subject sat with his head on a chin-rest seven feet from a screen that had a faint red light in its centre. On to this screen were projected two semi-circles of light, which made a smooth junction vertically through the middle of the red light. The brightness of the right-hand light was variable by either the subject or the experimenter, that of the left-hand or standard light by E alone. In a dark room, after he had been dark-adapted* and instructed, the subject was required to make two matchings of the standard (1·5 lumens) patch while fixing the red light with the right eye, the other being masked by a shield on the head-rest, and then to make two more with the left eye. In each case the luminance of the variable patch was alternately set too high or too low by approximately one lumen, and the accuracy of match was read off a galvanometer. The subject was then instructed to close his eyes while E blocked off the variable semi-circle and raised the luminance of the standard to 2·5 lumens. S then stared at the fixation point for one and a

* Using the Admiralty RL Adaptometer MKIA with the indicator set at 1 and an aperture of 15.

half minutes with one eye, then, after appropriate readjustments, made two further matches with the alternate eye. This additional stimulation was presented once to each eye. The readings taken were the differences, expressed in galvanometer readings, between the intensity of the two lights. (For a more detailed description of the apparatus and methodology, and the underlying theories, see Eysenck and Holland, 1958.)

(b) *Size matching* was carried out according to the same programme as brightness matching, and with the subject seated in the same position. The apparatus consisted of two cathode ray tubes, one above the other, facing the same way as the subject and visible to him in a mirror, at a net distance of 18 feet. On each tube was projected a circle of variable diameter, subject to control in the manner described above. A red light was situated midway between the two tubes. The standard stimulus was set at a diameter of 6 cm. for matchings and at a diameter of 7 cm. during the satiation period, which lasted for two minutes on each occasion. In this case too the "experimental" measures were taken with the alternate eye so that retinal effects were excluded and would not be registered as evidence of satiation. The readings recorded were differences expressed in galvanometer readings between the sizes of the two circles. (For a more detailed description of the apparatus and methodology, and the underlying theories, see Eysenck, 1960.)

3. Results

In the brightness matching test, on the assumption that satiation of the projection areas tends to reduce phenomenal brightness, the additional exposure of the standard stimulus at increased intensity was expected to cause the subject to set the intensity of the variable stimulus lower to match a phenomenally duller standard. In the circles matching test, additional stimulation with an over-sized standard was expected to cause a phenomenal displacement of the standard which would be reflected in smaller subsequent settings of the variable stimulus. These expectations were not borne out by the results which are shown in Table I, nor was there any relation between changes in variable stimulus setting and treatment, except for a tendency for the variable circle to be set larger in the descending matches under amytal treatment ($F=21\cdot2$ with 3/3 d.f.).

Table I

Brightness Matching Scores: 4 Pre-stimulation Trials Minus 4 Post-stimulation Trials in Arbitrary Units Excess of Standard Over Variable Illumination

	Placebo	Amphetamine	Amytal	Meprobamate
Block 1	9·5	10	1	2
Block 2	6·75	·25	3	21·25
Sum block	8·12	5·12	2	11·62

Size Matching Scores: 4 Pre-stimulation Trials Minus 4 Post-stimulation Trials in Arbitrary Units Excess of Standard Over Variable Size

	Placebo	Amphetamine	Amytal	Meprobamate
Block 1	−8	4·75	5·25	−7·50
Block 2	−4·5	5·5	−2·75	−15·25
Sum block	−6·25	5·12	1·25	−11·38

Results of analysis of variance: N.S.

Satiation dissipates with time. The first matches made after experimental stimulation ought therefore to be more likely to show the expected changes than later matches. The points of subjective equality (PSEs) and the intervals of uncertainty* for the control and first experimental settings on the brightness matching and size matching tests under the four treatments are shown in Table II. The data are presented as arbitrary dial readings representing excess of variable stimulus brightness or size over standard stimulus settings. Four points are evident in this table. First, errors in control settings vary with treatment in a consistent manner as between tests. Second, the differences of control settings made under the amylobarbitone treatment from those made under other treatments are similar to the differences of experimental from control settings for the other treatments (amytal is associated with similar errors to those arising from experimental stimulation). Third, the difference between control and experimental settings is markedly divergent under amytal from what it is under other treatments. Finally, in the size matching test under all treatments except amytal the difference in PSE between experimental and control treatments tends to take the predicted direction, but under amytal (and in all treatments on the brightness matching test) the difference has the opposite sign to that predicted.

TABLE II

Visual Matching Test Results in Units Excess of Variable Over Standard Settings

	Treatments							
	Placebo		Amphetamine		Amytal		Meprobamate	
	PSE	IU*	PSE	IU	PSE	IU	PSE	IU
Brightness Matching:								
Control	−8·81	8⅜	−9·94	6¼	−6·75	6¼	−10·87	10⅞
Experimental ..	−4·19	17⅜	−6·38	11¾	−6·75	6¼	−8·37	6½
Difference E–C ..	4·62		3·56		0·00		2·50	
Size Matching:								
Control	6·56	15	6·69	9⅞	3·00	10	8·12	16¾
Experimental ..	4·69	13⅜	4·87	10½	4·87	13¼	7·87	10¾
Difference E–C ..	−1·87		−1·82		1·87		−0·25	

* Interval of Uncertainty. The difference between the average setting in the ascending order of adjustment and the average setting in the descending order.

It may be supposed that the effect of stimuli on performance in visual matching tasks would be related to the amount of light admitted to the retina—i.e. to iris size. That this is a tenable interpretation of the variations in control settings in the visual matching task is shown by the calculations displayed in Table III. There are shown, for the four treatments, the errors in control settings as percentages of the sum across treatments, together with iris sizes similarly expressed as percentages. The iris sizes have been treated (by subtraction of a constant 80 per cent. of the standard size from the means in Table 2 in the paper dealing with effects of drugs on the pupil—Eysenck and Easterbrook, 1960) to emphasize the variance between treatments. The agreement of these two sets of ratios suggests that the experimental stimulation was not equated as between treatments.

* The differences between the thresholds determined in the ascending and descending orders.

TABLE III

Relation of Visual Matching Errors to Iris Diameters

	Treatments			
	Placebo	Amphetamine	Amytal	Meprobamate
Control settings as ratios of totals across treatments:				
Brightness matching	24·2	27·3	18·6	29·9
Size matching	27·2	26·9	15·0	31·0
Mean	25·7	27·1	16·8	30·4
Iris sizes (−k) as ratios of total across treatments	26·0	28·5	16·0	28·5

The effect of the experimental stimulation on the errors of adjustment in the two visual matching tasks can be estimated in a way which compensates to some extent for the inequalities of stimulation. This is done by expressing the experimental settings under each treatment as ratios of the control settings under the same treatment. These calculations are displayed in Table IV, and they show that the reduction of initial error that occurs on the subsequent experimental settings is proportionately greatest with the placebo treatment,

TABLE IV

Visual Matching Test Results

Experimental Error per Unit Control Error as Ratios of Totals Across Treatments

	Treatments			
	Placebo	Amphetamine	Amytal	Meprobramate
Brightness matching	15·2	22·6	35·2	27·1
Size matching	18·9	19·8	35·6	25·6
Means	17·0	21·2	35·4	26·4

least with amylobarbitone. The effect of treatments is significant overall ($F=44·2$ with 3/4 d.f.) but the differences between amphetamine treatment and either the placebo or meprobamate treatments are not. This, of course, is not a predicted relationship; amytal affects the difference in setting between control and experimental conditions but in the direction opposite to the prediction.

4. DISCUSSION

It cannot be said that the results bear out the expectation that depressant drugs would increase figural after-effects; while stimulant drugs decrease them. This may in part be due to the fact that the inspection time chosen (90 seconds in one case, 120 seconds in the other) was badly chosen from the point of view of the theory under investigation; much shorter periods would have been more appropriate. This was not realized when the experiment was designed and makes the results equivocal at best.

Another difficulty which arises in work of this kind and which may give rise to apparent contradiction, relates to the practice of using ascending and descending orders of presentation.

One of the earliest interpretations of figural after-effects to which Kohler's

satiation theory was opposed was that of "adaptation to the norm" (Gibson, 1933). Although applied originally in the context of perception of curved lines, this type of argument can be extended to many other perceptual tasks. Helson and co-workers (Helson, 1948; Michels and Helson, 1949, 1954) have elaborated an "adaptation level theory" which is said to predict changes in absolute and comparative judgments as a result of differences in the order of presentation of different stimulus values. Accordingly the experiments reported above were designed in such a manner that any after-effects demonstrated would be virtually independent of the order in which extremes on the continuum of variable (or comparison) stimuli were experienced.

The desired control against order effects was imposed by alternating directions of approach to the PSE on the comparison scale. This procedure may be said to have two sorts of effect: (*a*) it confounds order effects more or less effectively, and (*b*) it confounds the effects of "self-satiation" with the comparison stimulus (as Kohler and Wallach have described satiation due to experience with the test figure). On the other hand the distinction reflected in this statement may be invalid. Order effects and self-satiation effects may be identical. In fact satiation may be the mechanism of the adaptation which Gibson's (1933), Helson's (1948) or Johnson's (1949) theories describe—as Walker has suggested may be the case with the mechanism of the comparable reactive inhibition and that of increments to habit strength (1956).

In rationale the procedure used consists in stimulating an "experimental" cortical area in such a way as hypothetically to produce for instance an enhancement of the value of another stimulus subsequently presented to the same area. This change is then checked by approaching PSE with a similar but graduated stimulus projected on to another cortical area, *alternately from the end of the comparison scale which induces the same, and the end which induces the opposite, overt effects of satiation as those expected from the experimental stimulation.* It can be seen that success in demonstrating figural after-effects by this method is dependent on (*a*) inducing effects that will retain demonstrable magnitude until the comparative measures have been made, and (*b*) a perfection in counterbalancing of order effects which it is impossible to check by known means.

In view of the speed of dissipation of figural after-effects (e.g. Hammer, 1949), it is considered desirable to arrange the order of experience with the comparison figure deliberately so that self-satiation (or order effects) would operate to produce the same sorts of change in performance as those produced by satiation with the inspection figure. Thus in the test for Kinaesthetic Figural After-effect, the PSE on the comparison figure should be approached from the thin end if a wide inspection figure has been used with the expectation of inducing a shift of PSE towards the thin end of the wedge. The effect of self-satiation in the control area and the effect of satiation in the experimental area should then operate to produce the same sorts of change in judgment. Opposed to the apparent advantage of this method in rendering the phenomenon easier to investigate, is the dubious fault that it leaves open the possibility that the effects produced could be attributed to other causes. This fault is "dubious" because the "alternative" theories seem to operate at different levels of analysis, so that they are not competitors of the more fundamental satiation theory.

It is interesting to note that the results throw some light on perceptual errors quite independent of satiation and figural after-effects. Errors in control settings can be seen to follow with treatment for both the experiments; they are smallest for amylobarbitone, largest for meprobamate, with placebo and

amphetamine being quite small. It is difficult to account for this in view of the fact that both amylobarbitone and meprobamate are depressant drugs and might therefore be expected to react in the same direction. Here again is a finding where further research will be required before any definitive conclusions can be drawn.

5. Summary

The effects of d-amphetamine sulphate, sodium amylobarbitone, meprobamate and a placebo were investigated with respect to two measures of figural after-effect. The results do not support the hypothesis that depressant drugs would increase figural after-effects, and that stimulant drugs would decrease figural after-effects. It was found that the main effects of the drugs were on errors in control settings, rather than on figural after-effects; these errors were increased most by meprobamate, least by amylobarbitone. Several hypotheses are suggested as to the reasons for the failure of the experiment to support the hypothesis.

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