THE EFFECTS OF MEPROBAMATE ON PERCEPTION

III. THE SPIRAL AFTER-EFFECT

By

C. G. COSTELLO

Institute of Psychiatry (Maudsley Hospital), University of London

A REVIEW of the history and experimental findings relating to the spiral after-effect can be found elsewhere (5) and will not be repeated here. The reliability of the after-effect, the major role played by the cortex in its production and the evidence already obtained that the after-effect is modifiable in accordance with Eysenck's drug action hypothesis (2) indicated it to be a promising test in the investigation into the effects of meprobamate on perception.

The drug action hypothesis states that stimulant drugs increase excitatory potential and decrease inhibitory potential, while depressant drugs decrease excitatory potential and increase inhibitory potential (3).

Eysenck (4) has prepared a detailed theoretical formulation in an attempt to mediate the relationships between the length of visual after-effects (including the spiral after-effect) on the one hand and personality features, drug effects and brain damage on the other. On the basis of his theory he predicts that depressant drugs would shorten the duration of the spiral after-effect.

Meprobamate having been shown to act as a central nervous system depressant (4), it is predicted that the spiral after-effect would be decreased by the administration of meprobamate. Two studies were conducted to test this prediction.

STUDY I

METHOD

The spiral used in both studies is a four-throw spiral of 180°. It is 8¼ inches in diameter and is rotated by a variable speed electric motor controlled through a rheostat. The speed of rotation is set by means of a multiple speed strobe disc built into the back of the housing. The speed used in both studies was 100 r.p.m.

Illumination for the spiral was provided by a 60-watt and 40-watt bulb mounted on a laboratory stand 12 inches from the front of the spiral.

It was found in preliminary experiments reported elsewhere (1) that a photograph of the spiral placed close to the subject tended to produce more reliable results, when used as a projection field, for the after-effect, than when the spiral itself was used as the projection field.

The projection field in both these studies was a photograph of the spiral mounted on stiff black cardboard which was attached to the wall at the right of the subject. The photograph was 3 inches in diameter and the distance from the subject was 27 inches. Thus, the photograph subtended a visual angle equal to that subtended by the spiral which was 6 feet from the subject. An adjustable chin rest ensured that the same distance was maintained from both the spiral and the photograph throughout the studies. Illumination for the photograph was provided by a 40-watt lamp 1 foot away.

After a preliminary trial to familiarize the subject with the after-effect, the following instructions were given: "In a few seconds I shall ask you to close your eyes and I shall set the spiral rotating. When I say 'Ready!' I want you to rest your chin on the chin rest, facing the spiral but with your eyes still closed. When I say 'Now!' open your eyes and fixate the screw in the centre of the spiral. After one minute, the spiral will stop rotating, the lights in front of the spiral will go out and the light on your right will come on. At that point, I want you to turn, keeping your chin on the chin rest, and look at the photograph of the spiral. You will experience an after-sensation of movement. It may be an expansion effect or contraction effect coupled with rotation in the opposite direction. When all the movement has stopped, say 'Now!'."

The length of the after-effect was timed by a stop watch.

Two trials were given—a "contraction trial" followed by an "expansion trial"*. There was a one-minute rest pause between the two trials.

Each subject was given two treatments (1) placebo, (2) 400 mg. meprobamate on two different days, the order of treatments being counterbalanced. Both the placebo and meprobamate were in identically appearing tablet form and taken orally.

On each day the subject was given one session before treatment (initial session) and nine sessions $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 4, $4\frac{1}{4}$ hours after treatment.

In order to investigate the relationship between fixation and length of the after-effect, a test of fixation devised by Holland who presents the rationale for it elsewhere (5) was given immediately after the initial readings of the after-effect and $\frac{1}{4}$, $1\frac{3}{4}$, and $3\frac{3}{4}$ hours after administration of the treatment.

The test consists of rotating the spiral at 600 r.p.m. Any eye movements whether voluntary or involuntary, or due to blinking, produces on the uniform greyness of the disc a "flash" in which part of the spiral emerges and can be seen clearly for a fraction of a second.

The subject was told to fixate the screw in the centre of the spiral which was rotated at 600 r.p.m. for one minute. The number of "flashes" was recorded by means of a telegraph key which the subject pressed for each flash. The key was connected with an Evershed and Vignoles recorder travelling at a speed of one inch every five seconds.

Subjects

The total N in this study was six (four male, two female). They were all post-graduate students of psychology. The age range was from 25 years to 37 years, with a mean of 30·0 years.

Results

Table I shows the results of an analysis of variance carried out to test the significance of the differences between the spiral after-effect scores. It will be seen that two significant F ratios emerge, namely, those for "Subjects" and "Treatments". Figure 1 shows the results in diagrammatic form. It is noteworthy that though the subjects were tested at intervals up to $4\frac{1}{4}$ hours after administration of the treatment, the treatment/time interaction is not significant.

The significant differences indicate that considerable differences exist between people in the spiral after-effect and that, as predicted, meprobamate shortens the length of the after-effect.

* An "expansion trial" is one where a forward rotation of the spiral is followed by an after-effect of expansion. A "contraction trial" is one where a reverse rotation of the spiral is followed by an after-effect of contraction.

TABLE I

Source	Degree of Freedom	S. Squares	Mean Squares	F	P
Subjects	5	3689·684	737·94	411·34	<·001
Treatments	1	9·976	9·976	5·56	<·025
Times	9	11·880	1·320	—	N.S.
Subject/Time	45	60·862	1·352	—	N.S.
Treatment/Time	9	13·879	1·542	—	N.S.
Subject/Treatment	5	8·388	1·678	—	N.S.
Residual	45	80·730	1·794	—	
Total	119	3875·399			

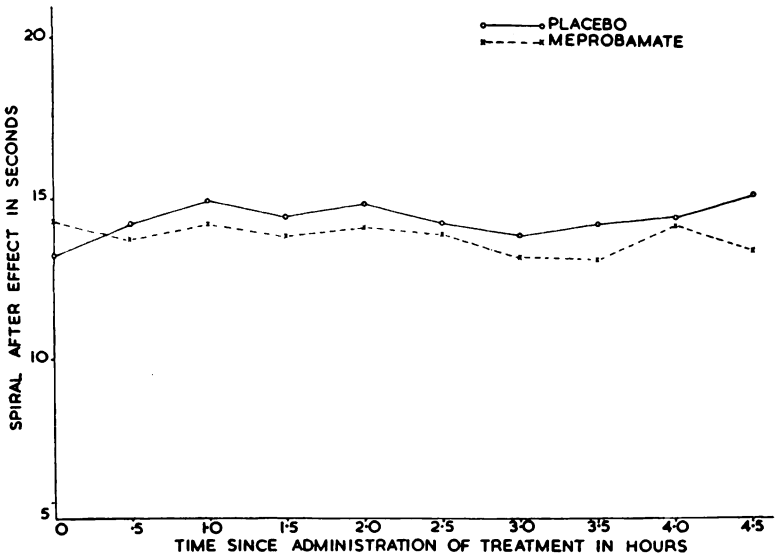

FIG. 1.—Duration of the spiral after-effect in seconds for a group of subjects under drug treatment (Study I).

It may be argued that the drop in the after-effect after administration of meprobamate is due to poorer fixation since this drug is a muscle relaxant. Insofar as Holland's fixation test described above is a valid measure, one would expect both a significant negative correlation between the length of the after-effect and the number of flashes on the fixation test and an increase in the number of flashes after administration of the drug.

The product moment correlation coefficient was calculated for six initial after-effect scores (mean of two trials) and six fixation scores obtained at the same initial session—r = −·35 which is not statistically significant. Table II

TABLE II

	Drug Day	Placebo Day
Initial session	20·166	16·333
¼ hour after administration of treatment ..	20·333	19·166
1¾ hours after administration of treatment	17·500	17·500
3¾ hours after administration of treatment	17·166	19·000

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showing the mean fixation scores for the six subjects at the four sessions on both drug day and placebo day clearly indicates that there is not a greater increase over time in the fixation score on the drug day.

Summary of Study I

Six subjects were tested on the spiral after-effect under two conditions on two separate occasions. The two conditions were (*i*) administration of placebo, (*ii*) administration of 400 mg. meprobamate. Testing on each day was done once before administration of the treatment and ½, 1, 1½, ½, 2½, 3, 3½, 4, 4½ hours after treatment.

A test of fixation was given before administration of the treatment and ¼, 1¾, and 3¾ hours after administration.

The results showed that the spiral after-effect was decreased after administration of meprobamate and that the results could not be explained in terms of poorer fixation after the treatment.

STUDY II

Method

The apparatus used was exactly the same as in Study I.

In this study three expansion trials were given with a one-minute rest pause between trials. The change from one contraction trial, followed by one expansion trial used in Study I, to three expansion trials, was due to the agreement between subjects that the expansion effect was more clearly defined than the contraction effect.

Each subject was given two treatments (1) placebo, (2) 600 mg. meprobamate on two different days, the order of treatments being counterbalanced. Both the placebo and meprobamate were in identically appearing tablet form and taken orally.

On each day the subject was given one session before treatment (initial session) and four sessions 1, 2½, 3, and 4½ hours after administration of the drug or placebo.

The Holland test of fixation was given immediately after each spiral after-effect test at each session.

Subjects

The total N in this study was six. All were female subjects. The ages of the sample ranged between 25 and 45 with a mean of 35·3.

Results

An analysis of variance on the mean after-effect scores at each session did not produce a significant treatment effect. A second analysis of variance was done on the raw scores. Table III shows the results of this analysis of variance. It will be seen that two significant F ratios emerge, namely, those for "Subjects" and "Times". Figure 2 shows the results in diagrammatic form. It can be seen that the results are in the right direction, i.e. the after-effect on the drug day is shorter than on the placebo day. It is noteworthy that as in Study I, the difference between the scores for each day remains constant over time.

That the F ratio for "treatment" is not significant is due to the size of residual 1 against which the "treatment" effect was tested. This residual,

TABLE III

Source	Degree of Freedom	S. Squares	Mean Squares	F	P
Subjects	5	1651·04	330·21	30·05	<·01
Days	1	2·06	2·06	—	N.S.
Treatment	1	36·00	36·00	3·27	N.S.
Residual	4	43·97	10·99		
Total	11	1733·07			
Times	3	46·04	15·35	7·11	<·01
Time-Subject	15	43·80	2·92	—	N.S.
Time/Treatment	3	2·45	·82	—	N.S.
Time/Day	3	7·01	2·34	—	N.S.
Residual	12	25·98	2·16	—	
Total	36	1858·35			
Final residual	96	196·85	2·05		
Total	143	2055·20			

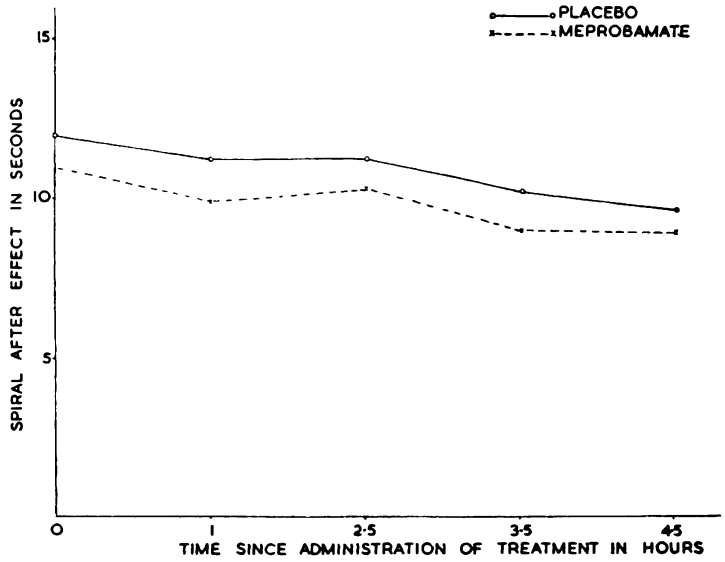

FIG. 2.—Duration of the spiral after-effect in seconds for a group of subjects under drug treatment (Study II).

significantly greater than the other residuals, is due to individual differences in reaction to the treatment. An extensive study into the effect of different dosages of meprobamate is under way and may throw more light on these individual differences and on the absence of a time/treatment interaction.

The possibility that the significant "Time" effect was due to the use of "expansion trials" rather than "contraction" and "expansion trials" was investigated with negative results. The investigation is reported in detail elsewhere (1).

Two product moment correlation coefficients were calculated. One of them was between after-effect scores and fixation scores at the initial session on the first day using data from both Study I and Study II; $r = \cdot 075$. The other correlation coefficient was between the same readings on the second day, $r = \cdot 065$. The spiral after-effect does not appear to be related to fixation as measured by Holland's test.

Summary of Study II

Six subjects were tested under two conditions each on two separate occasions. The two conditions were (*i*) administration of placebo, (*ii*) administration of 600 mg. meprobamate. Testing on each day was done once before administration of the treatment and 1, $2\frac{1}{2}$, $3\frac{1}{2}$ and $4\frac{1}{2}$ hours after administration.

A test of fixation was given at each of the above sessions.

The results showed that (*i*) there was a significant decrease in the spiral after-effect over time, (*ii*) the main treatment effect was not significant, owing to individual differences in reaction to the drug, (*iii*) the spiral after-effect was not correlated with the fixation measure used.

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