Arch.gen.Psychiat. 16, 740-749 (1967). LSD 1519

The Effects of LSD-25 on Creativity and Tolerance to Regression

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IN RECENT years, the interest shown by behavioral scientists in creativity has reflected what has for a long time been a popular preoccupation.[1-6] Willing authors have come forward, informing us how to acquire it, whether we must be neurotic to use it, and how to discover if we have that "divine fire." Attempts have been made to define the process involved, enumerate the steps essential to its functioning, and devise methods of testing an individual's creative potentiality.

Dynamic psychiatry has played a major role in the investigation of creative personality. Early psychoanalytic writers stressed the role of instinctual demands and neurotic conflicts in providing the motivation for creative sublimation. Having searched the lives of geniuses throughout history, investigators presented evidence to demonstrate how certain basic needs and fantasies had become interwoven in the content and structure of their work.[7-10] In recent years, however, the emphasis of speculation has shifted. Researchers began to realize that neurotic conflicts exist in many people, creative and otherwise, and consequently are not sufficient explanation for the efflorescence of creative output in a given individual at any given time.[11,12] Thus the theoretical emphasis became the exploration of the various ego functions involved in the utilization of basic drive energy for creative ends. From the psychoanalytic studies of Kris and Hartmann, and from the psychological research of Guilford, Barron, and Mednick, there has emerged an outline of characterological and cognitive traits related to the ability to do creative work.[5,13-15]

Recently there has been a growing interest in the manner in which physiological and environmental conditions interact with personality factors in facilitating or hindering creative productivity. A few of the factors considered have been the immediate physical setting, climatic conditions, and states of cortical arousal.[6,16] The speculation that altered states of consciousness—such as trances, or changes under sexual excitement—might be productive of originality is an old one. Familiar examples are Kekule, who derived his insight into the structure of the benzine ring while dreaming of a snake, and Coleridge, who was inspired to write the poem "Kubla Khan" during a narcotic trance. The importance of states of ego regression where "primary process" modes of thought predominate has been stressed by Kris as having an essential role to play in creative activity. This regression must, however, be balanced by the retention of certain ego functions which can rationally evaluate and utilize emerging primitive thoughts and feelings for productive ends.

It is but a short leap from our bedazzlement at the creative process to the notion that perhaps some wonder drug can make man's innate creative potential more easily available.[17] The rationale for such interest lies in the ability of a certain class of drugs to bring about states of regression which permit primary process thoughts easier access to consciousness. Since the discovery of lysergic acid diethylamide (LSD-25) many have questioned whether the ergot alkaloids might be of help in unlocking some of the secrets of creativity. These drugs both effect the perceptual processes and enhances the states of ego regression. Alteration in perception might allow the subject to approach familiar objects in a fresh and unique man-

Submitted for publication Jan 3, 1967.

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Read in part before the division meetings of the American Psychiatric Association, St. Louis, October 1965.

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ner, bringing into focus novel impressions that hitherto have fallen beyond the range of awareness.[18,19] The regression to primary process modes of thought might permit a greater fluidity in joining preconscious and unconscious fantasies, memories, and feelings into new ideational gestalts. A body concentration of such an agent might, hopefully, be obtained which would facilitate the emergence of primary process thought but maintain essential synthetic ego functions intact. This is important since creativity requires not only the formation of unique combinations of thought and associations but also the validation and refining of these new concepts and insights by the ego.

The appearance of psychedelic art and psychedelic music among LSD users suggests that the interest is hardly original with scientists. Advocates of LSD have for some time touted its creative potential, an advocacy which stems from the strong subjective feelings of creative drive that some users report.

The present study was undertaken to investigate the hypothesis that, through the proper selection of dosage and administration of one of these pharmacological agents to suitable subjects, their potential for creative performance could be enhanced. The drug LSD-25 was chosen as the experimental agent, because of the extensive literature available on its physiological and psychological effects.

The Pilot Study

There are two basic strategies available to researchers investigating a hypothesis such as ours. The first calls for carefully avoiding the sterile, unsympathetic, and presumably inhibiting, confines of the scientific laboratory. Rather, the drug is given to some potentially creative individual or group in a comfortable, natural setting. The advantage of this approach, aside from its relative simplicity, is the subject's freedom; he remains unencumbered by probing electrodes and plethysmographs, and as a consequence is allowed fullest reign of his creative capabilities. The methodological problems inherent in this approach are painfully obvious, however. The virtual absence of control over extraneous variables led us to choose the alternate research approach, which was to remain within the bland, possibly inhibiting but scientifically impeccable walls of the Mental Health Research Institute to execute our experiments.

The pilot study was performed to determine the optimum drug dosage. A group of normal subjects was chosen from a relatively homogeneous graduate student population. Under control conditions, each was tested twice with instruments we believed measured ego functions essential in creative productivity. The first testing occurred prior to the administration of the drug or placebo; the second, with an alternate form of the test, after enough time had elapsed for the drug to take effect. The null hypothesis would be rejected if the placebo subjects' scores showed no improvement (or even a decrement) from the first testing to the second, while the drug subjects displayed a significant improvement under the effects of LSD.

Fifteen subjects were selected for the pilot study. All had been examined psychiatrically by at least one of the investigators. Three dosage levels of LSD were investigated: 0.25γ/kg body weight; 0.5γ/kg.; and 1γ/kg. With the 1γ dosage, most of the subjects became restless and confused, approaching testing so disorganized and unmotivated that comparisons became useless. With the 0.5γ dosage, however, all subjects were able to participate in the formal testing. This was the level employed in the experiment proper.

While the pilot study thus answered the dosage question to which it had been directed, it simultaneously raised a far more interesting problem. While the same drug, in identical dosage schedules, had relatively uniform effects in many of the subjects, there were others who displayed marked variation. We did not submit the results to statistical analysis, but it seemed that whether or not a subject enjoyed the drug experiment had much to do with his performance on the retesting. Those subjects who seemed to enjoy the experience were not overwhelmed by the emergence into conscious awareness of instinctual impulses and vivid, drive-connected fantasies. They did not view the experience as being threatening to their sense of ego-intactness, and were able, when necessary, to return to the reali-

ty-oriented tasks we presented. For the most part, their retest scores showed improvement. Those who did *not* like the experience, however, showed no improvement or even a decrement. They tended to be more threatened, fearing the disorganization and deliberately attempting to control and sometimes even deny the drug's effects. They seemed to be uncomfortable with the emergence of primary process material, viewing it as ego alien.

We turned back to our earlier interview data in an effort to uncover the personality variables which might successfully differentiate those subjects who would improve under the drug from those who would not. Our clinical impression was that the two groups differed chiefly in what might be called "ego flexibility". Those subjects who subsequently improved under LSD seemed to be the ones who had best handled real-life stress situations, most thoroughly and productively assimilated personal experiences, and had the least need to suppress or deny instinctual material. While this appeared to be an intriguing finding, it was still intuitive.

The subsequent experiment thus added a second major aim. The first was to test the hypothesis that LSD-25, administered to a relatively homogenous group of subjects, would significantly increase this sample's performance on a battery of creativity tests, compared to a comparable control sample to whom a placebo had been administered. The second aim became the investigation of why certain individuals are more capable of utilizing the drug experience productively than are others.

Method

Subjects.—Thirty-one subjects, all males, 21 years of age or older were selected from a pool of 50 such volunteers. They did not know prior to volunteering for this experiment that psychoactive drugs were to be used. All were paid for their participation. The amount paid to the subjects was not in any way related to their performance of whether or not they received the active drug. A candidate was rejected if he displayed any obvious psychological or physical contraindications to his participation. Fourteen subjects were rejected at this state. The remaining subjects were seen by a clinical psychologist and given a battery of projective tests, consisting of a Rorschach, Holtzman, and Minnesota Multiphasic Personality Inventory at least one week prior to the actual experimental session. These tests were to function as a more objective measure of our intuitive feelings regarding an individual's ego flexibility. On the basis of these tests, the psychologist made predictions regarding the subjects' response to the drug. Those subjects who displayed an integrated mixture of affect and intelligence, in addition to abstract skill, were predicted to find the experience ego-syntonic. On the other hand, those predicted to find the drug experience ego-dystonic, were rigid, stereotypical, and inflexible in hand'ing the same material. Of the 36 acceptable subjects, five failed to keep testing or experimental appointments and were dropped. Of the remaining 31, 13 were felt to belong to the ego-syntonic ("improved") group, 18 to the ego-dystonic ("not improve") group. These predictions played no part in the assignment of subjects to the drug or placebo groups.

One of the tests that the subjects were asked to perform was a 15-minute period of free association. This was done before the administration of the drug as well as afterwards. This procedure will be described in more detail later. This period of unstructured speech provided a means by which subjects' reactions before and after the administration of the drug could be assessed. It permitted a check upon the prediction of a subject's response made by the projective tests. Independent predictions concerning subject reaction to the drug were made by an analysis of the content of the predrug session. The predictions were later compared to ascertain which supplied the better means of assessing probable subject reactions to the drugs.

The investigators, in consideration of the effect that suggestion and set play in influencing experimental data of this nature, endeavord to control the experimental procedure throughout as far as possible. At the time of selection, a short statement was read to all subjects concerning the purpose of the experiment. Some of the physiological and psychological effects of the drug were explained but the possibility of hallucinogenic or regressive experiences was not assessed. Each subject was instructed to refrain from eating within two hours of reporting for the experiment. This was requested so that the differences in absorption of the drug could be minimized.

Two subjects were tested at each session. Upon arrival each subject was introduced to his tester and the first battery of tests was given. Certain physiological measures were also taken at this time (blood pressure and pulse rate). Upon completion of the first half of the test, each subject was given a glass of distilled water. A dose equal to 0.5γ/kg body weight was added to the water of those randomly selected to receive LSD-25. Nineteen subjects received LSD and 11 did not. The subject following ingestion was escorted to the lounge where he could read or relax while waiting for two hours to elapse before he would be retested. Immedi-

ately prior to the second half of the tests, the physiological measures were repeated. These measures were taken to ascertain if there was any relationship between change in blood pressure and pulse and performance on the tests.

All subjects were escorted home by a friend or relative at the end of testing.

Tests.—The following tests were administered to all subjects:

(1) *Mednick Remote Association Test (RAT).*—The ability to bring remote ideations into associative relationship, Mednick believes, is an important element in the creative process.[18] Using this test, he has examined many students and found that their scores were a reliable, predictive measure of their potential creative ability, regardless of their field of interest. Three stimulus words are presented to the subject. They have no immediate relationship to one another, but all three may be associated with a unique fourth word. Normally the test consists of 30 such items. In this instance, the items were divided, odd and even, into what we hoped would be two equivalent, 15-item tests. One was administered prior to the drug or placebo; one following. Two minutes were allowed for each item. The measures were number correct (of 15) and mean time to correct answer.

(2) *The Modified Word Association Test (WAT).*—This is the first part of the Word Association Test described by Rapaport.[19] It was administered to determine whether or not LSD would facilitate an individual's ability to make more creative, less stereotypical responses. Originality and uniqueness, for our purposes, were considered as positive responses. Thirty of the 60 items were administered prior to the drug or placebo, and 30 afterward. The subject's responses were scored for latency of response and originality. Rapaport has provided latency categories (fast, intermediate, and slow) for each of the stimuli, as well as the most common responses, which served as our stereotypes. Any responses other than these were scored as originals.

(3) *Mosaic Design Test.*—This test was designed specifically for this experiment, but is similar to others presently in use.[20] The use of mosaic tiles gives the individual the opportunity to create an artistic design without penalizing him for any lack of technical skill in a specific plastic medium. It tests both his ability to conceive interesting patterns, and his capacity to execute his conceptions. Each subject was given an experimental board and containers filled with an equal number (25) of tiles of different colors and shapes. He was given two minutes to examine the materials, and 15 minutes within which to create some pattern with the tiles. There was no specification regarding the number of tiles a subject could use, or the amount of board space he must cover. Following the completion of the design, each was photographed in color. The designs were later rated by two judges on a 5-point scale, from 1 (highly disorganized, with minimal imaginative use of materials) through 5 (highly original design of superior organization and esthetic appeal).

(4) *Free Association Test (FAT).*—Each subject was placed by himself in a dimly lighted room, where he lay on a comfortable bed. He was instructed to repeat aloud any thoughts which came into his awareness during the subsequent 15-minute interval. The room was wired for sound, and the subject's comments were recorded and transcribed. We felt that the ability of an individual to give free reign to associations emerging from his preconscious is intimately related to the imaginative exercise involved in creativity. The transcripts were examined much as were the the projective testing materials, and each subject was subsequently predicted to improve or not improve on the basis of his facility with this test.

The basis of predictions was a quantitative and qualitative scoring of each recording for signs of disorganization and stereotype of content. We learned from our pilot study that those subjects who reponded best to the drug were able on free association, both to examine their internal perceptions (of affect and physical feelings) as well as sensitively observe their environment. Because the method used for making predictions from the content analysis requires lengthy explanation and illustration it will not be described in *this* publication. By the content analysis criteria 12 subjects fell in the improve group and 19 in the not improve. There was substantial but not complete agreement between the two criteria.

(5) *Gottschalk Figure-Perception Test (EFT).*—This test examines a subject's ability to perceive figures hidden in the general gestalt of a complicated line drawing. It was felt to be useful in determining whether or not a psychotropic drug actually assists an individual in widening his perceptual scope and in perceiving relationships hitherto obliterated by his dependence upon conventional, preconceived figural expectations. The experimental measures were number correct and mean time to correct answer.

(6) *Tachistoscopic Stimulation.*—This task was designed to determine whether the latency time for recognition of a word or an object as visually perceived is any shorter for a drug subject than for one who has received a placebo. Using a standard tachistoscope, word and figure stimuli were projected on a screen for the subjects. The number of correct responses was the measurement elicited.

Results

All scores are changes from predrug to postdrug or placebo testing. A positive score represents an improvement, or a better score in the second testing; a negative score repre-

sents a decrement. Because there were no differences between the control-improve (C1) and control-not improve (CN1) groups, whether projective or free association predictions were used, a pooled control (C) group, with $n=11$, is used in all comparisons.

The physiological data (see Table 1) bear out other investigators' findings. Both drug and control subjects' pulse rates dropped from the first testing to the second, but the drop for the C subjects was greater ($t = 1.60$, $P < 0.1$, one-tail). The drug subjects also exhibited a significant blood pressure rise ($t=3.17$, $P < 0.005$, one-tail), due to the mild pressor effect of LSD. A more interesting finding is the difference in pulse measures between the drug-improve (D1) and drug-not improve (DN1) groups. The subjects predicted by projective testing to improve under LSD evidenced a pulse rate drop, while the N1 subjects showed a rise ($t = 1.60$, $P < 0.1$, one-tail). It appears that the projective testing was able to differentiate, with minimal statistical significance, between subjects displaying opposite physiological responses to the stress of drug ingestion.

Table 2 presents the mean change data for the pooled D and C groups on the ten creativity measures: RAT, number correct and time to correct; WAT, unique responses, as well as fast, intermediate, and slow responses; EFT, number correct and time to correct responses; tachistoscope correct; and mosaic design score. Table 3 breaks these pooled scores down into improve and not improve categories as predicted from the projective testing. Table 4 presents the same breakdown for the predictions from content analysis of the earlier free association.

The mean changes for the pooled D and C groups are compared in Table 5. In all such analyses, one-tailed probability criteria are employed to test our specific predictions. Where the data indicate the opposite of the predictions occurred, two-tailed criteria must be met. These instances are marked with asterisks. Drug subjects prove to be significantly better than placebo subjects at producing unique responses to the WAT ($P < 0.05$). Contrary to prediction, however, the C subjects improve more in their mosaic

Table 1.—*Physiological Data, Mean Changes*

Test	Drug‡ (n=20)	Control (n=11)
Blood pressure	+4.95	−6.91
Pulse	−1.26	−6.37

	Drug		Control	
Test	Improve‡ (n=8)	Not Improve (n=12)	Improve (n=5)	Not Improve (n=6)
Blood pressure	+2.75	+6.54	−7.50	−6.20
Pulse	−4.75	+1.46	−3.00	−10.40

execution of ($P < 0.1$) than do the D subjects. The interrated reliabilities for the mosaic scoring were 0.79 and 0.85 for pretesting and posttesting, respectively. With the exception of the RAT time and EFT correct measures, all other results were in the predicted (D better than C) direction.

As predicted, there were no differences approaching significance in any of the DN1 versus C comparisons.

Table 6 presents data from the D1 versus C comparisons based on projective criteria. Again, the D subjects are significantly better than the C on WAT unique responses ($P < 0.05$). The D1 subjects also required significantly less time to make their correct EFT responses ($P < 0.10$). Using content analysis criteria, it was calculated that D1 subjects are again better on WAT unique ($P < 0.10$), but worse on the mosaic designs ($P < 0.10$).

Data bearing on the usefulness of the preexperimental predictions are presented

Table 2.—*Mean Change*

Test	Drug (n=20)*	Control (n=11)
RAT correct	−0.40	−0.89
RAT time	+3.08	−1.97
WAT unique	+0.95	−1.36
WAT fast	+0.15	+0.90
WAT intermediate	+0.25	−0.45
WAT slow	−0.40	−0.45
EFT correct	+0.15	+0.55
EFT time	−4.96	−2.53
Tachistoscope	+0.50	+0.27
Mosaic design	+0.08	+0.82

* N=20, except for mosaic, where n=19.

Table 3.—*Mean Change, Projective Criteria*

Test	Drug		Control	
	Improve (n=8)	Not Improve (n=12)*	Improve (n=5)	Not Improve (n=6)
RAT correct	+1.12	−1.42	+0.20	−1.50
RAT time	−1.98	+6.45	+4.96	−7.74
WAT unique	+2.38	0.00	−3.00	0.00
WAT fast	−0.62	+0.67	+1.40	+0.50
WAT intermediate	+0.62	0.00	−0.60	−0.33
WAT slow	0.00	−0.67	−0.80	−0.17
EFT correct	0.00	+0.25	+0.40	+0.67
EFT time	−11.28	−0.74	−2.21	−2.81
Tachistoscope	+0.25	+0.67	−0.60	+1.00
Mosaic design	−0.44	+0.50	+0.50	+1.08

* n=12, except for mosaic, where n=11.

Table 4.—*Mean Change Content Criteria*

Test	Drug		Control	
	Improve (n=9)	Not Improve (n=11)*	Improve (n=3)	Not Improve (n=8)
RAT correct	+0.89	−1.45	+1.00	−1.38
RAT time	+4.02	+2.31	+4.38	−4.35
WAT unique	+1.44	+0.55	−4.33	−0.25
WAT fast	+1.44	−0.91	+2.00	+0.50
WAT intermediate	0.00	+0.45	−1.67	0.00
WAT slow	−1.44	+0.45	−0.33	−0.50
EFT correct	+0.11	+0.18	+1.00	+0.38
EFT time	−6.63	−3.58	+4.14	−5.04
Tachistoscope	+0.67	+0.36	−1.67	+1.00
Mosaic design	−0.06	+0.55	+0.50	+0.94

* n=11, except for mosaic design, where n=10.

in Table 7. The projective criteria, used for the data in Table 8, proved to be among the most productive in the experiment. The D1 subjects produced more WAT unique responses ($P < 0.10$), more correct RAT responses ($P < 0.11$), and took less time for both their RAT ($P < 0.05$) and EFT ($P < 0.10$) correct answers.

Content analysis comparisons show that again, the D1 subjects made more correct RAT responses than did the DN1 subjects ($P < 0.10$). They also made more WAT responses that fell within the fast category ($P < 0.10$). The other D1-DN1 findings were not replicated, however.

The major findings may be summarized as follows:

(1) Projective testing can predict physiological reactions to LSD stressor effects. When experimental economy in subject selection is important, this may be of use in eliminating those individuals whose LSD response is essentially somatic.

(2) Control subjects perform with essentially the same capacity and facility as drug subjects who are not predicted to improve under the effects of the drug.

(3) Most comparisons were in the predicted direction (D better than C, or 1 better than N1), but most failed to reach statistical significance. Some were in the opposite direction than that predicted. In general, it may be said that this battery did not produce consistent results for any experimental subject grouping.

(4) Drug subjects were significantly better than placebo subjects at producing unique responses on the WAT. Drug subjects predicted to improve under LSD did significantly better than those predicted not to improve (by both projective and content criteria) on WAT unique responses scores. The projective criteria further differentiated between the two groups on EFT time scores, with the D subjects taking less time per correct response.

(5) Contrary to prediction, C subjects

Table 5.—*Drug vs Control*

Test	M_{Drug} $M_{Control}$	S Diff	t (29 df)	P
RAT correct	+0.49	1.51	0.32	
RAT time	+5.05	5.91	0.85	
WAT unique	+2.31	1.39	1.66	0.05
WAT fast	−0.75	1.02	0.74	
WAT intermediate	+0.70	0.71	0.99	
WAT slow	+0.05	0.85	0.06	
EFT correct	−0.40	0.25	1.60	
EFT time	−2.43	4.68	0.52	
Tachistoscope	+0.23	0.99	0.23	
Mosaic design	−0.74	0.43	1.72	0.10*

* Two-tailed.

Table 6.—Drug Improve vs Control
Projective Criteria

Test	M_{Drug} $M_{Control}$	S Diff	t (17 df)	P
RAT correct	+2.01	2.14	0.94	
RAT time	−0.01	5.57	0.00	
WAT unique	+3.74	1.91	1.96	0.05
WAT fast	−1.52	1.81	0.84	
WAT intermediate	+1.07	1.19	0.90	
WAT slow	+0.45	0.82	0.55	
EFT correct	−0.55	0.28	1.96	0.10*
EFT time	−8.75	5.17	1.69	0.1
Tachistoscope	−0.02	1.35	0.01	
Mosaic design	−1.26	0.55	2.29	0.05*

* Two-tailed.

Table 7.—Drug Improve vs
Drug Not Improve Projective Criteria

Test	$M_{Improve}$ $M_{Not\ Impr.}$	S Diff	t (18 df)	P
RAT correct	+2.54	2.01	1.26	0.11
RAT time	−8.43	4.24	1.99	0.05
WAT unique	+2.38	1.71	1.39	0.10
WAT fast	−1.29	2.02	0.64	
WAT intermediate	+0.62	1.40	0.44	
WAT slow	+0.67	1.41	0.48	
EFT correct	−0.25	0.29	0.86	
EFT time	−10.54	6.32	1.67	0.10
Tachistoscope	−0.42	1.23	0.34	
Mosaic design	−0.94	0.68	1.38	

were found to improve more than D subjects on their mosaic productions. The same finding results when the C subjects are compared with only the D1 subgroup. The C subjects, compared with the D subjects projectively predicted to improve, made significantly more correct EFT responses.

(6) The projective predictions proved more useful than the content analysis in most instances. Using the former, the D1 group made significantly more correct RAT responses, significantly more WAT unique responses, and took significantly less time on both the RAT and EFT tasks. With the content predictions as a guide, the D1 subjects did reliably better on RAT correct, and produced more fast responses on the WAT.

(7) The tests employed ranged from very productive to unproductive. The WAT fast, intermediate, and slow categories were generally unproductive. The RAT correct and time to correct scores showed the superiority of the D1 over the DN1 subjects. Unique responses to the WAT was a consistently useful measure, differentiating D from C and 1 from N1 subjects. Tachistoscopic differences were small, but in the predicted (D faster than C, 1 faster than N1) direction. On the EFT, C subjects made more correct responses, but D subjects took less time for each of their correct answers. The mosaic design test produced results which were consistently contrary to our predictions. Most of the changes were small, but tended to favor a greater improvement for the C subjects. The value of a three by three χ-square (D1, DN1, and C; improve, no change, deteriorate) was 6.78, which, with 4 df, was significant at the 0.12 level. This suggests that the C subjects were likely to improve, while the D subjects deteriorated or did not change.

Comment

From these results, we may draw the general conclusion that the administration of LSD-25 to a relatively unselected group of people, for the purpose of enhancing their creative ability, is not likely to be successful. Although there were intuitively strong, if statistically fragile findings to support our hypotheses, the inconsistency of the test battery results indicates that the general enhancement predicted did not occur. The most suggestive finding was that LSD-25 given to "suitable" subjects may increase the accessibility of remote or unique ideas and associations to their conscious awareness. The poorest showing of the drug subjects was on those tests requiring visual attention (mosaic, EFT, tachistoscope). It is possible that the action of the drug which facilitates a greater openness to remote or unique associations does not enhance the narrowing of attention upon a delimited perceptual field.

The authors speculate that greater openness to remote or unique ideas and associations would only be likely to enhance crea-

tive thought in those individuals who were meaningfully engaged in some specific interest or problem. There should exist some matrix around which the fluid thought processes can be organized if the experience is not to diffuse into a melange of affective, somatic, and perceptual impressions which may lead to feelings of anxiety or depression. Thus the indiscriminate use of LSD in hopes of improving creative thinking is to be cautioned against.

Beyond the interpretation of the results, this experiment raises a further question for discussion. The particular methodological problems encountered parallel the dilemma contemporary in the science of human behavior. The behavioral scientist wishes to obtain clean hard data from which he can draw conclusions and frame hypotheses. However, he is aware of the fragility of natural behavioral responses in all higher organisms and wishes to avoid imposing excessive artificial and rigid distortions through his experimental manipulations. This problem becomes particularly acute when dealing with a subject such as the effect of a poorly understood drug upon the process of creativity. If there is any facet of human experience which is elusive and highly perishable under controlled investigation it is creativity. Similarly, the nature of the psychedelic drug experience does not lend itself easily to standardization and experimental recording. When these two ingredients are brought together in the experimental mixture, the outcome can be difficult to interpret. However, it is the task of the psychiatrist to take as his field of study the investigation and treatment of a subtle set of human variables, for example, love, hate, fear, depression, euphoria, tenderness, etc. This data, though not readily systematized, is information and thus is amenable to classification and notation as it passes through a variety of transformations. Psychiatry in the past has lent heavily upon the intuitive powers of its clinical practitioners to derive its theoretical models and postulates. However, the application of the experimental techniques and statistical modes of data analysis to all realms of psychiatric investigation is necessary if the field is to develop its own basic science geared to synthesize the raw data of human experience. The implementation of this experimental project has reinforced the author's awareness of the necessity of this task and of its extraordinary complexity. In the light of these remarks several criticisms of the experimental methodology can be raised.

(1) There are no valid tests for creativity and thus no meaningful conclusion can be drawn from such an experiment. Only a creative worker operating within his own field of expertise can give relevant information about the effects of this drug upon creative processes.
(2) Particular subjects chosen for the experiments may have had little or no inherent potential for creative work and thus would not manifest any ameliorating effects of the drug.
(3) The atmosphere of the research laboratory is unconducive to any creative thinking.
(4) The subjects might require more than one drug trial in order to experience the maximum creative effects.
(5) An enhancement of a creative mentation might not become manifest until many hours or days following laboratory observations.
(6) The dosage appropriate for one subject may be ineffective in another.
(7) Fatigue and hunger effects might mitigate against the desired creative experience.
(8) The effect may become manifest only in creative solutions to problems within the realm of interest of the subject. If the test material does not interest him, he might not be capable of creative or original thought despite the effects of the drug.
(9) The subject's possible anxiety concerning this new drug and strange experience might have a masking effect upon the beneficial drug experience.
(10) Maximization of the positive effect might not appear without a trusting rapport between the subjects and the experimenter. This is difficult to achieve on the basis of only one interview prior to the actual testing.
(11) The procedure of screening subjects with possible emotional disturbance

might introduce a bias which would exclude those candidates most likely to improve under the influence of this drug.

In partial defense of the research methodology the following points can be raised. The tests applied do not measure creative ability of the subject but they do probe specific ego skills which are intimately entwined with the creative process. One of these tests (Mednick) has been given to thousands of subjects and their scores tend to be a high prognosticater of their creative ability as estimated by their teachers or colleagues.

A laboratory setting permits a better isolation of the variables of the drug effects than would a less structured environment. Such an alternative setting might introduce a myriad of intervening stimuli which might effect the subject's performance but are not amenable to estimation. In a similar experiment, Cohen and the McGlothlins utilized a tasteful apartment complete with stereo and flowers, allowing the subject to do as he pleased, but still found no results which could meet statistical criteria.[21]

The dosage chosen was one which was felt would produce the greatest psychological effect without being likely to participate a drastic disorganization of ego functioning for the majority of subjects. At higher levels certain critical factors central to creative thinking might be blunted. A relatively moderate dose was hoped to be likely to release the underlying potentialities of the personality. A higher dose might produce effects more characteristic of the drug than of the personality with which it interacted.

The screening procedures were introduced as a protection to the health of the subject. The simple inclusion of subjects in the first come, first selected basis was adhered to except when subjects were excluded for psychiatric and medical reasons. However, there may of been some self-selection by the subjects because this experiment was undertaken at a time when LSD was receiving bad publicity. There were several subjects who refused to continue participation once they knew that this drug was likely to be used.

In conclusion, the results of this experiment revealed that there is no evidence to state that LSD 25 made the subjects more creative. While the complexities of such an experiment make it methodologically challenging, unless this challenge is faced, the claim that LSD has a potential for increasing creativity cannot be substantiated and will remain anecdotal.

Summary

Since the discovery of lysergic acid diethylamide (LSD-25) there have been speculations and anecdotal reports of its enhancing effects upon creativity. We attempted to test this hypothesis by giving subjects a battery of tests which tapped ego resources important in their creative processes before and after they received LSD or a placebo. If LSD-25 had any enhancing effect upon these processes the test score of the drug group was predicted to increase as compared to the controls. A second aim of the experiment was to attempt to predict which subjects (liable to the administration of LSD-25) would be likely to respond syntonically to the experience and thus increase their test scores and which would show signs of anxiety and disorganization. Predictions were made on the basis of psychological tests administered a week before the experimental session. Physiological measures were also taken before, during, and after the experiment to determine if they had any predictive value for discriminating between those who responded well to the drug and those who exhibited high tension.

(1) Control subjects performed with essentially the same capacity as drug subjects predicted not to improve.

(2) Most comparisons were in the predicted direction (drug better than control or improve better than not improve) but most failed to reach statistical significance.

(3) Projective testing can predict physiological reactions to LSD stress or effects.

Methodological problems of relating changes in creativity to the LSD experience are discussed.

From these results the authors concluded that the administration of LSD-25 to a relatively unselected group of people for the purpose of enhancing their creative ability is *not* likely to be successful.

This research was undertaken under National Institute of Mental Health small grant No. MH 08216-01.

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