# Lysergic Acid Diethylamide (LSD-25) and Ego Functions

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In 1947, Stoll [32] in Switzerland reported on the effects of D-lysergic acid diethylamide (LSD-25), an ergot derivative which can produce profound psychological effects in humans when it is given in minute doses. Since that time, a large volume of literature has grown up around this substance. LSD has been put to many uses. Its chemical interactions within the body have been studied with the as yet unrealized hope of finding a chemical basis for mental illness. It has been of considerable value in the basic study of the physiology of the central nervous system. It is hailed by some as a dramatically effective adjunct to treating mental illness and is employed in many uncontrolled studies for this purpose. Thus far its greatest value, in my opinion, has been as an experimental means of studying psychological functions. Study of the psychological changes associated with LSD administration has intrinsic interest as a new and dramatic way of exploring human personality. Such studies are also needed in view of the continued use of LSD as a therapeutic adjunct. A basic understanding of the drug's effects is a requirement for anyone employing it to modify psychological processes in a therapeutic direction.

In view of the dramatic effects of LSD it is not surprising that many sweeping statements have been made regarding the nature of the psychological effects it produces. Some authors, particularly the early ones, have claimed that there is little distinction between schizophrenia and the picture which LSD produces in normal subjects. This claim has required extensive modification. Yet there are some similarities to schizophrenia, and in predisposed persons a schizophrenic picture may appear during LSD intoxication

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(Klee and Weintraub [18]). For the purposes of the present discussion we are most interested in the statement made by many authors to the effect that LSD "dissolves the ego," or "impairs ego functions." Although such statements are commonly encountered in the literature, in very few instances are they documented in anything but an anecdotal manner. A few workers have performed experimental studies on isolated functions, such as intellectual performance, but rarely with any attempt to incorporate their findings into any psychological theory. Abramson and his co-workers, in particular, have performed a large number of interesting studies of the effects of LSD on a variety of psychological functions. Savage [26] has written a useful and illuminating paper which deals chiefly with the effects of LSD on ego feeling. In it Savage uses Federn's theories of the ego as a basis for his discussion of LSD effects. According to Savage, many of the phenomena associated with the LSD reaction are derived from the drug's effects on perception and ego feeling. While this topic will be touched upon with a slightly different emphasis in this paper, the reader is referred to Savage's paper for a more detailed discussion of this aspect of the subject.

Savage's paper is the only one thus far, to my knowledge, to deal specifically and in depth with the effects of LSD on ego functions. The purpose of the present paper is to discuss the effects of LSD on a broader range of ego functions, bringing in both clinical and experimental data as a basis for discussion. It is not intended as a general review of the subject, however. The work which forms a background for this paper consists of a variety of clinical and experimental studies conducted at the University of Maryland, Psychiatric Institute, by a multidisciplinary research group. In these studies several hundred normal volunteer subjects received LSD in doses ranging up to 16$\mu$g/kg. The studies included both pharmacological and psychological investigations. Only the latter will be referred to in this paper. "Normal" volunteers are defined as persons who functioned adequately in their work and had no known history of psychiatric disturbance. Most clinically disturbed individuals were screened out in pre-experimental interviews. Doses of LSD used in the psychological studies to be reported were in the range of approximately 1$\mu$g to 2$\mu$g/kg body weight, orally administered. At lower dosages effects appeared less consistently, and at higher doses subjects were less willing and less able to cooperate in testing, since basic psychological functions are affected proportionately with the dose administered (Klee, Bertino, Weintraub, Callaway [17]).

In the course of our discussion we will attempt to relate our findings to psychoanalytic theory and, to a limited extent, to experimental findings from other disciplines.

The clinical aspects of the LSD reaction will be described only relatively briefly, since LSD reactions are described extensively elsewhere in the literature. Within one-half hour following LSD ingestion the subject begins to note a variety of changes. Physiologically there is evidence of increased autonomic activity, especially of the sympathetic system. Pupillary dilation, palmar sweating, nausea, tremor, etc, occur. A high level of anxiety is extremely common. This is often accompanied by euphoria or silliness with impulsive laughter, especially in the early part of the reaction. In the course of the reaction, which ordinarily lasts about six hours, the subject usually remains in a heightened affective state, although this is not always evident to the casual observer. Affective behavior is extremely varied and is related to the subject's over-all clinical response as well as to his momentary reactions to internal and external stimuli.

The other effects of LSD can be described largely in terms of the ego functions affected. Ego functions are considered to fall within three realms: perception, thought, and motility. LSD produces effects in all of these areas, and each will be considered in the course of the discussion.

## Perception

Perceptual changes occur under all environmental conditions, but are usually most

marked when the subject is lying down in a darkened room. Profound alterations in spatial orientation are usually described by LSD subjects. Most striking are the changes in visual and somesthetic perception. Distances seem alternately greater and less; objects appear to split into pieces, then reconstitute. Stationary objects appear to be moving, the walls seem to be closing in or pulsating. Hallucinations of colors, lights, patterns, and objects usually occur. Subjects often have difficulty in discriminating between hallucinated and real objects. In some cases, especially with large doses, subjects believe their hallucinations to be genuine objects and react to them accordingly.

The phenomenon of synesthesia occurs almost uniformly with a sufficient dose. Its most frequent and obvious form is exhibited when auditory stimuli produce changes in visual hallucinations. For example, the experimenter claps his hands and the subject sees flashes of color in time to the clapping.

Changes in somesthetic perception are striking and profound. Feelings of numbness and paresthesias of the entire body are usually experienced. Feelings of depersonalization and derealization may be marked. Subjects report: "My body is no longer my own." "I feel like I'm a bystander watching myself." "I feel as if I have no body." One psychiatrically unsophisticated subject reported: "I feel as though my body is melting away; I have no boundaries—scoop me up off the floor and tie me up in a sack to give me some limits"—and later, "I feel like I'm blended with the universe." Subjects may also have difficulty in differentiating themselves from other persons or even from inanimate objects, as discussed by Searles.[27]

These and a wide variety of other reports of distortions of body image are given by LSD subjects. Human figure drawings done by many of our subjects also give evidence of the profound disorganization of body image experienced under LSD. In one of our studies (Silverstein and Klee [28]) 18 male volunteers were asked to draw human figures under drug and control conditions. Each time the subject drew three figures: a male, a female, and finally, himself. All drawings were rated by four judges working independently. To summarize the findings, figures in the drug state showed less attention to detail, a greater number and severity of distortions, and more disturbed line quality in their drawings than those produced under control conditions. Drug figures also tended to be larger than control figures. Although there are alternative explanations for these results, the experimenters believe that the changes in drawings in the drug state were chiefly related to alterations in body image. Human figure drawings by LSD subjects also reveal a great deal of psychodynamic material, such as the state of defensive functioning, and psychopathology, such as paranoid tendencies, confused psychosexual identification, etc. Our material was not systematically analyzed for this material, but such a study should be rewarding.

Despite the subjective experience of numbness, subjects retain the ability to discriminate all types of sensations, including tactile, postural, and kinesthetic sensations. Most physical performance tests are carried out with only slight impairment, but subjects complain of difficulty in making their bodies "obey orders." It seems to the subject as though it really is not his body at all. As he is writing, for example, it may seem to him that some strange, unfamiliar hand is performing the act, a symptom quite similar to what is seen in the agnosias.

Subjects may also report unusual sensitivity to visual, auditory, or somesthetic stimuli. Some have complained of being painfully aware of the most minute details of their environments, including things which they would ordinarily overlook. For example, one subject reported: "Whenever I look at anything, it seems to penetrate me—right into me." During a test for synesthesia, when the experimenter was clapping his hands in the air, a subject reported: "Whenever you clap your hands, I feel it go through my body." A weak electric shock, applied to the forearm, may also seem to the subject as though it penetrates his entire body. Innumerable similar examples could be cited.

Time sense is also profoundly altered. Subjects report: "Time has no meaning," "Time is standing still," "Time passes very slowly," and subjects without a timepiece often estimate the time to be much later than it really is. They may, in fact, express the feeling that days, months, or eons have gone by since they began the experiment. The effects of LSD on time perception was studied by Boardman et al,[5] who found no consistent effects of the drug on subject's ability to measure one-second intervals. Using a different technique with 24 subjects, our results (Aronson, Silverstein, and Klee [2]) demonstrated a distinct effect of the drug on time perception. Subjects were asked to estimate four different time intervals, 15, 60, 120, and 240 seconds, by signaling after being given a starting signal. For each time period subjects tended to estimate the time interval to have elapsed sooner while under the influence of the drug. The results were highly significant statistically. These results are consistent with the subjective experience of an extended passage of time during the drug reaction.

The relationship of time perception to other ego functions has received minimal attention in the psychiatric literature. The loss of ability to estimate time accurately according to the clock is a most impressive subjective experience. Similar changes are known to occur in various other toxic states, as well as in dreaming and in mental illness. Further study is required to determine to what extent the change in time perception is a "primary" effect of changes in brain function (the "internal clock" running faster) and to what extent a secondary result of alterations in cognitive, perceptual, and affective processes. The contribution of intact time sense to the operation of other ego functions also requires study.

Among the perceptual phenomena which merit special note are the marked distortions of the way in which other persons are perceived. Their features are grotesque and constantly shifting, their behavior is absurd, and even their existence may seem questionable. These phenomena often add to the experience of one's being isolated and utterly alone in the world, if indeed one exists, and if there is a world. At such times nothing can be more reassuring to the subject than for a simple, relatively undistorted percept of another person to break through. For the moment both he and his surroundings are reinvested with meaning and with life.

Considering the variety of clinical reactions to LSD, it should come as no surprise that many of the perceptual distortions of other persons assume dynamic significance. An experimenter who seems malevolent may grow horns, or a subject who feels impotent may see his genitals shrivel up before his eyes. As noted earlier, a subject with very diffuse boundaries may be unable clearly to differentiate his thoughts and feelings from those of persons about him. These few examples may give some idea of the potential for studies with LSD in this area.

Now, how do such phenomena relate to ego functions? Following Freud, it has been recognized that the ego is a perceptual ego and most especially a "body ego." In "The Ego and the Id," [12] Freud stated: "The ego is first and foremost a body ego, it is not merely a surface entity, but is itself the projection of a surface." It is not entirely clear whether Freud meant simply that the ego arises from perceptual experiences, or if he meant that it requires a continuous perceptual supply in order to be maintained as well. In any case, there is good evidence that a continuous flow of stimuli of the various modalities is required to maintain "normal mental functioning." Studies of artificial sensory deprivation by Bexton, Heron, and Scott [4] and by Lilly,[20] and subsequently many others, have demonstrated that subjects deprived of a normal supply of external stimuli, without the use of drugs, may develop through disorders, visual hallucinations, disturbances in mood and affect, and even delusions. These effects seem to parallel those produced by LSD.

What are the consequences to the organism of such perceptual changes as are produced by LSD? For one thing, the individual's subjective existence, his "self," is at stake.

Lacking a reliable inflow (or integration) of stimuli, particularly from his body, the subject has lost much of the basis for his self-percept. As a result, feelings of depersonalization and unreality are quite common. Yet, internal processes continue actively. The subject continues to have an awareness of his own mental processes, which under LSD are likely to be largely in the form of vivid imagery. The stream of images passing before his attention may seem very real, even palpable, to the subject. Such images, distorted though they may be, represent, or have at some time represented, objects in the real, external world. How is the subject to discriminate at this time between these symbols and the real objects which they represent? Under normal (ie, nondrug) conditions, this is made possible by the perception of the self. This reference point, maintained largely by a constant integration of sensory information, allows a sharp discrimination to be made between inner and outer processes. The human has knowledge of the outer, or "real," world only by his own symbolic representations derived from immediate sensory information or from memory traces related to past sensations. In various forms of thought and fantasy, the symbols may be ordered with respect to one another in spatial and temporal sequences resembling those relationships obtaining in the real world. The intact, normal, waking person experiences little difficulty in distinguishing between his own productions and those events in the "real" world. This ability is taken for granted. He can do so as long as his self-percept is unimpaired. When LSD, in sufficient dosage, is administered, however, perceptual distortions occur, the self-percept is impaired and the ability to distinguish between fantasy and reality suffers.

Now, let us turn to some other aspects of the perceptual changes with LSD. We have mentioned certain symptoms which seem to indicate a heightened sensitivity to stimuli. Synesthesias are a particularly interesting example of this. Oversensitiveness to visual, auditory, and somesthetic stimuli are others. In all cases the subject seems to be flooded with more stimuli than he can handle. In the case of synesthesias these stimuli even overflow into other sensory areas. Yet, the stimuli are no greater than the subject is accustomed to handling ordinarily. Obviously, some change has occurred in the subject's handling of stimuli.

At this point it should be of interest to consider these LSD effects in the light of a statement by Freud in "Beyond the Pleasure Principle." [10]

> . . . For the living organism protection against stimuli is almost a more important task than reception of stimuli; the protective barrier is equipped with its own store of energy and must above all endeavor to protect the special forms of energy transformations going on within from the equalizing and therefore destructive influence of the enormous energies at work in the outer world. . .

In the same section Freud goes on to describe traumatic neurosis as a condition in which these barriers have been broken through—the organism, under such conditions, mobilizes all its resources to bring the stimulus under control.

The above quotation from Freud makes equally good sense whether taken psychologically or neurologically. It is not clear how Freud meant it. For the purposes of our discussion let us interpret his statement in a neurological sense. It would be reasonable to assume then that when Freud spoke of stimuli in this case he included more complex patterns of stimuli, rather than merely discrete stimuli, such as pin prick, for example. Perhaps it is also safely assumed that he meant the stimulus barriers exist in the brain, rather than at the periphery. Such barriers would presumably consist of processes limiting the spread of excitation between different functional areas of the brain.

The indications are that LSD, in some manner, breaks down these stimulus barriers of which Freud spoke. Nor is this merely a figure of speech. There is some reason to suspect that integrative mechanisms within the central nervous system (CNS) which handle inflowing stimuli are no longer able to limit the spread of excitation in the usual ways. We might speculate that LSD allows

greater energy exchanges between certain systems than normally occurs, without necessarily raising the general level of excitation of all cortical and subcortical structures.

The occurrence of synesthesias is consistent with this hypothesis. As far as I am aware, however, adequate neurophysiological evidence is lacking. Indeed, neurophysiological studies are probably far from giving any definite answer in either direction to this problem. It is not relevant to the aims of this paper to review such studies in detail, nor am I competent to do so. A few relevant papers will be mentioned, but the reader is referred to the neurophysiological literature for detailed treatment of the subject. A review by Evarts [9] reveals that neurophysiological studies involving psychotomimetic chemicals have provided considerable data which are often contradictory and are usually difficult to interpret. It is reported that LSD produces an activation or alerting of cortical electrical responses (Rinaldi and Himwich [25]). These authors concluded that LSD produces a stimulation of the mesodiencephalic activating system. Purpura [24] has indicated some of the complexity of LSD effects in his work which suggests that the inhibitory action of LSD on dendritic activity is more related to excitation of inhibitory neurons than to a blockade of excitatory synaptic activity. Studies by Bradley and Elkes [6] may also be mentioned. These authors, studying spinal and decerebrate animals, concluded that spinal and mesencephalic connections are necessary to demonstrate effects of LSD upon the electrocorticogram. This finding suggests that an intact, functioning, peripheral afferent system is necessary for LSD effects to occur in higher centers.

There is a seeming paradox in postulating that LSD subjects may suffer from something akin to sensory deprivation, yet in the next breath proposing that they may also suffer from a flooding of stimuli. The paradox may be resolved, at least in theory, by the following consideration. A physiological condition in which stimulus barriers are reduced may be expected to result in overloading at least some perceptual and associational areas of the brain. This would represent a flooding of stimuli in the areas affected. With sufficient flooding of an area, informational coding might break down so that the net effect would be loss of information—an end result equivalent to stimulus deprivation.

Another way to look at the question is against the background of some neurophysiological studies of Purpura.[22,23] Purpura demonstrated in cats that LSD, in doses comparable to those used in humans, facilitates axosomatic synaptic activity characteristic of specific afferent synaptic systems, and it inhibits axodendritic activity in nonspecific, interareal, and intercortical afferent systems. Thus, there is a facilitation of transmission of stimuli in the pathways from the retina to the optic cortex, for example, while there is decreased transmission of impulses between different parts of the cortex, as, for example, in the transcallosal pathway. This finding does not support the hypothesis mentioned above, that there may be an impairment of stimulus barriers within the brain. (Although it is probably not sufficient to rule it out either, since additional pathways could be involved.) It does appear to be consistent with the observed paradox of overstimulation and understimulation in the LSD subjects. Clearly, effects such as visual hallucinations seem related, at least in part, to overstimulation of the optical system. The impairment of transmission along association pathways within the cortex, however, would presumably prevent the subject from successfully integrating the stimuli which his brain receives. It would be analagous to an organism starving despite adequate food intake, because of a lack of digestive enzymes.

These speculations are admittedly crude and moreover are likely to be highly inaccurate. They are offered in the belief that it is not only tempting, but necessary, to attempt to relate psychological and neurophysiological phenomena in this field of research. Hopefully, more sophisticated explanations will be offered in the future, which can then be tested experimentally.

The consequences to the subject of the apparent loss of stimulus barriers is in some respects analogous to the situation in a traumatic neurosis. Only in this case it needs a much milder stimulus to produce traumatic effects. Thus, a slightly threatening situation, such as mild reprobation, scorn, or unfriendliness from another person, may loom large and ominous to the subject. Strong affective reactions may occur with what appears to be only the slightest provocation. The barriers are down not only to noxious stimuli, however. Subjects often obtain unusually strong pleasure from the simplest of things, such as a play of shadows on the wall, or an amusing incident. It is hardly necessary to mention that in such cases psychodynamic and other factors are involved as well.

Another neurophysiological finding may also help to account or some of these clinical phenomena. Monroe et al,[21] studied human subjects with implanted electrodes in the limbic system. After LSD, they found increased activation in this system, which was not reflected in cortical leads. This is a highly significant finding in view of the fact that there is abundant evidence that the limbic system plays a central role in the neural mechanisms involved in emotion. This finding also helps explain the increased affective state which is associated with LSD, as well as the heightened emotional responses to minor stimuli, discussed above. Further reference will be made to this finding later in this paper.

## Thought Processes

Thought processes in LSD reactions are, naturally, exceedingly complex and variable. Subjects experiencing paranoid reactions think differently from those with depressive reactions, and so on. We shall attempt to ignore these differences and concentrate on a few of the basic characteristics of thought which most LSD subjects have in common.

Thought takes on a quality which many subjects describe as dream-like. Concentration becomes difficult or impossible. Thoughts seem to follow a will of their own and are no longer at the subject's command. As the reaction progresses, thought may take on a visual, hallucinatory quality; when this happens the subject discovers his thoughts parading swiftly before him in visual form, as though on a three-dimensional screen. If left to himself, he may find himself swept irresistibly into a bizarre, autistic world of vivid imagery. When called upon to describe this experience he is at a loss for words.

Such thought processes have many of the earmarks of primary process thinking. We do not intend to dwell on them, however. Instead, we shall confine most of our attention to certain other aspects of thought, which are altered by LSD. These are the intellectual functions, especially problem-solving ability, learning, memory, abstract thinking, and association.

Jarvik et al [15,16] have shown that intellectual ability, including memory and problem solving, is impaired by LSD, proportionately with the dose. Such impairment is also readily observable clinically, in many tasks even as simple as serial seven subtractions. Many subjects who can normally perform this task easily cannot do so at all when under the influence of LSD.

Memory undergoes many alterations under LSD. There is sometimes a hypermnesis for remote events. In other cases this is not evident. On the day following the drug, and thereafter, there is sometimes amnesia for much of the drug experience. This generally occurs to an extent roughly proportional to the severity of the regression. In one case of ours, a subject's amnesia lifted when he took LSD a second time, then returned when the LSD wore off again.

In virtually all cases, with sufficient dosage there is memory impairment for immediate events. A subject given a simple sentence to repeat, repeats it in distorted form or asks over and over to have it repeated to him. Of course this may represent an impairment of learning as well as of memory. It would be difficult to separate the two processes under such conditions.

In order to test impairment of immediate memory more systematically, we employed the Wechsler Memory Scale, testing 16 sub-

jects who received a moderate dose of LSD (72$\mu$g) (Silverstein and Klee [30]). This test covers a number of aspects of memory for recent material, including memory for geometrical figures, digits, word associations, and for paragraphs of verbal material. Definite impairment of many aspects of memory was demonstrated. There is no doubt that memory is more severely impaired with higher doses of LSD, but subjects are difficult or impossible to test on the larger doses.

In another study (Silverstein and Klee [31]), with 24 subjects, tested on the memory span subtest of the Wechsler Memory Scale and given a dose of 2$\mu$g/kg LSD, it was demonstrated that memory span for digits was significantly impaired. In another pair of experiments (Aronson, Waterman, and Klee [3]) we tested the effect of LSD on the learning of paired associates. (The subject is given a series of words in pairs. His task is to respond with the second word of the pair when presented with the first. The number of trials needed is used as a criterion of learning ability.) The results of these studies indicate that this type of material, once learned, under the effects of LSD, is retained as well as when learned in the nondrug state. Over-all learning of a list of 22 neutral word associates was accomplished in no more trials for LSD subjects than for the controls. In the second experiment in which 30 paired associates, some of them emotional words, were used, over-all learning was significantly slower for the LSD subjects than for the controls. There was no difference between experimental and control groups in the amount of difficulty manifested in learning emotional words. A variety of explanations could be offered for the impaired learning under LSD on the second test. A simple explanation is that it was a longer and hence more difficult task. This would make it much more trying for LSD subjects whose attention span is limited. Another way of looking at the results is in terms of the LSD subject's inability to compartmentalize, or to separate one event from another. The hypothesis is offered that, along with his general failure to place bounds on perception and feeling, the LSD subject may also tend to lose cognitive boundaries. In the longer test, the subject has a greater reservoir of recently learned material to confuse with the required response. This hypothesis could be tested by repeating the original study and analyzing the learning errors made by LSD subjects as compared with those in the control state.

A study of Dual Pursuit performance was conducted with 20 subjects (Silverstein and Klee [29]). The Grether Dual Pursuit apparatus was employed. In this test the subjects' task was to keep two pointers, one vertical, the other horizontal, centered on their target marks, controlling them by means of two knobs, one operated by each hand. The pointers drifted slowly off their targets, and the subjects had to turn the knobs to return them to their marks. The time that both pointers were simultaneously on target was automatically cumulated for each trial. Learning and performance of this task were significantly impaired during the height of the drug reaction, as compared with controls. It appeared that this impairment was primarily related to a difficulty in concentration.

Now the significance of such intellectual impairment must be considered, especially in relation to ego functions. Conscious thought is considered to be mainly or entirely within the "conflict free ego sphere." The adaptive functions of thought are well recognized. Freud speaks of thought as "an experimental way of acting." [11] In the same paper he gives some emphasis to the role of memory as a foundation for conscious thought.

In *Ego Psychology and the Problem of Adaptation,*[14] Hartmann presents a detailed analysis of the role of thought in adaptation. He states:

> The intellect implies an enormous extension and differentiation of reaction possibilities; it subjects the reactions to its selective control; it creates and utilizes means ends relationships. By means of causal thinking connected with space and time perception, and particularly by turning his thinking back upon the self, the individual liberates himself from his slavery to the stimulus-reaction compulsion of the immediate here and now. The intellect understands and invents; according to some views its function is more to pose than to solve problems; it decides whether the individual is to accept the

reality of an event or to change it by his intervention. . .

LSD subjects have also been noted by some observers to lose the ability to think abstractly. DeShon et al [8] have reported that subjects asked to interpret proverbs often give very concrete answers to them. Others give abstract answers which are wide of the mark. We have ample experience with LSD subjects which confirms this finding. In order to study this area more systematically, the Gorham Proverbs Test was administered to 16 subjects under drug and control conditions (Silverstein and Klee [30]). The test, using a fairly wide selection of proverbs and allowing for controls, confirms and extends the clinical evidence for impairment of abstracting ability in LSD subjects. It is not to be supposed that this phenomenon is limited to the subject's ability to interpret proverbs. This is only one of many tests of abstract thinking or conceptualization that would be affected. Moreover, this change in thought processes is representative of a general and profound alteration of the LSD subject's experience of himself and his environment. This "concrete attitude" is one of the most impressive aspects of the LSD reaction, but is one which, by its nature, almost defies description by the subject on the abstract verbal level, at the time of the experience. Among its numerous manifestations is the pictorial quality of thoughts, which are poorly differentiated from real objects. The relationship to objects, including people, takes on an unusual quality and depth and an immediacy which dissolves the ordinary experience of continuity from moment to moment. Moreover, as noted earlier, the subject may be unable clearly to differentiate himself from his environment.

The following quotation from Goldstein [13] is relevant to the discussion at this point. Goldstein's observations of concretism in large numbers of patients with schizophrenia and organic brain damage led to this statement:

> The concrete attitude is realistic. In this attitude we are given over and bound to the immediate experience of the given thing or situation in its particular uniqueness. Our thinking and acting are directed by the immediate claims made by one particular aspect of the object or situation in the environment.
>
> In the abstract attitude, we transgress the immediately given specific aspect or sense impression; we abstract from particular properties. We are oriented in our action by a more conceptual viewpoint, be it a category, a class or general meaning under which the particular object before us falls. We detach ourselves from the given impression and the individual thing represents to us an accidental sample or representative of a category. . .

The remarks of Hartmann and of Goldstein enable us to appreciate how impairment of intellectual functions by LSD contributes to the unique experience which it creates.

The effects of LSD on the associative process were studied by the use of the word association test of Rapaport (WAT) (Weintraub, Silverstein, Klee [33]). In this study 25 normal male subjects were administered the test 1½ hours following a dose of 2$\mu$g/kg of LSD. Their responses were compared with those of a control group. In this test the subject is asked to respond with a spontaneous association to each of 60 stimulus words. Twenty of these words are considered to be "traumatic" and include such words as breast, masturbate, and mother. "Nontraumatic" stimuli include such words as chair, screen, and farm. Responses are rated on the basis of reaction time and on the basis of the quality and appropriateness of the response.

As compared with normal controls, LSD subjects were found to make more errors, have fewer popular responses, and to react more slowly. In addition "close reactions" predominate. (This is one of Rapaport's response categories and is exemplified in the extreme form by such responses as clang associations, definitions, and repetitions.) Serious deviations are also prominent, and the differential reaction to traumatic and nontraumatic words is abolished; that is to say, LSD subjects frequently responded to neutral words as though they were traumatic words. It is of significance that these responses following LSD differed not only from the responses of the normal controls but from the results obtained by Rapaport from schizophrenic, depressive, and neurotic patients. Of particular interest is the loss of

differentiation of responses between traumatic and nontraumatic words. As we have suggested previously (Weintraub, Silverstein, Klee [33]), there appears to be a dissolution of boundaries between the autonomous and conflictual areas of the ego.*

Another interesting way of regarding this result is suggested by the work of Bridger [7] who cites neurophysiological results of several authors which indicate that such drugs as LSD and mescaline "inhibit neocortical activity and activate the limbic system." (The evidence does not support the sweeping statement that these drugs "inhibit neocortical activity," but as mentioned earlier there appears to be an impaired conduction along association pathways, which is sufficient for Bridger's hypothesis.) On the basis of this evidence he postulated that such drugs would prevent the subject from being able to differentiate the signifier from the signified, or, in his experiments, the conditioning stimulus from the unconditioned. Bridger then went on to test this, using mescaline (which has effects almost indistinguishable from those of LSD), and found that indeed the stimuli were not differentiated from one another. The animals squealed and howled to the signal for the shock just as they did for the shock. Bridger offers the plausible explanation that in the absence of effective neocortical function the activated limbic system is unable to differentiate the two stimuli, thus leading the animal to react to both in the same manner. It is of interest in passing to observe the close analogy to the "concrete attitude" in humans, in which the signifier is also poorly differentiated from the signified, or the symbol from the object. Thus far, however, Bridger's concepts do not explain the loss of differential response to traumatic and nontraumatic words in our subjects. A further inference may be helpful. Starting with the premise that discrimination is impaired on the basis of impaired neocortical activity, and there is activation of the limbic system, which is likely to be associated with a hyperemotional state, subjective response may be determined not so much by the quality of the stimulus as by the state of the organism. A "neutral" stimulus becomes a "traumatic" one because it impinges upon an organism which has poor ability to discriminate and which is prepared to respond emotionally.

These considerations represent only a limited explanation of the phenomena at hand and ignore many other equally plausible explanations. The best test of their value will come from further experimental studies in man and other species.

### Defensive Functions of the Ego

In the preceding discussion little attention is given to the effect of LSD on the defensive functions of the ego as tested by the word association test. In a second study (Weintraub, Silverstein, and Klee [34]) a group of LSD subjects were compared with a group of controls in their ability to "correct" deviant responses on the WAT. In this study both groups were given the WAT in a drug-free state. One week later the test was repeated in both groups. In the second week, however, the experimental group received 2$\mu$g/kg LSD 1½ hours prior to the test. On the retest the control subjects (who were given no additional instructions) were able to "correct" a significant number of their pathological responses. The LSD subjects, however, tended to repeat their previous responses without any "correction." The authors hypothesized that normally there is a mobilization of ego defenses on the retest, enabling the subject to correct many of his original deviant responses. The failure of the LSD subjects to make this correction suggests a significant impairment of this defensive function.

This leads us to the general subject of the effects of LSD on ego defense mechanisms. We do not have additional completed experimental data on this subject, but a few clinical observations may be in order. It is generally remarked that LSD dissolves the repressive barriers, or that defense mechanisms are generally impaired. These statements, in my opinion, are not entirely accurate. It is true

* This interpretation of the results was suggested by Rapaport in a verbal communication.

that the subject's ability to repress is likely to be impaired. But as these barriers are lowered, and charged material threatens to enter awareness, an increased mobilization of repressive efforts often occurs in waves, operating massively and crudely to block out not only the threatening material but much associated material as well. As repression fails further, various other more regressive mechanisms are brought into play, such as denial and projection. Only occasionally will defense mechanisms fail almost entirely in certain subjects and a panic state ensue. More often, new defenses are brought into play, and the subject reaches relative equilibrium at a more regressed level. Certain mechanisms, especially repression and reaction formation, appear to be most vulnerable to LSD. Other, presumably more primitive defenses, such as regression denial, introjection, and projection, may function very effectively. For example, some predisposed subjects are capable of developing highly systematized paranoid delusions under the effects of marked LSD intoxication. In each case, subjects tend to fall back on those defenses which are most available to them, based upon their personality structures. Underlying conflicts and the presence or absence of stimuli in the environment which may evoke specific conflicts also play a role. By applying these principles, one can make a fairly accurate prediction of how a chosen subject will react after taking LSD (Klee and Weintraub [18]).

We may summarize by saying that LSD does interfere with the subject's ability to employ defenses in the most adaptive manner. The organism responds by mobilizing its resources and usually succeeds in achieving relative homeostasis at a new level.

### Motility and Behavior

We have already mentioned the difficulties in physical coordination experienced by LSD subjects, but there are also behavioral phenomena which seem worthy of description.

In "Formulations Regarding the Two Principles in Mental Functioning," [11] Freud noted the function of thought as a means of postponing action. "Thought, was endowed with qualities which made it possible for the mental apparatus to support increased tension during a delay in the process of discharge." Thus, when a drive attempts to express itself, the human is capable of pausing, weighing the situation, and, if necessary, postponing the energy discharge which the drive calls for. Very often the drive fails even to reach consciousness, if, in accord with the person's training, the time and place are inappropriate for its expression.

Considering the extensive impairment in thought processes produced by LSD we should expect some interference with this ability of the organism to bind tension and delay discharge. Actually, most LSD subjects remain rather passive while under the influence of the drug, avoiding direct mental and physical activity if possible.

There are exceptions, however. On some occasions during our studies we have seen subjects who found it difficult or impossible to control their behavior. These were usually persons who were rather aggressive and impulsive to begin with, but it sometimes occurs in other types. In the experimental setting, of course, these subjects were usually friendly and cooperative initially, but after taking LSD they found themselves overwhelmed with impulses, often of an assaultive nature. These feelings sometimes appeared to arise spontaneously or were provoked by a relatively slight incident, such as a painful venipuncture or a witticism directed at them by another subject. A subject at such times could barely resist putting his impulses into action. He would pace about, clench his fists, and grind his teeth to maintain control. Sometimes full-blown panic would ensue in the face of homicidal impulses which the subject felt he might be unable to control. One subject developed what appeared to be an hysterical paralysis of his limbs, apparently as a last-ditch control against assaultive behavior.

Such occurrences would lead us to believe that, for some subjects at least, there is an impairment of the ability to tolerate tension and to delay discharge. Further light is shed

on this question by a study employing the Porteus Maze test (Aronson and Klee [1]). This test consists of ten paper-and-pencil mazes graded for difficulty from very simple to very complex. Given unlimited time and several trials to complete each maze, the individual is given a score based upon the complexity of the mazes completed and the number of trials needed. The test is described by Porteus as a test of "social adaptability" or the ability to both inhibit impulsive solutions and execute critical planning toward the achievement of goals. Validation of these claims has been demonstrated by a number of studies in which the test has consistently differentiated between individuals of contrasting degrees of social adjustment, as determined by other criteria. Moreover, prefrontal lobotomy has repeatedly been shown to impair performances on the Porteus maze. It is well known, of course, that the lobotomized patient's behavior is characterized by poor judgment and poor impulse control.

Our results can be summarized very briefly. As compared with controls, subjects given 75$\mu$g or 100$\mu$g LSD showed marked impairment of performance on this test. Impairment was greater at the higher dose. The differences were highly significant statistically. These results not only confirm the clinical observations, but also demonstrate that the functions of judgment and impulse control are impaired, even in individuals in whom such impairment is not clinically evident. Apparently, other adaptive mechanisms, such as withdrawal and restriction of interest and effort, come into play to mask this impairment clinically in the majority of persons under the influence of LSD. Thus, the capacity for good judgment and impulse control is impaired by LSD, but many subjects succeed in employing adaptive mechanisms which mask this deficiency. Others may be less successful in doing so, especially when in a heightened affective state for whatever reason. Many of the considerations discussed earlier under the subject of ego defense mechanisms apply here as well. Subjects with a wide repertory of adaptive mechanisms (or defenses) at their disposal and with a minimum of strong psychic conflicts are least likely to give way to impulsive behavior.

## Improvement of Ego Functioning Under LSD

Sometimes when a subject is under the influence of LSD he will show signs which suggest "better" ego functioning. He may be more imaginative, freer, less defensive, wittier, etc. I am not convinced that such changes represent true enhancement or improvement of ego functions. A more parsimonious and a more plausible explanation is that moderate doses of LSD, like moderate doses of alcohol, may release the shackles of the inhibited person. An individual may thus experience a release of ego functions from repressive influences, with the apparent result that ego functioning is "better." We may also compare this change in some individuals with Kris' concept of regression in the service of the ego.[19] As Kris has pointed out, many creative persons are able to regress to more primitive ego states in pursuit of creative material. This is a reversible process which is not incompatible with a "healthy ego." Such a regression can be aided and deepened and even made more colorful with the aid of LSD. For the well-integrated individual this regression may be welcome and useful, but it does not represent a genuine enhancement of ego functioning.

## Comment

The preceding discussion touches upon only a small sample of the seemingly infinite variety of LSD phenomena, and much more could be said in the areas which are discussed. Another criticism is that the great bulk of literature on LSD has not been considered. My purpose will have been satisfied, however, if this attempt to organize some limited experimental data into a theoretical framework will illustrate the need for further efforts of this kind, both to give greater meaning to the data and to generate new hypotheses for additional study.

In its short history, psychiatry has developed at a pace which has been, to external appearances, disappointingly slow at times. During this period, however, the basic tools and concepts of psychiatry and related disciplines have been developing. It is this basic framework which has made possible the dramatic surge of experimental psychiatry in the past few years. Drugs with effects comparable to those of LSD-25, for example, have been known for generations, but it is only recently that we have been in a position to study them meaningfully. The long awaited millenium in which biochemical, physiological, and psychological processes can be freely correlated still seems a great distance off. This should not discourage us from responding to the occasional opportunities for observing parallels between these different orders of phenomena as are afforded us in experimental studies. Attention to these matters should be of great heuristic value and may also permit us to regard some aspects of personality functioning on new conceptual levels. The future promises increasingly rapid progress in our understanding of human behavior, since we need not rely entirely on the "experiments of nature" or the slow uncontrolled process of psychotherapy for our raw data, but can manipulate many psychological variables in the laboratory, under careful scrutiny. Many of our traditional concepts will probably be fortified with fresh evidence, others will be modified or discarded, but they will have served their purpose in serving as a foundation for further developments.

## Summary

A series of psychological studies with lysergic acid diethylamide (LSD-25) performed by myself and my associates with several hundred "normal" human subjects are described. The experimental data are discussed in relation to psychoanalytic ego psychology with an effort to demonstrate the usefulness of this theoretical model in understanding the effects of LSD. The field of discussion is also extended by introducing some tentative theoretical formulations which attempt to correlate certain psychological and physiological phenomena associated with LSD.

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