THE FUNCTIONS OF THE HUMAN FRONTAL LOBE*

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In 1930 the eminent neurologist Frederick Tilney (15) wrote as follows: "The entire period of human [evolutionary] existence, [may be spoken of] as the Age of the Frontal Lobe. . . . The frontal lobe, which has guaranteed such advantages to man, brought him his spiritual understanding, his social attributes, and his satisfactions from art and literature. . . . It is difficult to state which product of man's frontal lobe, his social development, his religion, his art, his literature, or his science, has meant the most." In contrast, Hebb (8) in 1949 wrote, "Although the frontal lobe is the favorite place in which to localize higher functions. . . . it is still true that there is no proof that any single higher function depends on this part of the brain."

Somewhere between these extremes the truth should lie.

Until the late 1930's our knowledge and theories concerning the functions of the frontal lobes were drawn from isolated instances of injury, tumor, or the like which occurred in humans or from cortical extirpation or stimulation experiments done upon animals. Extirpations in animals were disappointing to the theorists in that most frontal lobe operations failed to produce any pronounced and regular alteration in behavior after the primary effects of the surgery itself had disappeared. An occasional animal would show a marked change in behavior postoperatively but similar operations of other animals failed to produce the same results. The clinical reports of changes following injury or pathology of the human frontal lobes were even more unsatisfying. First, there were very few reliable records of the performance of the person before the injury took place, so that the postoperative status might be adequately evaluated. Second, only rarely could an accurate statement be made as to the portions of the brain which were injured or spared. Third, the clinical descriptions of the progress of patients who survived frontal lobe injury were, to say the least, puzzling. Descriptions varied all the way from no change whatever, to profound alterations in intellect, emotion, volition, and personality. Since the evidence was conflicting and since there was little opportunity for experimental determination of the facts, speculation was unimpeded.

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On November 12th of 1935, Moniz (neuropsychiatrist) and Lima (neurosurgeon) (of Lisbon, Portugal), carried through their first operation on the frontal lobes of a psychotic patient. Moniz wrote (12):

Mental disorders arise, in our opinion, in connection with the formation of [cortical] cellular connecting groups which have become more or less fixed. The cell bodies remain altogether normal; their axones may present no anatomic alterations, but their multiple connections, very variable in normal persons, may undergo more or less fixed arrangements . . . in certain morbid psychic states . . . . To cure these patients we must destroy the more or less fixed arrangements of cellular connections that exist in the brain, and particularly those which are related to the frontal lobes.

Moniz reported that of the first 20 mental patients submitted to operation seven recovered from psychosis, seven were improved, and six cases were not benefitted. For this and succeeding similar work Moniz was awarded the Nobel prize in medicine in 1949.

Moniz originated, and Freeman and Watts (3) in America developed, a new variety of brain surgery, called frontal lobotomy or leucotomy, for the alleviation of mental illness. The original surgical operation consisted of opening two small holes in the skull, one on either side, and inserting a leucotome (blunt dissector) into the brain through these holes. The leucotome is inserted to a depth of about six centimeters on successive sides and moved in a sweeping fashion so as to sever the white connecting tissue running between the thalamus and the frontal cortex.

The use of this surgical technique with psychotic mental patients produced in some instances astonishing results. In certain cases there was a rapid recovery from psychosis accompanied by a reduction of the self-conscious emotional reactions and a loss of “psychic pain.” After recovery from the operation some patients who had been totally disabled by their psychosis were able to return to the occupations which they had followed before their illness. Even old people suffering from a senile depression that had made their lives a burden to them found the depression replaced by a serenity of disposition. The most marked results were obtained in patients whose outstanding complaints were melancholia and/or obsessions, but perceptible alteration also occurred in many schizophrenic patients.

The mental changes which take place during and immediately following the operation are psychologically interesting. Since the surgery can be done under local anesthesia, the patient may remain conscious and able to report adequately. No change in complaints follows the fiber separation on one
side only. After a considerable portion of the connecting white fibers on
the second side are cut a marked change in mental state occurs. So long as
the white connecting tracts on one side are intact the patient remains oriented,
can carry out intellectual problems of considerable complexity, and, al-
though quieter, shows about the same degree of anxiety and distress as he
did before the operation was started. As a major portion of the connections
on the second side are severed the patient becomes unresponsive, disoriented,
and confused, and no longer exhibits any anxiety. At this point an occasional
patient may become more lively and engage the doctor in animated and
sometimes humorous conversation, or he may sing or say his prayers. But
all are unable to recall anything concerning their immediate surroundings,
and while the skin is being sutured, they may deny that they have been
operated upon. During the first few days following the operation, they
remain somewhat confused and disoriented. After a week they regain
orientation, and during the second week the mental confusion usually clears
up.

Patients who have undergone this sort of an operation (now known as
lateral transcranial lobotomy) are usually different from their prepsychotic
selves, although sometimes the difference is not immediately recognizable.
They are apt to be somewhat more indolent; they are often outspoken,
saying the first thing that comes into their heads rather than waiting to
think what response the remark will produce in others. They are aware
that they are hasty, undiplomatic, and tactless. The operation, when success-
ful, seems to break up or remove fixation on morbid emotional feelings. As
one patient expressed it, "The sensation has moved from the center of my
attention to the periphery."

In connection with the change in mental symptoms Freeman and Watts
(4) observed that certain patients who had also complained of unbearable
physical pain before operation were free from their complaints of pain after
lobotomy and at follow-up examinations months later seemed to have no
recolletion of the pain. Other lobotomy patients would describe the pain
when asked about it but their attitude toward the pain was changed. Both
the anguish and attention value of the pain seemed to have gone. The
pain was still there, but it was a sensation which could be disregarded
rather than a threat which could not be avoided. In 1943 they first at-
ttempted lobotomies to relieve intractable pain due to cancer, neurological
tumors, and phantom limb. In a fair number of cases there was a striking
relief from the unbearable pain, so much so that the narcotics which were
used to carry the patient through his agony could be discontinued.
More recently Koskoff et al (9), and Scarff (13) found that frontal lobotomy done on only one side of the brain seemed to be equally effective in relieving unbearable pain and the need for narcotics. Scarff demonstrated that it made no difference whether the lobotomy was done on the same or opposite side of the body from the origin of the pain or if the pain originated from both sides of the body. Also cerebral dominance was immaterial to the result.

Since 1940 a variety of surgical approaches have been devised. The openings in the skull through which the lobotomy is done have been made at almost every level. Operating through the thin portion of the skull over the eyeballs is known as supraorbital lobotomy. Actual surgical amputation of the frontal lobes (bilateral frontal lobectomy) has been carried out on a group of mental patients. The major veins draining the surface of the frontal cortex have been tied off with a resultant structural deterioration of portions of the cortical tissue served by the veins. Portions of the frontal lobes have been coagulated by the direct, momentary application of heat. Since the fiber tracts which connect the frontal cortex with certain nuclei of the thalamus are severed or rendered nonfunctional by most varieties of psychosurgery, the dorsal medial nuclei of the thalamus where these tracts originate, have been surgically destroyed. Collectively, brain surgery done with the intent of relieving the acute suffering of mental illness is called psychosurgery.

In 1946 the following observations could have been made with respect to relationships existing between the frontal lobes, mental illness, and psychosurgery. Some mental patients recovered completely while other patients were greatly improved although not cured, still other patients were no better, and a few were worse following psychosurgery. Since most of the operations were done in either a blind fashion (inserting the leucotome through a small hole) or in a way that did not permit one to be sure as to what particular portion of the brain was involved, there was no way of saying with any degree of accuracy whether any particular portion of the frontal lobes was more effective than another in bringing about recoveries. It had been observed that patients showing a press of emotion, agitated depression, or obsessive-compulsive behavior prior to the operation were more apt to improve than were patients in whom these features were not present. Some schizophrenic patients improved or recovered. As a rule, manic-depressive, alcoholic, and psychopathic personality cases did not improve following psychosurgery although there were exceptions. Most investigators had reported that there were changes in performance on sorting tests, on the
Rorschach test, and on reversible perspective tests. Most reports indicated that there was little or no loss in score on standardized intelligence tests, though the Porteus Maze test had been found to show a significant pattern of change after frontal lobe surgery. Finally there was debate on how one should judge the quality and amount of social and mental improvement brought about by psychosurgery.

The hope that it might be possible to shed light on questions of this sort led in March, 1946, to the organization of the first Columbia-Greystone project.1 This project was a collaborative venture of 12 medical and scientific disciplines and more than 50 investigators. Plans were made to apply, insofar as possible, the scientific method in an attempt to clarify the outcome of psychosurgery as well as to further general knowledge concerning the relationship between the frontal lobes of the brain and psychopathology.

Surgery was planned by the neuroanatomist in such a fashion that bilaterally symmetrical portions of the cortex of the frontal lobes would be removed in an open operation where the surface of the brain could be seen. (This new operation has been named frontal topectomy.) The plan of the operations called for removal of cortical tissue in such a fashion that in successive patients there would be different areas with some overlap of portions removed so that if particular areas were responsible for the mental changes the results might be related to the proper area. Medical, physiological, sociological, and psychological studies were planned so as to investigate from every angle a group of mental patients that were selected for study. After the plan had been worked out, 48 psychotic patients who had been in a mental hospital for more than two years and who had failed to respond to other forms of therapy were selected for therapeutic study. All of these patients were brought to the same hospital ward and all received the same treatment both before and after surgery. After as much relevant information as possible had been collected by various investigators the 48 patients were divided into 24 pairs. Each member of each pair was as nearly as possible equivalent to the other. The decision as to which of each pair should be operated was made by the medical and surgical specialists on the basis of which of the two was the best “risk” for operation. During the operative period two patients were taken to the surgery each morning. Both were anesthetized. Blood was taken from one for the blood bank; the other was subjected to brain surgery. The unoperated patients constituted

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1Unless otherwise stated the findings which follow are reported in Columbia-Greystone Associates, Selective Partial Ablation of the Frontal Cortex, New York, Hoeber, 1949.
a control group on which to base comparisons for the evaluation of changes which occurred among the patients who underwent topectomy.

After the operations had been completed the patients were studied for four months at the hospital by the co-operating investigators. At the end of this period the entire group of 48 patients were independently reviewed by hospital psychiatrists, who did not know which patients had been operated upon, to determine which patients were well enough to be recommended for parole from the hospital. The parole committee recommended that four of the 24 unoperated patients be paroled and that 20 of the 24 operated patients be paroled.

At this point it was found that for a variety of reasons not all of the patients who were thought to be parolable had suitable homes or places to go if they were to be paroled from the hospital. Hence, only four control patients and 16 of the operated patients were actually paroled from the hospital. At the end of two and one-half years 7 of the 16 operated patients were out and had never returned to the hospital. Three operated patients who were paroled had been back to the hospital for various periods of time but were out at the end of two-and-a-half years while six paroled cases had returned and remained in the hospital. The four paroled control patients remained out of the hospital. In the absence of any better objective measure of recovery or improvement from psychosis, being out of the hospital was the most acceptable criterion of improvement available. This was supported by the general observation that most of the paroled patients were changed in that they were free from their former psychotic state. Some of them were working and doing a satisfactory job for their employers.

The changes or social improvement of the operated patients were not found to be related to the age, sex, length of hospitalization, psychiatric diagnosis, or the weight of brain substance removed at operation. There were no regular or significant variations in blood chemistry, in the electroencephalograms, in the neurological findings, nor in the physiological or medical measures which could be related to the operation. So long as the motor area was not involved there was no paresis. If the motor area had been partially involved there was a transient paralysis followed by recovery. Although Broca's area was removed in two patients there was no evidence of any variety of aphasia in either, although in one of these two there was some residual dysarthria. Several patients had one or more convulsive seizures during the three months following operation, but in only one patient has the seizure pattern persisted. There were no basic changes in the sensory thresholds for pain, vision, audition, or cutaneous function. There were no
permanent changes in any motor or reflex functions (other than the convulsive seizures previously noted).

The psychological test battery included the Wechsler-Bellevue Intelligence test; Porteus Maze test; Continuous Problem task; learning and retention tests, comprised of both meaningful, semimeaningful, and verbal directions material; tests of the ability to abstract made up of sorting tests, the Weigl test, an Analogies test, an Essential Differences test and a Homograph test; tests of word association based on both the Jung list, the Orbison list and specially constructed lists; tests of time judgment for both filled and unfilled time; the determination of the threshold for visual critical flicker fusion; the Rorschach test; the Benton visual retention test; a memory for objects test; Levy movement cards; the Rubin figures; the Bolles progressive completion test; continuous addition and continuous subtraction tests; a double alternation test; the simultaneous concept test; a test of the sense of humor; a mirror drawing test; and inventories covering emotionality, physical and mental complaints, and social and ethical attitudes. This list probably comprised the most thorough psychological examination that had ever been given to a group of mental patients. Before considering certain specific changes which were brought about it may be stated that most of the changes in the test scores were found three weeks after operation and that the changes had usually disappeared by four months after operation. Such changes as did appear, either permanent or transient were not systematically related to any of the areas of frontal cortex removed, to the amount of cortical tissue removed, to the age, sex, or intelligence, diagnosis or years of hospitalization of the patient. The number of transient changes was greatest near the primary motor area (greatest in cases of ablation of Areas 6 and 8) and decreased in a regular fashion as one moved forward from Area 6 to Area 11—from agranular to granular cortex.

The Wechsler-Bellevue intelligence test, the word association test, time judgment test, mirror drawing, continuous problem task, all learning scores and most memory scores were unaltered. Most of the Rorschach scores and patterns were unchanged. There was no impairment or loss in the categorical attitude, in the ability to perform mental abstractions, or to make generalizations.

There was no evidence that any general factor of mental organization was significantly altered. Intelligence, speed, power, memory, attention, ability to abstract, verbal facility, and imagination, were not significantly decreased or increased.

Many, but not all, operated patients showed a transient loss of one year
or more in mental age as determined by the Porteus Maze test, which loss was regained at the end of four months by most patients including all those who made a social recovery. The threshold for visual flicker fusion (the critical rate at which flicker is perceived as a steady light) was decreased in nine patients, six of whom made a social recovery.

At this point we should emphasize several points since they are not in accord with the belief and knowledge we had in 1946.

1. We have no evidence of any permanent intellectual damage brought about by clean, uncomplicated surgery done on the prefrontal and orbital (granular) portions of the frontal lobes. It is possible that operations which involve the motor or premotor area, Areas 4 and 6, or their major centrifugal connections may produce some residual intellectual and psychomotor deficit. However, the evidence for this exception is not complete, satisfactory, or invariable. Removal of Area 44 (Broca's area) produced no disturbance in speech.

2. There is no evidence that such mental abilities as learning, memory, or association are changed or altered in any permanent fashion by ablation of the granular frontal cortex.

3. We obtained no evidence of loss or gain in creative ability, imagination, or high level intellectual achievement. We obtained no evidence of loss or change in social or ethical attitudes nor in humor.

4. Comparison of performance before and three months after operation on various projective tests including the Rorschach disclosed no regularly appearing change, even in those patients who recovered from psychosis.

5. The comparison of performance before and after operation with a wide variety of methods failed to show any regular alteration in the ability to generalize or to abstract, that is, the ability which Goldstein (5) called the categorical attitude.

Mainly, then, many things which might reasonably have been expected to occur did not occur.

Among the impressive and at the same time scientifically confusing facts which strike every careful observer of the behavior of the psychosurgical patient during the first month after operation are the marked changes (usually losses in terms of preoperative efficiency) in several, but not all of the functions tested or examined. One patient may be definitely slower on the tapping test, another patient has lost two years of mental age on the Porteus Maze test, the third patient definitely cannot remember as many objects which he has just seen as he could before operation, a fourth patient shows alterations in vocabulary function, and so on. But no regularity of
change is found even among patients who have had very similar brain operations. Frequently, but not always, it can be demonstrated that urging or pleading will extract a better performance which some have thought was an indication of loss in self-motivation. It is usually true that tests involving speed are more affected than untimed tests, so that others have thought a speed factor was involved. When psychologists return and apply the same or similar tests three months or six months after operation practically all traces of these changes, losses or gains, have vanished. A half-year after operation the test performance of the patients is usually as good or better than it was before operation. Usually the test performance closely approximates that of the unoperated control patient. The immediate postoperative changes were real but variegated and transient.

Some years ago Henry Head (7) analyzed similar phenomena seen in patients with brain injuries and concluded that the "extent to which the activities of a particular portion of the central nervous system exhibit at any moment signs of integration and purposive adaptation indicates its vigilance." These transient alterations following psychosurgery may be attributed to a decreased vigilance of the nervous system whose efficiency or capacity is lowered by the immediate effects of the surgery and their physical sequelae.

Within a very few days after operation a few patients will remark, quite spontaneously, "I'm well. The torment is gone. The voices are quiet." As time passes still others will remark that the distress or anguish is lessening. One of our patients said that the doctor didn't take out quite enough brain; that most of his trouble was gone, but not all. During a half year after operation there is clear verbal and behavioral evidence that the anguish or morbid emotion has evaporated or is diminished in a half to a third of those operated. Furthermore, the loss in anguish parallels the degree of recovery from psychosis.

A possible decrease in zeal (defined as ardent enthusiasm and active interest) following psychosurgery is a more debatable point than were the changes which we termed decreased vigilance and anguish. It may be, as some have said, that this change is merely a prolonged diminished vigilance or it may be that it is but the comfortable relaxation secondary to relief from intolerable anxiety and anguish. The diminished zeal shows itself in a variety of small ways in psychological examination as well as in everyday life. It takes more urging to get such a patient to give his best performance six months or a year after operation. He can do the tests, but usually he has to have an occasional prodding remark by the examiner to keep him going. In family life it is often reported that the recovered patient is lazy and careless.
If these characterizations are correct, the result of psychosurgery in approximately one-third of operated psychotic patients is an improvement from psychosis which is marked by a variable decrease in vigilance, anguish, and zeal. Are these three changes reflections of surgical damage done to the frontal lobe or are they part of the symptom picture of psychosis which changes when the psychosis as a disease is diminished? The evidence is not all in one direction but we are inclined to believe that the changes depend directly on the effect of the surgery. Those changes which have been attributed to a diminished vigilance are indeed transitory and appear immediately after operation and become less and less prominent as time goes by. The loss in anguish parallels the recovery from psychosis in those patients who do recover. But in nonpsychotic patients suffering from intractable pain the anguish is relieved by operation and was not part of a psychosis to begin with. The intractable pain may return or there may be a relapse into psychosis. In either event the anguish is again a leading symptom. A second operation may again bring relief. We now consider that this indicates that the anguish depends in some unspecific fashion on the generality of function of the frontal lobes. The evidence is clear that anguish is not localized in any particular portion of the frontal lobes. As far as we know at present anguish is not affected by brain surgery done on parts other than the frontal lobes.

We believe that the loss in zeal is related to the injury resulting from psychosurgery. The belief is based on reports made by clinical observers and not upon any systematic experimental study. Freeman and Watts (3) pointed out some years ago that lateral transcranial lobotomies in which the incisions were made more posteriorly gave rise to more frequent organic signs and more frequent deterioration to a vegetative level. In popular but inexact terms, the chances of making a “zombi” out of the patient increased as the incision involved more and more of the white connecting tracts of the agranular or motor cortex. The only patients we have studied ourselves who showed clearly this lack of zeal were one upper quadrant transcranial lobotomy done well back toward the fissure of Rolando and one in whom some portion of the cingulate gyrus (Area 24) was removed. The evidence is not overwhelming but it seems to point to some relationship between zeal and agranular portions of the frontal cortex.

An explanatory hypothesis of brain function which has often been advanced revolves about the possibility of compensation. Usually this means that the function which was lost or which is performed with diminished efficiency following brain damage, shows an increased efficiency with the
passage of time due to increased use of other methods in achieving the same result. Sheer and Shuttleworth (14) have obtained relevant evidence on this matter.

A homograph test is one in which the patient is required to give as many different usages as possible to each of a list of 12 words within a limited time. (For example, give as many different meanings as possible to the word DUCK.) The average score on this test in the second Columbia-Greystone project was 18.5 usages before operation. Ten days after operation an average of 30 per cent of the original usages were not given but 12 per cent of new usages were substituted by way of compensation. Ninety days after operation all but 10 per cent of the original usages were given while only 3 per cent of the substituted usages remained in the average score. We believe that this indicates that compensation is mainly a transient affair so far as verbal function of this sort is involved.

One further transient change deserves additional comment, namely, visual critical flicker fusion. This is the point at which the apparent flicker in an intermittent light source disappears and the light appears to be glowing steadily. This critical point varies among individuals. Those operated patients who had higher fusion thresholds suffered a reduction in threshold immediately after operation which decrease tended to be partially regained 90 days after operation. This phenomenon we interpreted as follows. The decrease means that there must be a greater time interval between flashes of light before there is a functional restoration of some mechanism which when tripped off sets up the visual process. If before operation this mechanism was so efficient that it was restored 24 times a second, then flicker would be perceived at 24 or at any rate less than 24. If the maximum rate of restoration was 25 times a second then flashes at 26 or 27 would overlap the restoration process and the result would be fusion which would be perceived as a continuous light. If the operation reduced the speed of restoration of the mechanism so that it was restored only 20 times a second then the threshold would be reduced, which is what we found. In patients who had a slow restoration mechanism to start with—one which restored itself only 18 times a second—little change might be produced and in such instances we did not find a change. In passing we should note that 9 of 17 operated patients who did this test in the first project showed a decreased threshold after operation and that 6 of the 9 recovered from psychosis. In the second project 3 of the 10 patients examined showed a postoperative decrease and 2 of the 3 were subsequently paroled from the hospital.

Intensive study of patients who have undergone several varieties of psycho-
surgery have been completed. It has not been demonstrated that interference with the granular or prefrontal cortex or its associated mechanisms produces any effect, the duration and occurrence of which is consistently related to the patient's improvement. The reduction in anguish or anxiety shown by improved patients may be related to the surgery or it may be a peculiar result of nonsurgical aspects of the operative procedure. Although it cannot be demonstrated that psychosurgery produces any particular effect it is worth examining certain hypotheses about how psychosurgery might produce improvement—if it does.

A number of investigators have advanced the idea that amelioration from psychosis is a quantitative affair. They have pointed out that many persons of schizoid personality become schizophrenic and that the psychosis is to be regarded as but a quantitative exaggeration of the basic personality. After operation such patients, they say, show a reduction in schizophrenic symptoms, returning to their prepsychotic schizoid personality. This, they regard as a quantitative reduction without change in basic personality structure. That there are psychosurgical patients whose improvement consists essentially in the diminution of troublesome schizophrenic symptoms cannot be doubted. That this explanation has serious limitations was indicated by the progress reports of several patients who were studied in the first Columbia-Greystone project and who recovered from psychosis. Two patients in particular, both hebephrenic dementia praecox, one a lobotomy and one a topectomy, were reported by social service and by the hospital psychiatrists to be of such changed personality that it was justified to consider that a qualitative difference in personality had resulted from the operation. Accepting for the moment the contention that the Rorschach method does reveal basic personality structure then the Rorschach personality sketches reported in the first Columbia-Greystone project are relevant to the point. These sketches indicated that some patients were essentially unchanged in personality structure following operation while others showed a definite change. Whether or not psychosurgery changes personality remains a debatable point, but certainly it is not established that changes are entirely quantitative and never qualitative.

The fact that the lateral transcranial lobotomy severs the fronto-thalamic connections has been repeatedly cited as evidence that cutting this specific system, rather than cortical removal, is necessary for a successful therapeutic outcome following psychosurgery. Certainly both the venous ligation operations and the Area 11 topectomies, which have in some instances been followed by undoubted amelioration from psychosis are clear evidence that
such specificity need not obtain. The report of Yahn et al (16), of 22 cases
of parietal lobotomy casts further doubt on the hypothesis of the specificity
of the fronto-thalamic tract. Yahn reported as follows, "Twenty-two pa-
tients were operated upon. . . . Only two cases with chronic schizophrenia
improved. The validity of the method could not be fully appreciated be-
cause in all cases other methods of treatment were tried; in 17 a previous
prefrontal leucotomy gave no results." Yahn obtained a slight improvement
following parietal lobotomy in two patients who had not benefitted from
frontal lobotomy, which is further evidence that severance of fronto-thalamic
tracts is not necessary in order to bring about recovery.

Another hypothesis has been constructed around the relationship existing
between the apparent deterioration or malignancy of psychosis of the patient
before the operation and his chances of ultimate recovery following psycho-
surgery. The general assumption has been that the patients showing the
least malignancy or deterioration were those having the best chances of re-
covery. The psychiatric reports from both the first and second Columbia-
Greystone projects indicate that the relationship between the ratings and
outcome are far from perfect. Either this hypothesis is invalid or the methods
of estimating malignancy or deterioration leave much to be desired. If
duration of hospitalization alone and outcome are compared, only a low
correlation was apparent in both studies.

A difficult question to answer if one holds to any theory of specificity
(specificity of tracts, cortical areas, diagnosis, personality type, or symptom
picture) and outcome is that of why certain psychosurgical patients who
recover following operation, continue in their nonpsychotic state for a
period of months and then relapse. When relapse occurs such patients show
the same psychotic symptom picture that was presented before the operation.
That is, whatever specificity in symptoms of disease existed, it was not
altered by the operation.

Finally, the loss of the anguish of intractable pain in certain—though not
in all—lobotomy cases, must be considered. These patients do not lose any
cutaneous sensibility, indeed some of them report that the pain from which
they have been suffering has not been extinguished but that its quality is
now such that it can be disregarded in somewhat the same fashion that the
hallucinated patient sometimes reports that lobotomy lowered the voices so
that they no longer demand his attention. It is customary to regard the
anguish in intractable pain as "real," in that it has a basis in actual physical
pathology, while hallucinations are considered "unreal," in that no known
physical basis exists. Evidently psychosurgery in some way disconnects,
wholly or partly, the mental bond existing between different orders of mental processes which may be either "real" or "unreal" in basis.

These considerations may be summarized as follows: Most psychological changes are transient and related to the operation. The loss in anguish associated with either psychic or physical pain is somehow a resultant mental disconnection associated with the event of operation. The amelioration from psychosis may be a quantitative affair but in some instances it seems qualitative rather than quantitative. The amelioration is only partially related to preoperative mental deterioration. Can any unity be brought into these conclusions?

Two alternative hypotheses suggest themselves. (a) Psychosurgery of the frontal lobes results in a narrowing of the field of attention so that there is a tendency for the patient to be stimulus-bound. (b) The surgery adds to the mental confusion of the patient. This confusion grows out of an interference with the associative bonds linking mental elements and is usually reported as a loss or decrease in the feeling of familiarity or increase in the feeling of unreality.

Mettler (11) pointed out that a leading symptom in lobectomy primates and in topectomized humans was a tendency to be governed by the immediate field of stimulation, particularly that portion of the field which had the highest attention-gaining value. Halstead (6) has also emphasized "stimulus-binding" after brain injuries. Peripheral stimuli which should be cues to more adequate or correct response are neglected. In these terms the changes after psychosurgery are to be conceived of as an overresponsiveness to immediate sense impression and a diminution of the effectiveness of those mental elements coming from past experience. In this fashion the loss of self-conscious anxiety, the forthright, bluntly spoken remarks, the lack of foresight, and loss in the anguish of intractable pain, become reasonable.

Landis and Bolles (10) have developed the idea that the loss of a feeling of familiarity shown by Zubin (17) to appear so clearly in patients following electric convulsive therapy can be extended to cover the general phenomena of amnesia and aphasia. Essentially the theory holds that the feeling of familiarity, is the associative bond holding the mental elements of memory and experience together. Electric convulsive therapy, head injury, and the like, act to break or weaken these bonds so that the conscious life becomes confused. Elements can be recognized but the feeling of familiarity is defective. Such patients are not sure how the facts, the elements of memory, experience, and of reality, fit together. It is as if the associations had weakened so that
the ideas are no longer connected as they were in the past or as they should be in normal mental life.

Either of these two hypotheses which we advance hold if it is accepted that psychosurgery decreases in an unspecific fashion, either peripheral attention, or the particular phenomenological attribute of feeling of familiarity. The transient postoperative changes are various because of selective inattention or the lack of familiarity. If the patient loses his psychic pain or psychosis, he may remark that the voices, the ideas are somehow detached from him. They can now be neglected, although if he thinks about them they are still available. The patient with intractable pain likewise becomes less bound to or familiar with his pain following operation.

We have consistently found in both the physiological and psychological studies a lack of specificity between the surgery done and the changes resulting. We have emphasized this lack of consistency in results and have argued that it does not fit in with most of the commonly advanced theories which purport to explain or rationalize the changes observed following psychosurgery. Either hypothesis which we have advanced is speculative but neither does violence to any systematic observations of which we are aware.

References

2. ———. Problems of the Human Brain: II. (In press.)


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