THE EFFECTS OF MEMORY ALTERATION IN SCHIZOPHRENIC
PATIENTS TREATED WITH ELECTROCONVULSIVE
SHOCK THERAPY

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THE EFFECTS OF MEMORY ALTERATION IN SCHIZOPHRENIC
PATIENTS TREATED WITH ELECTROCONVULSIVE
SHOCK THERAPY

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CHAPTER I

PRESENTATION OF PROBLEM

Introduction

In 1938 two Italians, Cerletti and Bini, introduced the use of electroshock for the artificial production of convulsive seizures. Since that time many studies have been concerned with the widespread usage of electroshock treatment. Electroshock has proved of great value in the treatment of psychotic depressions, in manic reactions, and in certain selected cases of schizophrenia.

The effect of electroshock on depression is independent of whether or not the depression is of manic-depressive, involutional or reactive type. Electroshock is also very effective to an almost equal, or slightly less degree, in other conditions in which defenses are either insufficient or inoperative. This is particularly true of acute catatonic states, as well as other schizo-affective states, in which schizophrenic and affective features commingle.

While defenses become re-erected following electroshock, they also appear to become more flexible, thus facilitating psychotherapy and a general widening of the patient's adoptive potentialities. Electroshock is least effective in neurotic states and in the general group of schizophrenic states, in
which it is inferior to other forms of treatment; namely, to insulin coma treatment in most cases of schizophrenia.

The amnestic phase following electroshock therapy, like all other clinical phenomena, shows considerable variation from patient to patient and from shock to shock, even in the same patient; but next to loss of consciousness, it is the most prominent clinical feature observable.

Statement of Problem

The problem of this investigation is twofold. First, to demonstrate the effects of the variation of convulsive-non-convulsive electroshock treatment used in this study in relation to memory alteration in schizophrenia as measured by the Wechsler Memory Scale. Second, to determine those aspects of memory that are the most affected, and those that are the least affected by this form of treatment. As the schizophrenic process is introduced as an intervening variable, it would be anticipated that the degree of memory alteration is also an indirect measure of the effect of electroshock treatment on the schizophrenic process. It has been shown that the functional intelligence of psychotic patients is generally reduced fifteen to twenty-five points. As Mental Quotient (M.Q.) correlates highly with intelligence, an improvement on M. Q. would suggest therapeutic improvement in the schizophrenic processes. Since electroshock treatment is not considered to be very effective in schizophrenia, it is believed that there will
be no significant improvement in memory quotient. Significant reduction in M. Q. would be believed to be a result of the after effects of the electroshock treatment where the transient residuals of memory impairment and confusion still persist.

The main limitation of this study consists in not retesting these patients at later and intermittent time periods to observe the degree of improvement or persistent impairment. The amnesia for the treatment is one of the reasons for its popularity, and it has impressed some clinicians to such an extent that they have proposed amnesia as a cornerstone for theoretical explanations of the therapeutic efficacy of electroshock therapy.

Background Knowledge and Theory

Learning, retention, and memory are three stages that every event, whether laboratory learning or life experience, undergoes; and the failure of memory may be attributed to one of these three aspects:

There may be deficiencies in the original learning; or there may be a natural interference with the retention process; or the active remembering which we call reproduction, recall, or recognition may fail. It is important to know which one of these three aspects we are concerned with when we speak of the global concept of amnesia. If there were no opportunity to learn or to experience a given event to begin with, amnesia for the given fact or event would be out of the question. Thus the events occurring during the unconscious state in electroconvulsive treatment are not properly forgotten. They were never experienced. Similarly, some events occurring just before shock are not always retained, either because they were not fully
observed, or because insufficient time elapsed between the registration of the memory trace and the shock so that the condensation period required for crystallizing the memory was not sufficient. Third, retention may be unimpaired, but the patient may be unable to reproduce exactly the memory in question. This inability may be the result of alteration in the memory trace or may be due to certain intraorganic conditions such as fatigue, emotional attitudes toward the memory, etc. The importance of memory alterations due to emotional or other interpolated psychological variables has been stressed by the Gestalt School, as well as by general learning theory and has been proposed as one of the theories for explaining forgetting. Finally, the fault may be not with the learning or registration, nor with the reproduction, but with the actual memory trace itself. There may be actual destruction of memory in the organic sense. In such cases the memory is of course lost forever, and only learning anew will cause the material to be retained (3, pp. 33-34).

In all of these considerations it must be remembered that there are individual differences in learning, retention, and active remembering. Consequently, a certain amount of forgetting is to be expected in some patients and a greater or lesser amount in others regardless of the influence of shock. It must also be remembered that the registration process in mental patients is much slower than in normal individuals; hence at least some of the apparent amnesia observed clinically may be due to imperfect registration.

The mode of action of electroshock is not entirely known and none of the theories regarding its action is adequate to cover all the available data. Some investigators suggest that,

Cerebral anoxia, a result common to all the shock therapies, may somehow be the basis for the mental improvement. In both hypoglycemic and convulsive shock therapies the brain is deprived of energy and
oxidative metabolism to a degree that renders it inadequate to support cerebral function. The mechanisms producing these conditions are different however. With hypoglycemia, the brain is deprived of glucose and cerebral metabolic rate is depressed. With electroshock brain activity is raised to such a high pitch that cerebral function cannot be sustained by the oxygen and glucose coming to the brain in the blood (2, p. 555). Alexander showed that,

The memory disturbances following convulsive electroshock are not due to a structural type of lesion, but rather to a physiologic state of cortical inhibition; by demonstration that these memory disturbances can be readily cleared up by nonconvulsive treatment which produces excitation of the cerebral cortex in contrast to convulsive electroshock which appears to produce inhibition (1, pp. 220-221).

Many clinicians take a less physiological approach in explaining memory disturbances following electroshock. They tend to believe that,

People forget things because some psychic force pushes the memory out of consciousness. The experimentalists, although they permit the workings of other types of memory losses also in their framework of explanations, believe that forgetting takes place primarily because of the interference of other memories (3, p. 37).

The clinical observations vary from observer to observer, but it is generally agreed that there are at least four different phases of memory involved. The first deals with the immediate effects which are apparent at the moment the circuit is closed. The second deals with the memory losses which seem to become aggravated after the fourth or fifth treatment session. The third deals with the general confusion and disorientation which occurs between treatment periods and which no doubt affects the entire mental life of the individual.
Finally, the fourth deals with the long-range net effect of the treatment after cessation of electroconvulsive therapy. The type of memory loss in each of these four phases differs considerably and it is well to bear in mind the particular phase of treatment when discussing experimental results (3).

As a result of early observations a systematic effort was instituted to determine the different aspects of memory that suffers and those that go unscathed. By utilizing implanted memories, it was found that recall and relearning show a complete loss after shock; whereas, recognition memory is hardly touched by the shock treatment. Another result of this investigation was the fact that remote memory was less affected than recent memory. That is, implanted memories that were further removed in time from the shock showed less effect of the shock than those that were learned immediately before electroconvulsive shock. It was concluded that in orthodox means of stimulation, shock does not destroy the memory trace, but simply disorganizes it (3).

Whether or not memory losses constitute a basic feature of electroshock therapy is still debatable. The hypothesis that the patient recovers because his memory for adverse events or retraction is wiped out is hardly tenable since no evidence for destruction of memory traces is available. Even in instances where memory loss has persisted for a longer period, there is a suggestion of slower recovery rather than of complete annihilation. The evidence from loss of
familiarity seems to be highly suggestive. Since the feeling of familiarity bridges both the field of memory and the field of emotion, it may be possible that a lowering of the threshold of familiarity is sufficient to free the patient from his anxieties about certain events and situations which formerly proved to be disruptive of his organized mental life. It is this link between emotion and memory that may contain the essence of the change that occurs in electroshock therapy.

Assumptions and Hypotheses

Since memory quotient on the Wechsler Memory Scale is highly correlated with intelligence, and recognizing the tendency for a functional reduction of abilities associated with the schizophrenia reaction, and improvement in M. Q. would be believed to be related to an improvement in the schizophrenic process. Since electroshock treatment is not considered by many to be very effective in the treatment of schizophrenia, it is believed that there will be no significant improvement in memory.

Since memory impairment is a classical feature of patients treated with electroshock therapy, it would be presumed that the number and frequency of electroshock stimulations administered would bear a relationship to the degree of memory alteration. On the assumption that significant reduction in memory quotient would be believed to be associated with the after effects of the electroshock whereby the transient
residuals of memory impairment still persist, the following hypotheses were set up for investigation:

1. Post shock testing will reveal a reductive tendency for the Memory Quotient scores.

2. Post shock testing will reveal a reductive tendency for the seven subtests on the Wechsler Memory Scale.

3. The number of convulsive electroshocks will be negatively related to change in Memory Quotient scores.
CHAPTER BIBLIOGRAPHY


CHAPTER II

RELATED STUDIES

An investigation of the literature pertaining to the effects of electroshock treatment in relation to memory impairment discloses that the variability of results is related to various factors, such as the techniques of measurement, the varied and extended use of shock treatment, and the duration of elapsed time from the termination of treatment.

Electroshock convulsions were first studied by early investigators with regard to the effect it had on animals, and with the hope of discovering basic principles governing the manifestations of electroshock convulsions which could later be tested at the level of human behavior.

These investigations showed that animals demonstrated a reversible impairment of habit-retention, habit-performance, and learning ability which bears an reverse relationship to the time after an electrically induced convulsion. These decrements, when they do appear, may persist for an extended period of time. General activity is reduced significantly during a series of electroshock convulsions, this reduction continuing for some time after the first convulsion to its initial level. Weight loss occurs immediately following the first convulsion, reaches its maximum as the treatments
continue, and returns to the level of control only after the treatments have ended (6).

Studies have shown that tissue impedance is altered not only as a function of the intensity of the stimulus, but also as the number of convulsions increases (5).

Other reversible changes are: markedly impaired respiration of brain tissue. Cortical electrograms show disturbances in the electrical activity of the cortex during the electroshock convulsion.

There are certain irreversible changes which may occur under certain conditions of stimulation. Such changes, in the form of hemorrhage or nerve cell alterations, may be found when the dosage is of high intensity and long duration. It is, however, doubtful that histopathologic changes in the brain occur within the usual range of electroshock dosages (7).

Literature on the prolonged effects of electroconvulsive shock treatment in regard to human behavior is relatively scarce.

Rabin reports a study of six chronic schizophrenic patients who had after several years been subjected to a total of from 110 to 234 electroshock treatments, were studied by means of the Rorschach test and additional standardized psychometric techniques.

Over half of these patients presented a picture of organic effects as measured by (1) repetition of the same response or preservation of content, (2) paucity of content,
(3) color naming and color describing, (4) deterioration of the fantasy life (5).

Due to the scarcity of subjects, inadequately explained procedure, and the failure to mention the time element of the psychometric testing, this study offers very little light to the effects of prolonged application of electroconvulsive shocks, in regard to organic deterioration.

Janis and Astrachan tested the hypothesis that,

After the gross organic effects of electroshock treatments have cleared up, the patients are left with a residual memory impairment which is manifested by a reduction in mental efficiency in tasks requiring the production of previously acquired symbolic associations (2).

Their study designed to test the prediction that electroshock treated patients will exhibit more recall errors, and will be generally slower in responding to routine questions about their past.

Using a control group of eight and an experimental group of nine, they equated their backgrounds with respect to age, sex, occupation, duration of current hospitalization, and date of onset of the mental disorder. The electroshock treated group and the control group were not, however, equated on diagnostic categorization. Both groups ranged from neurotics to psychotics, although they differed little in regard to severity of illness and type of mental symptoms. The electroshock treated patients received from ten to thirty treatments, spaced three times a week. The mean of treatments
for the entire group was 18.7 convulsive treatments.

Post-treatment testing indicated that the treated patients revealed pronounced recall failures. The forty items in the test elicited a wide range of detailed information. The initial pre-treatment test showed no significant difference between the two groups. After treatment, however, the electroshock group displayed a significant decline in the number of questions they were able to answer. The electroshock group also showed a higher average response time. Mean response per item was greater, fewer specific details were produced in response to those questions which elicited at least some personal information, and they left more questions entirely unanswered.

Stone studied the effects of electroconvulsive shocks on cognitive functions in psychotic patients that were as-

sessed by means of the Wechsler Memory Scale. Two groups of patients were tested. Group I, composed of fifteen patients, took Form 1 just one day before their first, and Form 11 one day after their last convulsive shock. The loss in memory quotient is indicated by a difference of 17.1 points (15.1 per cent of the initial score) between the mean scores. Group II, consisting of fourteen patients, took Form 1 just one day after their last convulsive shock and Form 11 slightly more than two weeks thereafter. There was a mean gain of 23.1 points in Memory Quotient, a value that is 27.9 per cent of the score on Form 1. Practice effects from taking a second
form of the memory test are believed to be small if present at all. Data were not available to determine what further losses would attend additional shocks, or what gains would accrue from additional time for recovery.

The Wechsler Memory Scales are highly correlated with scores from the Army Alpha tests of intelligence given at corresponding times.

"In view of this and other evidence, it is suggested that in appraisals of electroconvulsive shock we are concerned with a generalized alteration of cognitive functions, of which memory changes are only an integral part" (6).

Stone conducted a study on the course of change in intellectual functions associated with electroconvulsive shock. Five forms of the Army Alpha Intelligence test were administered to fifteen hospital patients at spaced intervals during and after a course of electroconvulsive shock therapy at the New York Psychiatric Institute and Hospital. The test scores showed, with five exceptions, an appreciable decline from the first to the last of the shock series, and a corresponding rise in scores during the three weeks following the last treatment. The mean of final test scores for this group of patients is approximately 18 per cent higher than that of their best previous scores (usually the initial test score). The gain is ascribed chiefly to improvement in the mental status of the patients as a group. Three patients who had taken one or more standardized intelligence tests before the
onset of illness offered a basis for comparing the relatively normal pre-illness level of test performance with that following the course of electroconvulsive shock (7).

Janis investigated the problem of whether post shock amnesia clears up completely during the usual recovery period (two to three weeks after the termination of treatment), or is the patient left with any residual impairment of recall functions after the organic syndrome disappears.

Using nineteen patients not equated diagnostically and a control group of eleven, Janis proceeded to interview the patients in which a wide range of personal memories was elicited. The experimental group was given a minimum of eight convulsive treatments spaced three times a week. A post-treatment interview was administered approximately four weeks after the termination of electroconvulsive treatment in order to test the patient's ability to recall the material he had been asked to recall at first.

It was found that everyone of the patients in the experimental group displayed definite retroactive amnesia four weeks after electroconvulsive treatment were able to recall practically every detail previously given.

Five of the ECT (electroconvulsive treated) patients were followed up two and a half to three and a half months after the last ECT. The conclusion of the follow-up studies indicated here that (1) "Amntheses are by no means limited to events of the recent past, although experience by no means
limited to events of the recent past, although experiences during the six months prior to treatment are more likely to be forgotten than those which had occurred in earlier periods" (2). "It appears that amnesias are selectively determined (disturbing episodes leading to hospitalization are more likely to be forgotten than other types of past experiences)" (3).

In the follow-up of four patients, two and a half to three and a half months after ECT the findings reinforced the conclusion that the post-ECT amnesias persist well beyond the usual period during which there is recovery from the transient "organic effects of ECT." This conclusion applies only to a standard series of electroshock treatments.

Since the advent of nonconvulsive electric stimulation or "countershock," many studies have been concerned with its physiological and psychological effects. Alexander reports on an extensive study carried out on ninety-eight patients, sixty-two of whom received 305 convulsive electric stimulation treatments, either in connection with convulsive electroshock or alone. The ninety-eight patients received 1081 electric treatments in all.

Alexander started using nonconvulsive electric shock treatment or "countershock" as a means of terminating prolonged apnea or laryngospasms which sometimes occur following convulsive electroshock treatment. He found that "countershock" promptly restored respiration as well as reversing
the circulatory side effects following convulsive electroshock treatment.

Nonconvulsive countershock also has modifying and alleviating effects upon three other complications of electroshock treatment. Namely on the so-called memory loss, on the reduction of spontaneous activity, and on post-electroshock anxiety.

I found that memory disturbance following electroshock was not only less pronounced than with convulsive electroshock alone, but appears that in a number of cases receiving convulsive electroshock only, memory frequently was dramatically restored as soon as a further convulsive treatment followed by a nonconvulsive countershock or a nonconvulsive treatment alone was given (1, p. 242).

Post-shock anxiety is not relieved if the nonconvulsive countershock is given through the standard placement in the frontal regions. Countershock in this placement frequently has an aggravating effect upon the post-shock anxiety. However, when the countershock is given through placement in the temporoparietal regions, it succeeds in alleviating post-shock anxiety (1, p. 243).

Convulsive treatment through frontal leads inhibits respiration temporarily; nonconvulsive treatment through frontal or temporoparietal leads stimulates respiration. Conclusive treatment through frontal leads relieved depression but reduces awareness for memory content and may enhance anxiety which nonconvulsive treatment through temporoparietal leads relieves anxiety and restores awareness for memory content, but may enhance depression. By using both, it is possible to avoid the "untreatable" residual after electric shock treatment (1, pp. 249-250).

In the summation of these studies, it is apparent that the action of electroshock remains unknown. Shock treatment is an organic treatment altering the metabolism of the brain tissue and that these changes produced in brain tissue have to be studied in correlation with psychological changes. As
Schilder expressed it "We are dealing here with an organic treatment reflected in psychological attitudes."
CHAPTER BIBLIOGRAPHY


CHAPTER III

METHODOLOGY AND DESCRIPTION OF INSTRUMENTS

Subjects

Forty women institutionalized at the Wichita Falls State Hospital, Wichita Falls, Texas, served as subjects in this investigation. These forty white schizophrenic women between the ages of twenty and fifty were diagnosed by the ward doctor, and borderline cases were excluded from this study. The schizophrenic reaction was clearly evident in all of the subjects tested. The subjects were chosen from the same ward and all of them were supervised by the same doctor. No attempt was made to differentiate the subjects into the various types of schizophrenia, nor was age considered except between the range of twenty and sixty-four as the Wechsler Memory Scale allows for age variation within these limits. Educational background was noted but not utilized in the controls, as it was not deemed pertinent to the problem. Duration of illness was not noted because studies by Howard, Beeb, Collins and others have shown that duration of illness has little effect on the M.Q. (1).

None of the subjects had any record of previous electro-convulsive treatment. They were all administered Form I of the Wechsler Memory Scale four days after their arrival at the hospital, and testing was done in the morning in a
secluded room off the ward. This time was allowed for routine processing of the patients and also to permit them time to achieve some degree of adjustment in the ward.

The retesting, utilizing Form II of the Wechsler Memory Scale, took place five days after the final non-convulsive treatment. This time was chosen principally for two reasons: (1) The patients on this ward are often discharged a few days after termination of treatment and would not be accessible for testing. (2) This time was considered sufficient to allow for the wearing effects of the shock treatment in regard to immediate memory recall. The major limitation of this study was the inaccessibility of patients for follow up study at various time intervals, as the time element is an important factor in relation to the wearing effects of the electroshock stimulations.

Description of Instruments

Wechsler Memory Scales Form I and II

The only instruments used in this study were the Wechsler Memory Scale, Forms I and II and the electric shock machine. The latter was used only by the ward doctor. However, the procedure of its utilization is pertinent to the obtained data and will therefore be described in detail.

The Wechsler Memory Scale consists of two forms, I and II. Form I was devised by David Wechsler in 1945. The scale was a result of some ten years of experimentation during
which time various items and groups of items were tried out. In its present form, it has been used since 1940 in Bellevue Hospital with provisional norms, based on the examination of approximately 200 normal subjects, ages twenty-five to fifty, both men and women. The subjects were not hospital patients. In about 100 of these, intelligence ratings obtained with the Wechsler-Bellevue Adult Scale were also available. Standardization was achieved as follows:

Mean scores for the population were obtained for each five to ten-year interval (ages twenty-five to fifty). The mean score of each age group was then plotted against the mean weighted intelligence test scores available for the subjects on the Verbal Performance and Total Scales of the Bellevue Examination. When this was done, it was observed that the line of means off the Memory Scale paralleled very closely that of the Performance part of the Bellevue. A trial and error technique was then used for equating scores on the Memory Scale with scores on the Performance Scale with the aim of making available the I. Q. tables of the Bellevue Performance as a first approximation for the obtaining of a memory quotient table (4, p. 88).

Both forms of the Wechsler Memory Scale consist of seven subtests. Test I, Personal and Current Information, consists of (How old are you? Who is President of the United States? etc.) The test discriminates very little or not at all between normal or even near normal subjects. It was included because of its usefulness in the examination of subjects with special defects, like the aphasics and seniles regarding whose disturbance it often throws useful light.

Test II consists of five simple questions like "What year is this?" "What day of the month is it?" , designed to test the subject's immediate orientation.
Test III, Mental Control, consists of three sub-items: counting backwards from twenty to one, repeating the alphabet and counting by three's. Its value is primarily in cases of organic brain diseases that are not too far gone but show defects which would not be made evident by simple rote memory items.

Test IV, Logical Memory, consists of two memory passages similar to the memory selection on the tenth year level of the Stanford-Binet and similarly scored. The subject's score is the average of the number of ideas he produces correctly on both passages. The test is intended to measure immediate recall of logical material.

Test V is the Memory Span for digits forwards and backwards. The series used are those employed in Wechsler-Bellevue Scales except that the maximum number of digits used in the series are limited to eight and seven, respectively.

Test VI is a test of Visual Reproduction which requires the subject to draw from memory simple geometric figures exposed for a period of ten seconds. Two of the figures are taken from those used in the Army Performance Scale, the third is taken from the Binet designs.

Test VII, Associate Learning, consists of ten paired associates, some easy and some hard, which the subject is required to learn in three trials. The items included were derived from the paired-associate list originally used by Wechsler in his study of the retention defect in Korsakoff psychosis.
The method arrived at for calculating M. Q.'s was essentially empirical and was arrived at by plotting the mean memory scores for different ages against the weighted scores of the Bellevue Scale (ages twenty to twenty-four years), and then trying out various constants which would keep the mean M.Q. for any age group equivalent to the mean I. Q. for that age group. The general form of the equation arrived at was \( Y = X / Ca \) where \( Y \) = the adjusted or corrected score, \( X \) the subject's original (raw) score on the Memory Scale, and \( Ca \) a constant which is a function of the age of the subject.

**TABLE I**

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For example, if a subject is twenty-two years of age, one should look in the 20-24 age bracket and add the constant which is directly across from it. In this instance it would be 33.

Table II on the following page shows the M. G. equivalents.
### TABLE II

**TABLE OF M. Q. EQUIVALENTS**

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</tr>
<tr>
<td>65</td>
<td>59</td>
<td>85</td>
<td>81</td>
<td>105</td>
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<td></td>
</tr>
<tr>
<td>66</td>
<td>59</td>
<td>86</td>
<td>83</td>
<td>106</td>
<td>114</td>
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<td></td>
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<tr>
<td>67</td>
<td>60</td>
<td>87</td>
<td>84</td>
<td>107</td>
<td>116</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>61</td>
<td>88</td>
<td>86</td>
<td>108</td>
<td>118</td>
<td></td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>62</td>
<td>89</td>
<td>87</td>
<td>109</td>
<td>120</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Method of Obtaining Approximate M. Q.'s for Revised Memory Scale**

1. Sum subject's partial subtest scores.
2. To this total, which is the subject's raw score, add constant assigned for age group in which subject falls, as given in Table II. This new sum is the subject's weighted or corrected memory score.
3. Look up equivalent quotient for this score in Table III. The value found is the subject's M.Q. as corrected for age.
4. Example: A subject, age forty-two, makes a raw score of sixty-four. Looking up Table II, one finds that the bonus to be allowed is forty, which makes a corrected score of 104. Looking up Table III, one finds the equivalent M.Q. to be 110 (4, p. 94).
The advantages of the Memory Scale are (a) its brevity—it takes on the average of fifteen minutes to administer, (b) it is relatively satisfactorily standardized, (c) the fact that an allowance is made for memory variations with age, and (d) the memory quotients obtained are directly comparable to the subject's intelligence quotient. The last is very important because it makes possible comparison of the subject's memory impairment with his loss in other intellectual functions.

To determine the relationship of first and second test scores on Wechsler Memory Scale, Form I was administered followed by Form II after an interval of from one to sixteen days (mean, four days). The subjects, twenty-seven in all, consisted of seventeen student nurses who had from one to four years of college work and ten female hospital patients, diagnosed as psychoneurotics whose ability to work on tests of this kind was adjudged by their chief physician as unimpaired. All of the hospital patients had the equivalent of high school or better education. The nurses were working at and the patients were living in New York Psychiatric Hospital, where the memory scale was administered to psychotic patients in connection with their course of electroshock therapy.

Since the majority of the psychotic patients were known to be above average in intelligence, it was assumed that this group of student nurses and psychoneurotic patients would afford a
suitable basis for estimating comparable changes in total score, due to repetition of the test (3).

Secondly, the two scales were administered to sixty college students, approximately three fourths girls and one fourth boys, who were enrolled in the elementary course in psychology at Stanford University. For half this number, Form I preceded Form II by a period of two weeks; for the other half, Form II preceded Form I by the same interval of time. The means of the total scores together with the critical ratios of differences between successive scores appears in Table III.

### TABLE III

**The Significance in Mean Total Scores on the Wechsler Memory Scale Form I and II**

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Means of Total Score</th>
<th>Difference $t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27</td>
<td>11-73.2  11-72.9</td>
<td>0.3 0.17</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>11-74.42 11-76.57</td>
<td>2.15 2.42</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>111-73.98 11-75.55</td>
<td>1.55 1.01</td>
</tr>
</tbody>
</table>

The loss or gain resulting from taking the two forms of the memory scale from one to sixteen days apart are small.

The directions for administration of Form II are identical with those prepared for the original form of this memory scale.
Utilization of Electroshock Technique

The technique of electroconvulsive-nonconvulsive shock therapy utilized in this study will be explained in detail as the method utilized here deviates somewhat from the more orthodox techniques of electroshock therapy.

The apparatus operates on 110 volts, 60 cycle alternating current and contains mainly a variable transformer ohm volt and ampere meters, and an automatic timer. The combined voltage and time settings constitute the "dose". Applications may range from 70 to 130 volts continuing from 0.1 to 0.5 seconds. Usually eighty volts for 0.2 seconds are tried; if this fails to produce a convolution, the voltage may be increased to ninety or 100 volts and the period of application increased.

After the first convolution there is a constant increase in threshold of five to ten volts. Therefore, ten additional volts should be given routinely in the treatment subsequent to the first seizure. After four treatments with this voltage, longer latent period is usually encountered and another five volts will need to be added. Electrical stimulation on the exposed brain has shown that a generalized seizure in man is obtained with a current ranging between five and ten milliamperes. The convulsive threshold of the brain is, of course, the same in electric shock treatment. Readings of 500 to 1000 milliamperes during the procedure mean, therefore that by far the greatest part is
lost in penetrating the tissue: only one hundredth or less may reach the brain. This clinical conclusion was confirmed by an electrologist (Plisset) who calculated from purely technological considerations that only one hundredth of the current applied to the skull (2). The dose is determined by the convulsion threshold of the patient. This threshold is higher in female than male patients and higher in middle aged than in younger persons. The threshold becomes elevated after the first seizure. Electrode paste is applied on the temple region to prevent burning of the skin and the spoons are then applied.

The patient becomes unconscious immediately after the current is closed and has no memory of a "shock." The convulsions conform closely to those of spontaneous origin with a tonic phase (characterized by continuous tension or contractions) continuing for approximately ten seconds followed by a clonic phase (a series of movements characterized by alternate contractions and relaxations) of somewhat longer duration. The convolution is accompanied by apnea (a transient suspension of respiration because of a decrease of carbon dioxide tension of the blood with the resultant absence of stimulation of the respiratory center). To alleviate the respiratory and circulatory side effects of the convulsive electric shock treatment, the "spoons" are applied to the neck region where the patient receives one to two seconds of nonconvulsive or counter shock. This also has the effect of relieving post-shock anxiety.
Fifteen to twenty minutes after the initial electro-convulsive shock, the patients are administered a second electroconvulsive shock. The termination point is reached when the patient is almost completely disorganized and disoriented in all three spheres. The behavior of the patient at this state of treatment is that of a vegetative nature. They are unable to care for their toilet needs and soil their beds. Speech is irregular and incoherent. The time factor necessary to reach this level of deterioration and disintegration varies from patient to patient. It is at this level that nonconvulsive electric shock treatment or "countershock" is applied. The patient receives under eighty volts for twenty seconds, this is administered twice a day with a fifteen to twenty-minute interval, and patients receive this treatment every other day for a period of eight days. This form of shock treatment is very painful, but is believed by some authorities to restore memory defect as well as alleviate anxiety at the end of the convulsive treatment series.
CHAPTER BIBLIOGRAPHY


CHAPTER IV

STATISTICAL ANALYSIS AND SUMMARY OF FINDINGS

For determining the degree of alteration between pre-shock and post-shock testing, Fisher's $t$, which is the maximum of significance at various levels, was utilized (1).

Inasmuch as the Memory Quotient on the Weschler Memory Scale is a composite of the seven subtests with respect to a constant for age variation, it was quite possible that the subtest scores would not be evenly distributed, and a skewed distribution of the subtests could in one direction or the other, appreciably alter the Memory Quotient, and perhaps present a picture that was a function of one or two subtests and not a distributive result of the seven test composite. Therefore the Fisher $t$ was utilized in determining the degree of alteration of each of the seven subtests. The implied assumption in determining the degree of difference between pre-test and post-test scores is that these seven subtests which purport to measure varying aspects of memory, will be related to the influence of electroshock. It is of clinical significance to evolve a better understanding of those subtests that indicate a significant reduction in relation to convulsive shock and those that indicate little or no reduction.

The $t$ scores obtained for the Memory Quotient and each of the subtests are presented in Table IV.
<table>
<thead>
<tr>
<th>W.M.S.</th>
<th>N</th>
<th>M_D</th>
<th>S_D</th>
<th>z Score</th>
<th>D.F. (N-1)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Q.</td>
<td>40</td>
<td>6.85</td>
<td>1.722</td>
<td>3.97</td>
<td>39</td>
<td>.001</td>
</tr>
<tr>
<td>I</td>
<td>40</td>
<td>1.17</td>
<td>0.208</td>
<td>5.59</td>
<td>39</td>
<td>.001</td>
</tr>
<tr>
<td>II</td>
<td>40</td>
<td>1.025</td>
<td>0.175</td>
<td>5.85</td>
<td>39</td>
<td>.001</td>
</tr>
<tr>
<td>III</td>
<td>40</td>
<td>5.75</td>
<td>0.301</td>
<td>1.90</td>
<td>39</td>
<td>-</td>
</tr>
<tr>
<td>IV</td>
<td>40</td>
<td>0.075</td>
<td>0.279</td>
<td>.27</td>
<td>39</td>
<td>-</td>
</tr>
<tr>
<td>V</td>
<td>40</td>
<td>-.35</td>
<td>.79</td>
<td>1.95</td>
<td>39</td>
<td>-</td>
</tr>
<tr>
<td>VI</td>
<td>40</td>
<td>-.35</td>
<td>.479</td>
<td>.76</td>
<td>39</td>
<td>-</td>
</tr>
<tr>
<td>VII</td>
<td>40</td>
<td>3.85</td>
<td>.621</td>
<td>6.19</td>
<td>39</td>
<td>.001</td>
</tr>
</tbody>
</table>

Memory Quotient scores revealed a reductive tendency of 3.97, which is statistically significant at the .1 percent level of confidence.

Subtest I, II, and VII were significant at the .1 percent level of confidence. Subtest V is not statistically significant, but does indicate a slight reductive tendency.

Subtests III, IV, and VI were not statistically significant, therefore acceptance of the null hypothesis supports the rejection of the originally posited hypothesis.

Since the Memory Quotient is a function of the seven subtest composite, the degree of influence on the significant subtest scores was sufficiently great, so as to elevate
the over-all test to a level of significance, even though all of the subtests did not approach this level.

For determining the relationship between the number of convulsive treatments received and the difference between pre-shock and post-shock testing, Pearson's Moment Correlation was utilized (2). The significance of the correlation was tested by the use of the \( t \).

### TABLE V

**RELATIONSHIP BETWEEN NUMBER OF ELECTROCONVULSIVE TREATMENTS AND DIFFERENCES OF PRE-TEST, POST-TEST SCORES**

<table>
<thead>
<tr>
<th>W.M.S.</th>
<th>N</th>
<th>( r )</th>
<th>( t )</th>
<th>( \frac{D.F.}{(N-2)} )</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Q.</td>
<td>40</td>
<td>.050</td>
<td>.31</td>
<td>38</td>
<td>-</td>
</tr>
<tr>
<td>I</td>
<td>40</td>
<td>.105</td>
<td>.16</td>
<td>38</td>
<td>-</td>
</tr>
<tr>
<td>II</td>
<td>40</td>
<td>.676</td>
<td>5.61</td>
<td>38</td>
<td>.001</td>
</tr>
<tr>
<td>III</td>
<td>40</td>
<td>.106</td>
<td>.09</td>
<td>38</td>
<td>-</td>
</tr>
<tr>
<td>IV</td>
<td>40</td>
<td>-.413</td>
<td>2.79</td>
<td>38</td>
<td>.01</td>
</tr>
<tr>
<td>V</td>
<td>40</td>
<td>.352</td>
<td>2.32</td>
<td>38</td>
<td>.05</td>
</tr>
<tr>
<td>VI</td>
<td>40</td>
<td>.072</td>
<td>.44</td>
<td>38</td>
<td>-</td>
</tr>
<tr>
<td>VII</td>
<td>40</td>
<td>.043</td>
<td>.38</td>
<td>38</td>
<td>-</td>
</tr>
</tbody>
</table>

The correlation between Memory Quotient and number of convulsive shock treatments is .05, and a \( t \) score value of .31, which is not statistically significant. Therefore,
acceptance of the null hypothesis statistically supports the rejection of the originally purposed hypothesis.

Subtest II yielded a correlation of .676 and was statistically significant at the .1 per cent level of confidence. Subtest IV yielded a negative correlation of -.413 and was significant at the .1 per cent level of confidence. Subtest V yielded a correlation of .352 and was significant at the .5 per cent level of confidence. Subtests I, II, III, VI, and VII were not statistically significant, therefore, substantiating the null hypothesis.

The mean number of convulsive treatments received was twelve, with a range from eight to thirty-two. Therefore, it is conceivable that a relationship could exist between the number of convulsive treatments and pre-test, post-test score differences outside of the range reported in this study.

Summary of Findings

From the data considered in this study, the following conclusions are drawn:

1. There apparently is a significant reduction in Memory Quotient scores between pre-test and post-electro-convulsive shock treatment.

2. Not all of the subtests reveal a significant reduction. Only those that deal with Personal and Current Information, Orientation, and Mental Control revealed a significant reduction.
3. Correlations between Memory Quotient scores and number of convulsive treatments received did not reveal a significant relationship.

4. The total M.Q. score revealed no significant relationship to the number of electroconvulsive shock treatments.

5. The number of electroconvulsive shock treatments showed a varying relationship to the subtest scores. Subtest II, Orientation, revealed the highest relationship and was statistically significant. Subtest IV, Memory Selections, indicates the second highest correlation, but revealed a negative relationship. Subtest V, Digit Span, revealed the lowest significant relationships. The remaining subtests indicated slight tendency to be related to number of electroconvulsive shock treatments, but were not statistically significant.
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CHAPTER V

SUMMARY AND INTERPRETATION

Summary

Forty white schizophrenic women between the ages of twenty and fifty served as subjects for this study. They were administered Form I of the Wechsler Memory Scale prior to receiving a series of convulsive-nonconvulsive electroshock treatments. Five days after their final nonconvulsive stimulation they were administered Form II of the Wechsler Memory Scale. No attempt was made to differentiate the subjects into the various types of schizophrenia, nor was the duration of illness noted because studies have indicated that duration of illness has little effect on the Memory Quotient.

The problem of this investigation was twofold: first, to demonstrate the effects of the variation of convulsive-nonconvulsive electroshock treatment reported in this study in relation to memory alteration in schizophrenia; second, to determine those aspects of memory that are most affected and those that are least affected by the electroshock.

It was discovered within the scope of this study that there was a significant memory impairment following this variation of electroshock treatment. However, this impairment
is not a result of a generalized reduction of the seven subtest composite, but rather the effect of specific subtests which reveal a highly significant reduction. The remaining subtests on this scale revealed no significant reduction.

Interpretation

It can only be concluded that at the time of retesting the patients evidenced a significant memory reduction. Since time has been shown to be an essential factor in regard to the post-effects of convulsive treatment, no definite conclusion can be made as to the nature of the memory impairment. Follow-up studies are needed to determine whether or not the memory impairment associated with this type of electroshock treatment is the result of organic and irreparable damage or whether it is a residual transient impairment which at a later date would be restored or improved to the pre-shock level. Many studies have indicated that with the orthodox method of convulsive treatment (that is administered three times a week), the impairment is transient, and that the persistent amnesia that is so characteristic of this treatment is of a selective and temporary nature. Inasmuch as two of the three subtests that revealed significant reduction were concerned with Orientation and Personal and Current Information tends to suggest that the impairment is transient with selective amnesia.
If the impairment were organic in nature, it would appear likely that the reduction would be indicated by a general lowering of performance on all of the subtests rather than a subtest to subtest variation of significance.

In testing the third hypothesis to determine whether or not the number of convulsive treatments was related to the difference of pre-test-post-test scores, it was discovered that the Memory Quotient revealed no significant correlation, although some of the subtests indicated a significant relationship.

As a result of the limited possibility for an expanded variation of responses, the correlations for the subtests may not be yielding the same relationship that might have been discovered had the subtests offered a less restricted range.

Most studies on electroshock have concluded that electroshock reduces or eliminates tension, apprehension, and anxiety, regardless of the origin, and in the same way eliminates the feeling of depression. Therefore it influences certain emotional symptoms like anxiety, depression, and to some extent tension, regardless of the diagnostic grouping to which they may belong. This would mean that the dynamic structure of the schizophrenic process is not so much influenced as are certain emotional symptoms in its framework. It does not affect underlying conflicts, but reduces the impact of the symptom.
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