

# THE EFFECT OF ELECTRO-CONVULSIVE THERAPY ON INITIATIVE

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HELPING the senile patient is not easy, and treatment today is largely palliative. Recent cybernetic work (Ashby, 2), however, offered a suggestion that some alleviation might be possible. This paper describes briefly the underlying theory and how we investigated the matter clinically. (Only an outline of the theory can be given here.)

## THE CYBERNETICS OF OLD AGE

The fundamental logic of mechanism is now well founded (Ashby, 3) and sufficiently developed for a good deal to be said about “mechanisms” in general. (“Mechanism” here means whatever is law-abiding and regular in its behaviour; it therefore *includes* psychosomatic and emotional mechanisms so far as they are not merely indeterminate.) So far as neurons are basically law-abiding (and what physiologist doubts this?), so far will the brain be “mechanistic” and subject to the laws of mechanism.

Outstanding in these laws is the fundamental tendency of any system to go to equilibrium. When a pendulum goes to its central position, or a watch-spring goes to the run-down state, the equilibrium is simple, obvious, and uninteresting. But when the system is as complex as a human being, the equilibrium may be equally complex, with partial equilibria, mobile equilibria, equilibrium at a cycle, and so on. A consequence of this fact is that if the system is acted on (disturbed, stimulated) by surrounding conditions, its state at any moment tends to be characterized more by what has happened recently than by what happened earlier—the so-called law of experience (Ashby, 4).

The law implies that if the changes in the surrounding conditions are statistically constant, the response of the system has a fundamental tendency to diminish (Ashby, 5). (An example of conditions that are always changing but which are constant in how they change is given by a recurrent waveform—the tick of a clock for instance.) Thus the well-known and ubiquitous phenomenon of “habituation” (often called “adaptation” when it occurs in a sense organ) is to be expected whenever a mechanism, such as the brain, is subjected to conditions or stimuli that are statistically constant.

Now it is a peculiar virtue of the modern logic of mechanism that its theorems are equally valid whether the system is small or large, and whether the time-interval is brief or protracted. They will therefore be applicable to the whole brain, considered over a life-time. Over such a span, many variations of

stimuli or surrounding conditions will form a statistically constant sequence. Though events never recur exactly, a great deal of life is repetitious: day follows night, and night follows day; when one is young, one encounters new dishes at meal-times frequently—as one gets older, surprises at meal-times get rarer. As one gets older, more and more events are recognized as mere repetitions of what has happened before. Thus, as a person's life goes on, there is a growing tendency towards generalized habituation. The possibility arises that this process, now well understood, may play a major part in the condition known clinically as "senility".

(Senility is sometimes regarded as analogous to the "wearing out" of a man-made machine. Any resemblance can be only superficial: a machine wears out by losing substance that it cannot replace; the living body, on the other hand, is in a steady state at which loss and replacement are closely balanced over many years: a man who gets fatter as he gets older can hardly be said to be "wearing away". Since positive evidence for this concept is practically non-existent, it must be dismissed as little better than a metaphor.)

When a system has arrived at an equilibrium (of whatever type), and is thereby restricted to keeping within some set of states, there are, in general, just two ways by which an external agent can act on it to get it away from the set of states. One method (of little interest to us in this paper) is to make a permanent alteration in the system's conditions or parameters, so as to induce a new field (Ashby, 1); in it, the set of states may be no longer equilibrial, so that the system can move to a new region of states; being leucotomized is such an alteration. The second method (of particular interest here) is to subject the system to some stimulus that is powerful enough to be effective and is also very different from all the stimuli that have arrived before. (The two methods are not mutually exclusive; for if the system contains step-functions, a stimulus that is transient may leave permanent changes on the step-functions, so that the rest of the system is affected persistently by their new values.) If, therefore, the senile patient is suffering from an extreme degree of the process called habituation when it occurs transiently, the giving to such a patient of an extremely unusual stimulus might be expected to restore him to some degree of normality. There were thus reasons for thinking that some senile patients might be benefited to some degree by the giving of a very strong and unusual stimulus. Outstanding in these qualities, of course, is electro-convulsion; and we considered the possibility that the patient who showed the picture of extreme habituation—the cabbage-like—might be favourably affected by its application. We decided therefore to select cases who might be regarded as specially likely to benefit, to divide the group into subgroups by some irrelevant ("random") criterion, and to give the treatment to one subgroup while retaining the other as control.

We did not overlook the fact that the results might throw light on the mode of action of E.C.T.—a question as obscure as ever, even after twenty years of experience and research.

#### THE PATIENTS

For simplicity and uniformity the patients were all women. Excluded were the schizophrenic dements, those aged over 90, and the leucotomized; also excluded were those whose senility might be considered clinically as containing a depressive element, for we did not wish this factor to confuse the issue. We selected primarily those who might be described as excessively stable, cabbage-

like, by the behavioural criterion that they tended to react to ordinary stimuli and events with a reaction of less than ordinary size. (This group must be characterized in this way, for it does not correspond to any generally accepted clinical grouping.) Thus we included cases that showed marked apathy, passivity, and lack of initiative; we excluded those that were restless, aggressive, active in body, or actively deluded or hallucinated.

The subjects' conditions and their changes with treatment were assessed by three independent observers: the medical clinician, the psychologist, and the ward sister. The latter was the chief observer, for she lived with the patients and could detect subtle changes that might elude others. For this purpose a 28-item questionnaire was constructed. The questions, and how they were scored, define what we mean, below, by "clinical improvement" and "initiative". They are given in Table I. (The letters on the right are referred to later.) Each

TABLE I

1	Has the patient been out of bed today?	..	..	..	..	Y	Y
2	Has she got out of bed without being asked?	..	..	..	..	—	Y
3	Has she washed herself?	..	..	..	..	Y	Y
4	Has she done her own hair?	..	..	..	..	Y	Y
5	Has she fed herself?	..	..	..	..	Y	Y
6	Has she used words like "I want . . . "?	..	..	..	..	—	Y
7	Has she found her own way to the lavatory?	..	..	..	..	Y	Y
8	Has she been mute?	..	..	..	..	N	N
9	Has she talked to herself?	..	..	..	..	N	Y
10	Has she been hallucinated?	..	..	..	..	N	Y
11	Has she been destructive?	..	..	..	..	N	Y
12	Has she complained about anything?	..	..	..	..	—	Y
13	Has she resisted being moved (from her chair, or bed, or room)?	..	..	..	..	N	Y
14	When by herself, has she laughed or cried?	..	..	..	..	N	Y
15	Has her mood fluctuated greatly?	..	..	..	..	N	Y
16	If uncomfortable, would she move of her own accord to a better place?	..	..	..	..	Y	Y
17	At meal-times, did she make her own way to the table?	..	..	..	..	Y	Y
18	At table, did she pass the salt, etc., to the other patients?	..	..	..	..	Y	Y
19	Did she ask any questions of the Staff?	..	..	..	..	Y	Y
20	Did she help the Staff in any way?	..	..	..	..	Y	Y
21	When with others, did she <i>start</i> a conversation?	..	..	..	..	Y	Y
22	When other patients were active, did she join in with them?	..	..	..	..	Y	Y
23	Did she interfere with the other patients?	..	..	..	..	N	Y
24	Did she do any writing?	..	..	..	..	Y	Y
25	Has she looked at today's newspapers?	..	..	..	..	Y	Y
26	Has she read any magazines or books?	..	..	..	..	Y	Y
27	Has she turned on a radio or television of her own accord?	..	..	..	..	Y	Y
28	Has she occupied herself with knitting or sewing or any other occupation or hobby?	..	..	..	..	Y	Y

question called only for Yes or No. The questionnaire was filled up in the evening and referred to the events of that day only.

As it was thought that the extra attention given to the subjects might induce changes, and in order to be able to eliminate the effects of any secular change as the investigation proceeded, a control group was separated, differing only in that they were given no E.C.T. It was obtained simply as those cases who had been judged suitable for inclusion but whose relatives refused permission for the treatment. We are satisfied that the somewhat unusual method of selection introduced no major bias between the two subgroups.

As might be expected, sedatives could not be entirely withheld during the investigation, but their amounts were small and they were given usually during the night. We followed the rules: (i) give as little as possible; (ii) if some has to

be given, keep the amount as constant as possible throughout the investigation. Records were, of course, kept of the amounts used and on what days they occurred. We are satisfied that the effects were insufficient to introduce major error into the conclusions.

#### THE PROCESS

First, each patient was assessed on the measurement scale for three days (Monday, Wednesday and Friday). During the next three weeks she had nine convulsions (three in each week on alternate days). Convulsion was induced by 150V, A.C., square-wave of about 1 second duration, bi-temporally, under thiopentone, with succinylcholine chloride ("Scoline") as relaxant, followed by oxygen. Despite their ages, the patients' physical conditions were not affected adversely by the treatment.

During the week following the last convulsion, the patient was assessed on the measurement scale for three days as before; and a similar three days' measurement was made a month later. Thus the questionnaire was filled in nine times for each patient, a total of 252 questions.

An investigation of this type must not, in fairness to the subjects, be prolonged if its uselessness should become manifest. We watched the results closely, as patient followed patient, and decided to stop after 16 patients had been treated (8 with convulsions and 8 controls). Though this number is very small, we did not feel justified in prolonging the investigation further. The results were then analysed.

#### THE RESULTS

From each questionnaire of 28 questions an index of "clinical improvement" was assessed by counting the number of answers (Yes or No) that agreed with the first of the two letters given in Table I. Thus had a patient been marked entirely as shown in the first column, she would have received the maximal marks for Clinical Improvement. (This scoring *defines* how we are using the words "clinical improvement".) As the three forms in one week differed only in factors we were not interested in, the three marks were added together so as to reduce sampling vagaries. Thus each patient gave three scores for Clinical Improvement:

- B: Before the convulsions
- I: In the week following
- II: A month later.

(These symbols will be used in what follows.)

Similarly each questionnaire gave a score for Initiative by counting the number of answers that agree with those marked in the right-hand positions in Table I. (The method of scoring defines what we mean by "initiative".) Thus, for each patient, three scores similar to B, I, and II were formed for Initiative.

The two scales are partly correlated, but not wholly so; for questions 9, 10, 11, 13, 14, 15, and 25 interpret the answer inversely. Thus, to the question "Has she been destructive?" an answer "yes" would imply an increasing activity or initiative, but a clinical deterioration.

The patients' scores for Clinical Improvement and for Initiative are given in Table II.

With our clinical material, we considered that the error would be least if each patient acted as her own control. We were thus interested primarily

TABLE II  
Clinical Improvement Initiative

Patient No.	E.C.T.	Clinical Improvement			Initiative		
		B	I	II	B	I	II
1 .. ..	+	23	25	27	12	16	13
2 .. ..	+	25	24	23	13	16	2
3 .. ..	+	16	18	16	20	9	17
4 .. ..	+	61	36	42	45	27	29
5 .. ..	+	49	29	29	30	13	11
6 .. ..	+	37	25	34	25	10	18
7 .. ..	+	31	45	30	24	30	15
8 .. ..	+	12	18	20	8	7	7
9 .. ..	-	44	46	37	34	38	25
10 .. ..	-	24	22	18	19	17	15
11 .. ..	-	26	28	26	15	14	11
12 .. ..	-	16	19	45	27	8	29
13 .. ..	-	19	18	18	8	11	9
14 .. ..	-	33	35	32	12	22	22
15 .. ..	-	58	55	59	57	53	49
16 .. ..	-	22	22	22	12	11	11

in how the patient changed from her initial state. We therefore formed, for each patient, on the scores for Clinical Improvement, the differences:

$$d_1 = I - B$$

$$d_2 = II - B$$

$$d_3 = II - I = d_2 - d_1.$$

Similar differences were formed also on the scores for Initiative. The null hypothesis, for testing significance, is that the quantities  $d_i$  are distributed about zero. Each  $d_i$  is based, of course, on the answers to 168 questions.

#### Clinical Improvement

Taking first the scores for Clinical Improvement, no trend is obvious; and  $t$ -tests for whether  $d_1$ ,  $d_2$ , and  $d_3$  have means displaced from zero show the displacements to be non-significant. Thus there appears to be no uniform tendency for the patients to be improved.

There is a possibility, however, that the patients are being affected individually, some better and some worse, so that the changes do not show on the average. This possibility can be tested by seeing whether the scatter in the scores increases after E.C.T.  $d_1$  is a measure of the immediate response, of how much the patient has been changed; and its variance measures how much the patients have differed in their changes. Taking the corresponding values in the controls as basis for comparison, the variance in  $d_1$  was increased by 37.4 times, which is highly significant ( $P < 0.001$ ,  $n_1 = n_2 = 7$ ).  $d_1$  shows no significant difference, so the effect is evidently not sustained.

This conclusion was clearly supported by clinical observation. Some of the patients were undoubtedly changed for the better, though none to a major degree. Unfortunately, these were balanced by the patients who were influenced unfavourably; on balance, we could not say that any major gain had been achieved. We had the impression that such improvement as there was occurred in the patients whose dementia was simply senile, rather than of the organic or pre-senile type. But the numbers are too small for any confident assertion.

*Initiative*

The results above were for Clinical Improvement. Those for Initiative showed that  $d_1$  was significantly depressed ( $0.02 > P > 0.01$ ,  $n=7$ , two-tailed test.) The variances of  $d_1$  and  $d_2$  showed no change. Evidently the treatment was tending, if anything, to depress Initiative.

A number of other tests (on orientation, colour-preferences, reaction-time, etc.) were carried out; but as they showed no significant changes they need not be detailed here.

## DISCUSSION

In its major aim, the investigation has shown that some improvement can be achieved in some cases of senile dementia by the use of E.C.T. On the other hand, some patients are made somewhat worse, and when improvement does occur it is not of major degree. It seems, therefore, when one considers the risks that are inseparable from E.C.T. in its present form, that E.C.T. cannot be recommended as a worthwhile way of improving the condition of the senile patient. If however some substantial modification of E.C.T. is found in the future, that can give E.C.T.'s results without its risks, then the possibility of helping the senile patient in this way should not be forgotten.

But before any question about how E.C.T. should be modified can be answered, we must know more about how it acts. At present, the amount we know about this is practically zero. A minor aim of the investigation was to test, by using cybernetic methods, whether E.C.T. acts simply as a very powerful and non-specific disturber (rather than as a specific alterer of particular variables or parts.) Were this so, the score for Initiative would almost certainly have risen; the fact that the scores for Initiative tended, if anything, to fall suggests fairly strongly that E.C.T. acts through some specialized mechanism rather than as a non-specific disturber.

It is worth noticing that the action of E.C.T. cannot be purely on the factors, whatever they are, that are responsible for depression; for several patients in this series showed distinct improvement though they showed previously no trace of depression. E.C.T. evidently can act on factors other than those responsible for depression. More can hardly be said at the present time.

## SUMMARY

In an attempt to alleviate the inactivity of senility, a selected group was treated with electro-convulsive therapy and measured before and afterwards for the amount of initiative shown and for the degree of clinical improvement. Special scales were constructed so as to make the measurements objective.

A small degree of clinical improvement was shown clearly in some cases but not in all. The simply senile cases responded better than the organic or presenile.

The results were considered from the cybernetic point of view to see if they would throw light on how E.C.T. acts. The evidence suggests that it acts on some specific mechanism rather than as a generalized activator of the whole cortex.

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