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Psychological Theories of E.C.T.: A Review

By EDGAR MILLER

Since the inception of the use of artificially induced convulsions as a therapeutic agent in ;5 by Meduna and the modification of this method of treatment by the use of electric currents by Cerletti and Bini in 1938, a vast literature has accumulated on this form of psychiatric treatment. Yet, despite this vast literature and the passage of over 30 years of experimental opportunity, no predominant or convincing rationale for the use of electro-convulsive therapy (E.C.T.) has emerged; Meduna's (53) original theory of the incompatibility of schizophrenia and epilepsy having been long discredited. E.C.T. remains, therefore, an empirical form of treatment.

The immediate effect of E.C.T. is most noticeable at a physiological level, but it is usually prescribed for its alleged psychological effect on affective symptoms; and hence, in trying to explain the effects of E.C.T., both physiological and psychological theories will be of interest. However, it is the purpose of the present paper to review only psychological theories of E.C.T.

Theoretical approaches towards explaining the effects of electroconvulsive shock (E.C.S.) on animals will also be considered. As the work on E.C.S. with animals has been more empirical than corresponding work with humans, it has led to more consistent findings and a sounder basis for theorizing. Hence, theories drawn from animal research may be able to give useful leads for explaining the effects of E.C.T. on humans.

What Needs to be Explained?

Before considering theories in detail it is necessary to be clear about what phenomena are to be explained. Therefore, the main and the most established phenomena will be briefly presented below.

(i) The Therapeutic Efficacy of E.C.T.

Although most theories of E.C.T. assume a beneficial therapeutic effect, the evidence for this from well-controlled studies is somewhat equivocal (65). However, at least two controlled studies (44, 68) have indicated that depressed patients treated by E.C.T. have a better clinical outcome than those not so treated. Campbell (12) draws attention to the idea that E.C.T. may be effective in speeding up recovery that is under way rather than by actually causing recovery. There is evidence in favour of this (24) and Slater's (69) reassessment of Karagulla's (42) data is also consistent with this idea.

A large number of studies agree that recovery following E.C.T. is better for affective disorders, especially depression, than for other disorders. Similarly, some recent research (13, 54, 66) has confirmed the common clinical impression that recovery rates are better for endogenous than for exogenous depressions. However, studies comparing the response to treatment of different diagnostic groups have generally not controlled for differences in untreated remission rates.

It seems reasonable to conclude that, compared with most other psychiatric treatments, the therapeutic efficacy of E.C.T. is reasonably well established. Even if Riddell's (65) conclusion that an unequivocal proof is lacking is accepted, there is at least a strong indication that E.C.T. is more effective that no treatment at all, especially in cases of endogenous depression.

(ii) Memory Disturbances

Almost all authorities who have considered this problem agree that E.C.T. causes a degree of memory loss for events preceding the treatment. Experimental verification of this has been provided (10, 39), and Cronholm and his associates have made an attempt to explore the parameters of this effect (19, 20, 21).

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(iii) Confusion

A large number of authors, especially those advocating the intensive use of E.C.T., report that E.C.T. produces confusion, the extent of which seems to depend on the number and frequency of the treatments (10, 30, 43, 72). Paradoxically, besides itself producing confusion, E.C.T. is used effectively in certain conditions, such as severe manic excitement, in which confusion is present as part of the clinical picture. In these latter conditions E.C.T. appears to clear up confusion rather than cause it, but this may well be because the E.C.T. acts upon the cause of the original confusion thus reducing it to a greater extent than any added confusion due to the E.C.T.

(iv) Other Psychological Effects

Investigations of the effects of E.C.T. on a large number of psychological tests, on motor speed and on perception, have also been carried out but the results are often contradictory and do not lead to clear cut conclusions. The important effects of E.C.T. appear to be the first three given above.

A point also worth noting here is the fact that in all forms of convulsive therapy it is the convulsion itself which is necessary for the effects to occur and not some other incidental feature of the treatment situation. This has been demonstrated for both drug induced convulsions (7, 16) and E.C.T. (22).

In the actual discussion of the psychological theories that have been put forward to explain the effects of E.C.T. it seems most convenient to split the theories into two fairly well defined groups:

(a) Those influenced by theories of a psychoanalytic nature.

(b) Others.

(a) Psychoanalytic Theories

A large number of theories have been put forward from within a psychoanalytic framework. These were often initially applied to drug-induced convulsions, but most such theorists made little distinction between drug induced convulsions and E.C.T. (3, 35). As it is the convulsion itself which seems to be the effec..., agent in all forms of convulsive therapy reasonable to apply theories originally desi... to account for the effects of drug-ind... convulsions to E.C.T. also.

Among this group of theorists, all agree, ei... explicitly or implicitly, that E.C.T. has effects by assisting the process of repression, ... is hence opposed to psychoanalysis, which a... at recovering repressed material (70). Ab... goes further than any other theorist with ... concept of repression in that he uses it to acc... not only for the beneficial effects of E.C.T. ... for the amnesia and other negative sequelae ... treatment. He claims that these effects are ... what he would predict on the basis of st... repression having taken place.

The various psychoanalytic theories differ ... to the hypotheses put forward concerning ... mechanisms which either cause or accomp... repression. The three most common s... hypotheses are discussed below and have be... used in varying permutations and combinati... by the different theorists.

The Regression Hypothesis:

A number of authors (2, 3, 31, 58, 62) ha... regarded the treatment as producing regres... of behaviour to infantile, or even pre-na... levels. Usually the regression is thought of ... being psychologically induced by the stre... involved in the treatment situation, tho... Power (62) feels that the regression is physic... induced by the convulsion. Power argues t... the tonic and clonic phases of the convul... are similar to movements seen in the foetal ... of both man and sheep, and that these there... represent a return to a foetal level of nerv... functioning. Others, holding that the regres... is psychologically induced, relate post-c... vulsive behaviour, such as apparent suck... movements or faecal smearing, to the Freud... stages of psychosexual development (31, 58... assert that the oedipal conflict is reactivated ... 73).

As with most hypotheses within this cl... there has been little attempt at experime... verification. Cameron (11) claims that care... observation of patients following E.C.T. d...

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reveal infantile speech or behaviour in the
ay that this has been described by child
chologists such as Piaget or Gesell. One basic
iculty with this hypothesis is that it is
ficult to test convincingly, as it is always.
sible for those so predisposed to interpret
rtain features of the clumsy, semi-voluntary
haviour of a semi-conscious and confused
tient as "infantile".

In conclusion, this hypothesis is definitely
n-proven. Even purely as a description of
st-convulsive behaviour regression is not very
nvincing (11).

e Fear Hypothesis

The central tenet of this hypothesis is that it is
e fear induced by the treatment, rather than
e actual effects of the convulsions, which is the
ective agent. This hypothesis has received
nsiderable support (1, 2, 3, 27, 31) and was
st strongly advocated when drugs were used
induce convulsions. As Good (31) strongly
mphasized, a large number of patients under-
ing leptazol (Cardiazol, Metrazol) therapy
owed unmistakable signs of fear and it is also
ely that many patients undergoing E.C.T. are
t without fear. However, to jump from this
the argument that fear is the effective element
treatment is not supported by the experi-
ntal evidence.

Cook (17) compared ratings of fear in 275
ients undergoing convulsion therapy with
ssments of clinical improvement, and con-
ded that, if anything, the trend was in the
rse direction to that predicted by this
pothesis. Cook performed no statistical analy-
but the writer, using Cook's published data,
been able to show that the reported trend in
reverse direction was significant at the 5 per
t. level. Two other investigations (7, 16)
ng leptazol therapy have used the technique
comparing patients treated in the normal
and with the injection of a similar amount
drug too slowly for a convulsion to occur.
is latter procedure is reported to create as
h fear as the standard procedure). Neither
ese investigations produced results support-
the fear hypothesis.

more recent experiment (23) compared

degree of fear as measured by the T.A.T. and
other measures with rated improvement in
patients treated by E.C.T. and a control group
who were anaesthetized but had no convulsion
induced. Again no relationship was found
between fear and clinical improvement, though
the measures of fear used were rather poor and
it seems that ratings of fear and improvement
were not done independently.

The experimental evidence does not, there-
fore, support this hypothesis, and one experi-
ment even shows a significant trend in the
opposite direction (17). To argue, as does Abse
(1), that such experimental results do not
disprove this hypothesis, as the fear may be at
an unconscious level, is not permissible. Ad-
vocates of this hypothesis, such as Abse himself,
base their original arguments on the fact that
patients do show overt signs of fear.

The Punishment Hypothesis

A third main hypothesis occurring in psycho-
analytic theories is to postulate that the patient
regards the treatment as a form of punishment
(2, 3, 46, 56, 58). Korson (46, p. 41) states that:
"The individual delivers himself into the hands
of a strict, but in the end forgiving, parent figure,
who will mete out punishment justly and allow
atonement and delivery from evil. Acceptance
of punishment allows the patient to assuage his
conscience, fear and anxiety becoming un-
necessary once retribution has taken place."

This hypothesis assumes guilt to be a central
feature of illnesses treated effectively by E.C.T.,
and this is in agreement with the general
clinical impression that endogenous depressives,
who often show strong guilt feelings, respond
most favourably to E.C.T. Other apects of the
hypothesis are less satisfactory. It assumes that
the patient identifies the doctor with his parent.
This, in turn, implies a regression to childhood,
at least to a stage at which the child is dependent
upon parental sanctions and discipline.

There has been no direct test of this hypo-
thesis, although Lockwood (49) has tested a
derivation of it based upon Rosenzweig's (67)
classification of responses to frustration. Lock-
wood argued that intropunitive subjects should
show the best response to E.C.T., but failed to

confirm this in two separate experiments. However, this is not a crucial test, as the punishment hypothesis could be valid without Lockwood's extension of it being valid also. The punishment hypothesis remains, therefore, non-proven.

Summary of Psychoanalytic Theories

The general criticism can be made of nearly all psychoanalytic theories that they rely heavily on factors in the treatment situation other than the convulsion itself (e.g. the patients' fear of treatment), thus ignoring the consistent finding that the convulsion is the effective agent in treatment. In addition they rely on a background theory which is in itself unproven. Psychoanalysis seems, therefore, not to be a fruitful starting point for an explanation of the effects of E.C.T.

(b) Non-Psychoanalytic Theories
Somatic Theories

There are a large number of somatic theories. All have in common the obvious inference that if some fairly permanent behavioural change occurs in the patient as a result of treatment, such a change must be correlated with some somatic change within the nervous system. A large number of suggestions have been made as to the change that occurs (26), but these generally lie outside the scope of this review.

Psychological research has been attracted towards one particular type of somatic theory which assumes that E.C.T. has its effects by damaging nerve cells (29, 73). One group of experimenters (71) found that their subjects, after three E.C.T.s, showed a definite change in Rorschach responses towards the pattern of responses produced by patients with diffuse brain damage. Others have found that short-term response to treatment is correlated with positive results on the amylobarbitone test for brain damage (41).

The worth of such findings, and of findings from similar experiments, is strongly jeopardized by the general unreliability of such indices of brain damage. A more direct approach is obviously to be preferred, and there is some evidence of vascular changes, probably tem-

porary, in both human and animal brains af... E.C.T. (34, 50).

The evidence is consistent with the possil... of a small degree of diffuse brain damage be... caused by E.C.T. Unfortunately this still lea... the structural theory unproven, as it is neces... to demonstrate that the damage involved is t... main agent of behavioural change and ... merely an incidental feature of the treatment.

Theories Involving Amnesia

These predominantly centre around t... suggestion that the treatment-induced amne... might be responsible for the beneficial effe... (11, 40, 43, 59, 70). It is often pointed out th... amnesia is usually greatest for experiences whi... come immediately before treatment, and ... psychotic episodes, being usually recent, a... more likely to be affected by amnesia than t... more normal experiences from the subjec... distant past. Janis (40) also feels that t... amnesic action of E.C.T. becomes a new learne... defence mechanism enabling the subject ... similarly banish stressful experiences occurri... subsequent to treatment.

The amnesic effect of E.C.T. is the appare... rationale for treatment by "regressive" E.C.T. (30, 43) or "depatterning" as it is called l... Cameron (11). The general principle ... regressive E.C.T. is the intensive use of E.C.T. at rates of one or more treatments per day un... the patient is in a totally amnesic state, al... confused and often doubly incontinent. As t... patient recovers, he learns, or is taught, ne... and better adjusted patterns of behaviou... Several authors have enthusiastically reporte... the results of this form of treatment on chroni... patients, but there has been no attempt at ... controlled study. There is only one report of t... use of regressive E.C.T. that has come to t... conclusion that it is of no value (75).

A variation of this theory is the suggesti... that there is a differential loss of materi... relating to the patients' psychopathology (1... 40). Cameron (11) suggests that as the amne... following intensive treatment recedes, the... further events are recalled to the extent th... they are compatible with the emerging fram... work of the patients' behaviour. If the patient ...

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...erging into a normal pattern of behaviour ...e events related to previous abnormal ...haviour will be incompatible and hence not ...alled. Janis (39) interviewed patients before ...d after E.C.T. and found that, as compared ...ith controls, the treated patients showed ...mnesia which was more apparent both for ...cent material and for anxiety provoking ...aterial. However, an adequate test of the ...ypothesis of differential action of the amnesic ...ffect of E.C.T. is almost impossible because of ...e difficulty of controlling for the degree of ...arning of both normal and pathologically ...lated material.

...Direct experimental investigations of the role ...ayed by amnesia in the therapeutic effects of ...C.T. are not available. Information of some ...levance comes from work with unilateral ...C.T. (47, 52), where the general finding is ...at unilateral E.C.T. can be as therapeutically ...ffective as bilateral E.C.T. but gives significantly ...ss memory impairment. This suggests that the ...erapeutic effect of E.C.T. does not depend on ...mnesia, but it is a possibility that even the ...ilaterally treated cases had some degree of ...amnesia which was adequate for therapeutic ...ficacy. No untreated controls were used to ...st for this.

...The evidence from unilateral E.C.T. points ...way from, but does not definitely disprove, ...eories of E.C.T. based on amnesia. A direct ...perimental test of this theory would be useful.

...her Theories

...Other theoretical approaches (35, 57) have ...mphasized the "shock" aspect of shock ...eatment. The treatment is regarded as giving ...e patient some sort of psychological jolt to ...ing him face to face with reality. Foulds (28) ...ed a similar idea in postulating that the effect ...f E.C.T. was to break up painful thoughts. ...ulds' own experiment gave confirmatory ...ults, but others (68) were unable to replicate ...s findings.

...Hetherington (36) felt that depression is ...arked by motor retardation but also by ...er-activity of thinking. E.C.T. helps the ...pressive by abolishing motor retardation and ...oducing psychic retardation. His own ex-

perimental results are consistent with this view, but this study has been criticized on the grounds that the experimental and control groups were not properly matched (12).

Research with Animals

The possibility presents itself that the results of work on animals might help towards improving the rather dismal theoretical picture of E.C.T. given above. Accordingly, the major trends in theorizing about the effects of E.C.S. on animals will be outlined.

Before doing this, certain differences between human and animal studies must be noted. Firstly, theorizing in animal research has been mainly concerned with the phenomenon of retroactive amnesia (R.A.) and obviously not with therapeutic change. Secondly, E.C.S. is not given with an anaesthetic, whereas E.C.T. is. Although the convulsion is the effective therapeutic agent in E.C.T. it is possible that the anaesthetic has a minor effect as it has been shown, on animals, that anaesthetics have an R.A. effect of their own (4, 61). There seems no good reason to suppose that an electrically induced convulsion in an animal is a different phenomenon from such a convulsion induced in a human and, therefore, providing the relevant procedural differences are borne in mind, it is reasonable to use theoretical ideas derived from animal research to suggest theoretical approaches for work with humans.

Neural Consolidation Theory

This is the most prominent theory in E.C.S. research with animals, and often other theories in this field were inspired by alleged inadequacies in this theory. Briefly, the theory assumes that for any memory to become established it is necessary for the original memory traces, which are only temporary in form, to be transferred to a more permanent form, i.e. consolidated. An E.C.S. occurring within the time period that consolidation is taking place will break up the process of consolidation, causing R.A. for material not already consolidated.

Early experiments (25, 74) showed retention to be a negatively accelerated function of the

interval between learning and E.C.S. and were generally accepted as demonstrating the validity of this theory. More recently these early experiments have been criticized, as they used several learning trials, thus giving the early trials time to consolidate before the later trials came along (61). More satisfactory experiments using one learning trial followed quickly by a single E.C.S. (45, 51) have, however, upheld the consolidation theory. Other experiments using the same initial design but going on to give further learning trials and E.C.S.s have concluded that other factors come into operation when several E.C.S.s are given (15, 38). Chevalier (14), again using a one learning trial and single E.C.S. design, has shown that the R.A. effect remains undiminished over 30 days.

Lewis and Maher (48) have brought together a number of results inexplicable by the consolidation theory. One experiment (5) has shown that a series of E.C.S.s given a few days prior to learning have a proactive effect. Others (9) have shown that a series of E.C.S.s given a few days after learning, and hence long after what would generally be considered as the consolidation period, can also disrupt retention. Brady (8) also found that when a learned response was obliterated by a series of E.C.S.s given some time after learning, there was some degree of recovery of the response 30 days after the last E.C.S. As the breaking up of consolidation should give a permanent loss, this last result is also inexplicable by the consolidation theory.

The consolidation theory has been universally upheld by experiments using the one learning trial followed by a single E.C.S. paradigm. However, other experiments give results unaccountable for by this theory. It is of importance from the point of view of subsequent discussion to note that in the latter group of experiments a series of E.C.S.s has always been used; no one has yet demonstrated proactive or retroactive effects after a long delay from a single E.C.S.

Conflict Theory

This is analogous to the fear theory of the psychoanalysts for E.C.T. It suggests that E.C.S. has its effect by being an aversive or fear-provoking stimulus. Coons and Miller (18) an experiment replicating some features of earlier experiment by Duncan (25) obtai results which they interpreted as showing fear was induced by E.C.S. Unfortunately, experiment failed to control for the effect E.C.S. alone, and so the effect of E.C.S. confused with other variables (37).

Experiments using one aversive learning quickly followed by a single E.C.S., in a dir test of this theory, have shown that the amn effect of E.C.S. is stronger than any indu fear (45, 51). However, other experimen have found that after a series of E.C.S.s ha been given apparently aversive effects of E.C. do appear (15, 25).

As the conflict theory cannot account for th results of experiments using the one learni trial and single E.C.S. paradigm. it cannot used to displace the consolidation theor Experiments giving several E.C.S.s have foun effects attributable to fear but which could explained in other ways. It would seem reaso able to suppose that undergoing a series E.C.S.s is an "unpleasant" experience for a rat; the problem is whether any fear occurri is of significance in explaining the effects E.C.S.

Competing Response Theory

This theory, originally proposed by Adam and Lewis (5) to account for an apparen deficiency in the consolidation theory, assume that some aspect of the response to the E.C.S becomes conditioned to stimuli in the surround ings. The most recent statement of the theory by Lewis and Maher (48), who suggest that th coma following the seizure is due to "protectiv inhibition" and that components of th inhibition become conditioned to surroundin stimuli in the experimental apparatus.

If this theory is correct, it would be predicte that E.C.S. given in the same location a learning took place would disrupt learning muc more than when given in a dissimilar situation The original proposers (6) tested this and obtained confirmatory results, but in a simila experiment Quartermain et al. (64) found tha the location in which E.C.S. was given wa

ng stimulus. Coons and Miller [evant, as would be predicted by the riment replicating some feature olidation theory. However, the two ex- experiment by Duncan (25) o ments did differ in the timing and number which they interpreted as showi C.S.s, with Quartermain *et al.* using a induced by E.C.S. Unfortunate E.C.S. and short learning E.C.S. interval, ent failed to control for the e Adams and Lewis using several E.C.S.s and alone, and so the effect of E.C. ger learning E.C.S. interval. l with other variables (37). ain, it seems that the experiment (64) iments using one aversive learni the single E.C.S. and short learning E.C.S. followed by a single E.C.S., in al supports the consolidation theory. is theory, have shown that the a a longer learning E.C.S. interval and a E.C.S. is stronger than any i of E.C.S.s is used it appears that other , 51). However, other experi s come into play which could be attributed nd that after a series of E.C.S peting responses, as suggested by Adam en apparently aversive effects of ewis, or explained in other ways. ar (15, 25).

conflict theory cannot account f experiments using the one l *o-Factor Explanation of E.C.S.* l single E.C.S. paradigm. it ca main conclusion that seems to follow displace the consolidation the above review of theories of E.C.S. is ents giving several E.C.S.s hav a two-factor explanation seems to be ttributable to fear but which c ed. Experiments using one learning trial d in other ways. It would seem d quickly by a single E.C.S. have suppose that undergoing a s ently given evidence in support of the is an "unpleasant" experienc consolidation theory. Where longer problem is whether any fear o g E.C.S. intervals and several E.C.S.s nificance in explaining the e been used, results inexplicable by the dation theory have been obtained. Hence s that an E.C.S. given within the period required for the consolidation of memory will disrupt consolidation, but the massing

Response Theory

heory, originally proposed by S.s results in other effects. The remaining vis (5) to account for an a n is to explain these other effects. y in the consolidation theory, possible that the additional effects due to e aspect of the response to the E.C.S.s are the result of competing conditioned to stimuli in the su es or fear, but another explanation is most recent statement of the t. The giving of several E.C.T.s to humans and Maher (48), who suggest wn to result in confusion, and it is lowing the seizure is due to "pr e likely that giving several E.C.S.s n" and that components esult in an analogous state of "confusion" become conditioned to surr at. Confusion would explain the inability the experimental apparatus. als to learn following massed E.C.S.s, theory is correct, it would be p the failure to perform learned responses .S. given in the same loc veral E.C.S.s given a comparatively took place would disrupt learni ne after learning. In the latter case it n when given in a dissimilar s e expected that when the confusion had ginal proposers (6) tested t e to disperse the learned response would confirmatory results, but in a , as was found by Brady (8). Pearlman nt Quartermain *et al.* (64) fo 61), using drug-induced convulsions, ion in which E.C.S. was gi so proposed a similar two-factor ex-

planation of E.C.S. The loss of learned responses was accounted for in terms of disruption of consolidation with a short learning–convulsion interval and in terms of confusion with a longer learning–convulsion interval.

The difficulties in postulating a state of confusion in animals receiving massed E.C.S.s are twofold. Firstly, such a concept as clouding of consciousness, which is part of the general psychiatric description of confusion, is almost meaningless when applied to animals. However, it would be possible to define confusion in animals operationally in terms of other features of confusion, such as spatial disorientation or possibly impairment of attention. Secondly, it is not yet possible, on the evidence available, to completely eliminate the conflict or competing response theories as explanations of the effects of massed E.C.S.s, but experiments could be designed to test these theories against the hypothesis of confusion.

DISCUSSION

In 1948 Gordon was able to write a paper entitled "Fifty shock therapy theories" (32). Since then, theories have continued to multiply, and it is obvious that the present review has had to be content with a sample of the principal psychological theories. It is also obvious that none of the theories discussed so far is near to being considered adequate. Doubtless the steady proliferation of theoretical speculation is related to the lack of success of earlier attempts.

We are thus left with two further problems for discussion. Firstly, there is the problem of why the theories put forward have been so lacking in success. Secondly, whether it is possible to suggest ways for a more successful theoretical approach.

Why Have Theoretical Attempts Failed?

The reasons for failure appear, basically, to be threefold. Firstly, knowledge of the aetiology of illnesses treated by E.C.T. is minimal. If it were possible to reliably implicate a process or processes, of whatever nature, as being the cause of endogenous depression, then this would give an excellent lead to investigations and theory-building with E.C.T. (Conversely, of course, an

explanation of the effects of E.C.T. would help investigations into the nature and causes of mental illnesses, particularly depression.)

Secondly, and more seriously, the work on the effects of E.C.T. has revealed little well-established information, even when the vast literature on the subject has been carefully combed (63). It is known fairly definitely that E.C.T. is beneficial in cases of endogenous depression, that it has an effect on the recall of past events and that it causes confusion. Systematic exploration of these effects has generally not been attempted; a notable exception being the work of Cronholm and his associates.

A third reason for the lack of success in theorizing is that in many instances the theories put forward have been highly speculative, based on clinical impressions only, and not tied down to experimentally established phenomena. Such theories, besides often being difficult or impossible to test, have no more validity than the impressions or assumptions on which they are based and seem merely to confuse the issue.

Suggestions for Better Lines of Approach

A much-neglected source of inspiration for workers concerned with E.C.T. is the work on the effects of E.C.S. in animals. This is due presumably to the fact that most work on E.C.T. is done by psychiatrists, whilst that on E.C.S. with animals is done mainly by experimental psychologists. The animal work could present a useful model for E.C.T. research, as it is much better executed as far as the experiments are concerned, the relevant parameters are well explored (at least for the R.A. effect) and the theorizing is more closely tied to experimental findings.

The main suggestion coming from the above review of animal research is that of a two-factor theory of E.C.S. in terms of the interruption of memory traces and also a confusion effect produced when several E.C.S.s are administered within a short period of time. That this latter confusion effect may be particularly important in explaining the effects of E.C.T. on human psychiatric patients is also suggested by the frequent mention of confusion in clinical reports of E.C.T. It is possible, for example, that E.C.T.'s effectiveness may be partially spurious,

as a series of E.C.T.s may mask the pati illness because of the induced state of conf. in much the same sort of way as a seri E.C.S.s given to a rat have been found to a learned response. Unfortunately, little perimental research has been done on ᵖ E.C.T. confusion. That which has been (55, 72) has done little more than sho existence experimentally.

Experiments using unilateral E.C.T. (47, are also of theoretical interest. These sug that memory disturbances and confusion fol ing E.C.T. may be less if the electrodes placed unilaterally as opposed to the u bilateral placements. Further experimen exploration of the use of unilateral E.C could contribute greatly to the determination the role played by memory disturbanc confusion, and possibly other factors, in t therapeutic effects of E.C.T.

CONCLUSIONS

The main, unavoidable conclusion arisi out of this review is that we have come ve little way towards explaining the effects E.C.T. Explanations that have been put forwa tend to have been speculative and unconvinci The outstanding fact that emerges is that explanation of the phenomena can only be adequate as the data on which it is based. the experimental data on the effects of E.C. are so poor, the biggest contribution of theo etical significance in this field must come fro more careful and detailed exploration of th effects of E.C.T. and the parameters on whic they depend. Without this, further theoretic development will be gravely hindered, if n impossible.

It is further suggested that help in th solution of the problem may be obtained fro utilizing the results of experimentation o animals as such research has certain advantage over that using human patients. Work o unilateral E.C.T. also presents interestin possibilities.

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