INITIAL PSYCHIATRIC ILLNESS IN INVOLUTIONAL WOMEN

III. ELECTROENCEPHALOGRAPHIC FINDINGS

By

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INTRODUCTION

A MULTI-DIMENSIONAL study of a consecutive series of female patients, aged 40–55, in whom psychiatric illness necessitated first admission to a mental hospital, has already been reported in its general and clinical aspects (Tait, Harper and McClatchey, 9) and in relation to the psychological test findings (Orme, 6).

Of the 54 women included in the original group, 46 had EEG records taken on admission. In 8 cases recordings could not be made at the appropriate time, for technical reasons or because of the clinical urgency of instituting treatment —such as E.C.T.—which alters EEG patterns. The technique of EEG examination has been described previously (McAdam and McClatchey, 1). In the present investigation, band-pass filters (Morris and Dawe, 4) and per cent. time-recording units (Morris, 3) were employed to aid accurate measurements of the EEG variables under consideration.

HYPOTHESES AND METHOD

The electroencephalographic side of this study was intended to explore further some hypotheses about the relation between certain persistent personality traits, on the one hand, and patterns of the normal range of EEG variation, on the other, which have already been reported in respect of a group of male alcoholics (McAdam and Orme, 2). In brief, findings then indicated that a dichotomy of personality traits might be related to the EEG tracing as a whole. Qualities which might suggest "extraversion" were apparently related to a predominance of high frequency (i.e. beta) activity in the EEG, and those suggesting "introversion" to a predominance of alpha activity. Further, from the EEG patterns there were statistical indications of a general EEG dichotomy, namely that a predominance of high frequency activity was associated with a low alpha index, little sign of low frequency activity, and a tendency for the alpha index to change; whereas a high alpha index was associated with a low index of high frequency activity, a relatively larger amount of low frequency activity, and was constant. Lastly, an inverse correlation was found between alpha index and alpha frequency; that is, the lower the dominant alpha frequency, the higher was likely to be the alpha index. These findings were discussed, and compared with those of Saul *et al.* (7, 8) and Mundy-Castle (5).

It was felt that a further study, on broadly similar lines, should be carried

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out on another group of patients, to see if similar correlations might emerge. The group of women chosen for the present study, although confined in age range and in being first admissions, reflected a heterogeneous selection of diagnoses, thus adding an additional dimension of comparison. In addition, a number of more impressionistic hypotheses about personality and EEG pattern had now been formulated which often seemed borne out on a case basis. These are mentioned immediately below, and it seemed opportune to attempt a preliminary trial of their validity when applied to a group of patients for whom adequate clinical data were available.

The assessment of the EEG data was therefore made by the senior author quite independently of any information on clinical state or psychological test results, and only when all findings were complete was the material evaluated and compared. The EEG variables measured were five in number:—

1. *Alpha Index*. This represents as a percentage the duration of time in which alpha activity is present. As a broad statement, it was felt that a high alpha index represented a "low fantasy control", and conversely. By "low fantasy control" is implied a pre-occupation (without tension) with internal events, a persistent and consistent homeostatic adaptation largely irresponsive to environmental interruptions: it might be found associated with a passive withdrawn personality type (cf. Saul, 7) or pathologically with a sustained mood change in hypomania or apathetic resigned depression, or in a classical conversion hysteria. "High fantasy control" (a low alpha index) would correspondingly imply greater environmental pre-occupation, and less with the inner life. The records were therefore sorted into four groups: of high fantasy control (11), fairly high (6), moderate (13) and little (16).

2. *Alpha Frequency Spread* represented the range of frequencies in the alpha band occurring in any single record. A wide range might be related to irregularity of thought sequences, and vice versa. Where the alpha frequency was regular, therefore, the thought sequences might also be assumed to be stable, logical and predictable; conversely, where it was irregular, the thinking might be catathymically determined and the responses to stimuli apparently random. In these terms, the records were sorted into regular (19), fairly regular (16) and irregular (11).

3. *Dominant Alpha Frequency* itself, where this existed, was held to determine primary or secondary functioning (cf. Mundy-Castle, 5). A relatively fast stable alpha rhythm would equate to primary function, and a slow stable alpha rhythm to secondary. Very broadly, primary function would imply quickness and variability of response, and secondary a tendency to rumination, to constancy and perhaps obsessional thinking with a long reaction time. Of the records only 20 could easily be classified in this manner, these being composed of 11 primary and 9 secondary. Intermediate records numbered 6, and the remainder were insufficiently regular to be classified; these latter two groupings have been excluded from the calculations.

4. *Amount of Beta Activity* in the record was assessed, and classified in terms of none (7), little (20), moderate (8), fairly high (6), and high (5). Hypothetically, a high amount of beta (high frequency) activity might be linked with "aggressiveness", a driving or perhaps constructive character, or pathologically with trends exploiting the environment, as in a complaining manipulative hypochondriasis.

5. *Amount of Theta and Delta Activity present* was assessed. The hypothesis was that this related directly to "affective impulsiveness" or lability. Where it

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was low, there might be little variability in expression of affect, although pathologically it might be very low where the affective expression was sustained and consistent, as for example in mania, depression or conversion hysteria. Where the amount of slow activity was high a tendency to emotional explosions might be present. Slow activity was assessed as none (10), little (21), moderate (8), and relatively high or high (7).

The problem was therefore to see whether any of these variables had any relation to the independently assessed clinical and psychological data, whether related to diagnostic category or independent of it.

Results

A. *Internal Correlations of the Five EEG Indices*

The five EEG indices, outlined above, were first examined to see if any internal correlations, each with the other, appeared, either on the lines which had been evident in the study of alcoholics, or in any other way; if such combined EEG patterns appeared, a consideration of the clinical data in their light might prove of interest.

There was some slight evidence of trends of association in certain combinations. Thus, higher alpha indices (in terms of our hypothesis, low or moderate fantasy control) were associated with irregularity in the alpha range (unstable, illogical, and unpredictable thinking): only 9 of 29 patients with higher alpha indices had regular alpha frequencies, as opposed to 10 of 17 patients with lower alpha indices (χ^2 (Yates)$=2\cdot364$: $P<\cdot2$). Where the alpha index was high, moderate to high amounts of slow activity appeared in 12 of 29 cases, as opposed to only 3 of 17 cases where alpha index was low ($\chi^2=1\cdot773$:$P<\cdot2$): this is in accord with the findings in alcoholics. In none of the other eight instances of comparison—including the relation between beta and alpha amounts—was there any indication of association between the EEG variables.

The two trends which are mentioned are of no statistical significance. We must therefore assume that in the present investigation there was no support for the previously recorded view of an overall EEG dichotomy, and there was no firm indication, for the numbers involved, of any other association between EEG variables.

B. *Psychological Data and EEG Variables*

The patients concerned in this study each had a Standard Psychological Interview, the Rorschach Test, and the Thematic Apperception Test. From the total data obtained a psychological dichotomy was made between the most and least typical sections of the sample (Groups A and B respectively). This dichotomy, on examination, bore some relationship to "extraversion-introversion" dichotomies. On the other hand, the psychiatric distinction between non-psychotically depressed and psychotically depressed patients (Groups C and D respectively) also seemed to have affinities with "extraversion-introversion" dichotomies. However, Groups A:B and C:D were themselves unrelated—a feature suggesting that "extraversion-introversion" was not a unity but applied to at least two unrelated modes of variation. This work has already been reported in detail (Orme, 6).

The relation between "extraversion-introversion" and EEG patterns, apparent in a group of male alcoholics, has been outlined above. In the light of this previously published work, chi-square examinations were now made

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between the two personality dichotomies of the present study of involutional women, and the five EEG variables assessed for this group.

The results obtained are essentially negative. No significant relationship was evident between any of the EEG measures and the psychological A:B dichotomy. The absence of significant associations persisted when (*a*) stable EEGs alone were considered; (*b*) the A:B dichotomy was linked with the C:D dichotomy, on the hypothesis that the group A+C should be extraverted in both ways, and B+D introverted; and (*c*) the psychotic-depressive Group D was excluded (as the alcoholic group specifically excluded psychotics).

The only trend of association noted was between high and low alpha index and B:A. The level of probability here was between 0·1 and 0·2. This trend is in keeping with previous work, but is here only of a low level of statistical significance.

C. *Clinical Data and EEG Variables*

Many clinical data, referring to the biological and sociological background of the patients, their current symptoms and behaviour, and their diagnosis were available (Tait *et al.*, 9). All this material was evaluated and compared with the EEG indices, but here only those items which seemed particularly relevant to the hypotheses, or those which in fact showed, however unexpectedly, any trend of association, are mentioned.

1. *Age.* Three age groups were considered: 40–44, 45–49, and 50–54. Age did not seem related to alpha index, to primary or secondary function, to beta amount, or to slow activity. There were, however, indications that the greater the age the less the regularity of the alpha activity. In the full table ($r=4$) $\chi^2=10\cdot76$, $P<\cdot05$, but this is affected by the smallness of the numbers involved. Condensing into regular, as opposed to fairly regular and irregular taken together, and making a fourfold table with patients under and above 45, χ^2 (Yates)$=3\cdot3$, $P<\cdot1$. There is therefore some indication that thought sequences, in our terminology, show increasing irregularity with age.

2. *Insomnia.* Data were available concerning the incidence of insomnia, and whether this was of early or late type, or combined. There was no evidence of association with any of the EEG variables.

3. *Menopause.* It was recorded whether or not the patients were past the menopause. Of the 17 patients regarded as having high or fairly high fantasy control (that is, of lower alpha indices) only 3 had passed the menopause; whereas 14 of 29 in the moderate to high alpha index ranges had done so ($\chi^2=3\cdot101$: $P<\cdot1$). There was thus some indication that patients who had passed the menopause showed less fantasy control. Similarly only 5 of 27 patients with no or little beta activity had passed the menopause, as opposed to 12 of 19 with moderate to high amounts of beta activity ($\chi^2=7\cdot72$: $P<\cdot01$). It would therefore seem that beta activity, indicating according to our hypothesis "aggressiveness", may be of more frequent incidence in post-menopausal patients. There were no indications of correlation of the menopause with the other three EEG variables.

4. *Exhaustion and fatigue*, as repetitive complaints, were next considered. There was some trend for exhaustion and fatigue seeming more prominent with increasing irregularity in the alpha range, that is, in our terminology, of irregularity in thought sequences; contrasting regularity on the one hand with records which were irregular or only fairly regular on the other, $\chi^2=2\cdot887$, and

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$P<1$. There was also some indication that complaints of exhaustion and fatigue were more common in patients with high and fairly high amounts of beta activity (9 of 11) than the others (16 of 35) ($\chi^2=3{\cdot}063$, $P<{\cdot}1$); this might be regarded as being in accord with the broad terms of the hypothesis.

5. *Tension, and agitation,* occurring as prominent symptoms in the clinical picture, showed no relation with any of the five EEG variables.

6. *Delusions, Hallucinations, and Clearly Paranoid Symptoms* were not of frequent occurrence in the clinical material, but none of these psychotic phenomena, for the numbers available, showed any indication of association with the EEG data. The only possible exception to this statement is that of 9 patients with clearly paranoid symptomatology, 8 had no or little beta activity present.

7. *Hypochondriasis* was considered in each of two forms; firstly where repetitive hypochondriasis was expressed in fairly real somatic terms, and secondly where the hypochondriasis was psychotic and bizarre. There was no sign of association of either with the EEG variables.

8. *Obsessive-Ruminative Symptoms* were present in clear and persistent form in only 7 of the 46 patients. Only 3 of the patients regarded as having primary function were clinically obsessional, and 1 of those with secondary function, which lends no support to our hypothesis that secondary functioning might be associated with rumination and obsessive thinking.

9. *Over-particular Personality:* This personality rating, covering the type of rather rigid, meticulous, particular but not pathologically obsessional character said to be of common occurrence in involutional illness, was given to 17 of the 46 patients. There was no indication of any relationship with the EEG data; 5 patients with this type of personality were regarded as having primary function as opposed to 2 with secondary function, again contrary to our expectations.

10. *Aggression, and Demanding Behaviour.* The occurrence of aggressive symptoms, and of lesser degrees of demanding behaviour, dissatisfaction and critical attitudes was clinically rated. Clinical manifestations of this sort showed no correlation with the EEG variables.

11. *Mood Swings,* occurring in the past, showed no hint of association with EEG patterns.

12. *Self-blame, and Self-criticism,* as sustained clinical features, showed similarly no correlation with EEG data.

13. *Diagnosis.* The patients represented a variety of diagnostic categories, including psychotic depression, a number of neurotic syndromes, alcoholism, and schizophrenia. No relation between diagnostic category and EEG data could be ascertained. It may however be mentioned that 5 of the 6 hysterias lay in the category of moderate or little fantasy control, which would agree with expectation.

Discussion

In general, the results fail to show support for the hypotheses.

Firstly, with regard to the association between "extraversion-introversion" and EEG patterns, and with regard to the overall EEG dichotomy, both formerly reported for the group of alcoholics, the current investigation failed to give any significant confirmation of the previous findings. One reason for

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this may lie in the fact that the group of involutional women was much more heterogeneous in clinical composition, a majority of the group being psychotic. It was noted (Orme, 6) that there were indications that introversion-extraversion may be a more complex variable than is sometimes appreciated. In severe disturbances particularly, as with the involutional group studied here, its components may be less integrated than in normals and less disturbed subjects. Another possibility is that the alcoholic group as a whole either possessed (or lacked) some personality feature—and by so doing, simplified the position by holding constant certain variables. Whatever alternative applies, the reduction of the correlation between EEG and personality variables in the involutional group may well be attributed to its more complex composition.

Secondly, the set of general and loosely framed hypotheses about the possible clinical meaning, for this group of women, of the 5 EEG variables found little support on analysis. Where there was some suggestion of association, as in the relation to the menopause of high alpha index and of greater beta activity, this was outside the terms of the hypotheses. These negative results can be interpreted in various ways. They may be taken at their face value as indicating that there is in fact no relationship of the type suggested between clinical data and EEG variables, or more correctly that this relationship if it exists is not sufficiently strong to be manifest in this number of patients. Alternatively we may wonder whether the design of the investigation was sufficient to test the hypotheses adequately. The EEG data and the assessments of clinical state were kept rigidly apart, the clinical variables being derived from the observations of two clinicians and determined by a third. This was a matter of deliberate policy, in the desire to avoid any possible contamination or bias in the clinical assessments. However the coincidence of loosely formulated hypotheses and relatively crude independent clinical data may make for an incomplete testing ground, and more refined techniques of study will be at least considered.

Summary

1. Following on work showing a dichotomy of personality traits in alcoholics which was related to EEG patterns, a broadly similar investigation of a group of involutional women having their first major psychiatric illness is reported. In addition, certain other hypotheses about the clinical meaning of EEG variables were tested.

2. The results in general did not support with any degree of confidence the earlier findings and did not verify the additional hypotheses. The reasons for this are discussed.

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