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Electroencephalographic variants and genetic predisposition to schizophrenia

PETER HAYS

From the Department of Psychiatry, University of Alberta, Edmonton, Alberta, Canada

SUMMARY Schizophrenic patients (249) were divided into those with and those without a family history of major functional psychosis. The same patients were then divided into those with entirely normal electroencephalograms and those whose traces contained some variant of normal. Traces were interpreted without knowledge of the patients' identities, and the question of the presence or absence of positive heredity had been decided without knowledge of the patients' electroencephalographic status, so that the discovery that normal electroencephalograms correlated highly significantly with positive heredity, and vice versa, commands attention. It is considered in the setting of previous work on psychoses and organic and electroencephalographic findings.

Many attempts have been made to correlate electroencephalographic abnormalities and variations with the subtypes of schizophrenia, and to determine any patterns specific to or highly associated with that psychosis. Unfortunately, the classical subdivision of schizophrenia into catatonic, hebephrenic, paranoid, and simple types, rejected by Kraepelin (1919) himself, is at best no more than a convenience; and the boundaries of the schizophrenic syndrome itself are vague and the criteria used vary very widely from one country to another. It is, therefore, not surprising that, as noted in standard texts (Slater and Roth, 1969), 'a number of anomalies have been described in the EEG of schizophrenics but hardly any of those reported on the strength of qualitative observations have stood the test of time', and thus that (Solomon, 1967) the 'EEG is of relatively little aid to the clinical psychiatrist'.

However, it is also recognised that schizophrenics in general have a higher incidence of abnormal electroencephalograms than non-schizophrenics (Torrey and Peterson, 1974); one abnormality, slow waves in the 4 Hz range, is more common in illnesses with catatonic features (McMahon and Walter, 1938); and there is a general feeling, made explicit by Bleuler (1950), that schizophrenia is a catch-all term which includes several separate illnesses. Thus, the negative literature notwithstanding, this is an area which may still be explored with hope.

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Method

A series of schizophrenic patients, so diagnosed by others in each instance, has been under my care since 1963. Of these, the great majority have had electroencephalograms. Those who did not were unselected, the omission being due to refusal, transfer, death, or some other cause unconnected with any expectations held about the type of tracing that might result. Performing multiple electroencephalograms increases the chances of finding variants, and it is, therefore, necessary, in an exploratory study susceptible to bias, to settle on a standard number of readings; for practical reasons only one electroencephalogram was intended for each patient, and in those few instances where more than one was done a single trace, selected at random, was read. The only patients excluded from the study were those, few in number, who had been schizophrenic but who had a history of usage of illicit drugs such as LSD or of an excessive use of alcohol during the year before the onset of the psychosis, and these patients were set aside without reference to their electroencephalograms.

All traces were rendered unidentifiable by covering the first page with opaque card before interpretation. I read them in large batches some time after the investigations had been done. A trial run was done on about 60 traces, and these were divided into (a) those which contained no variants, and (b) those departing from this state in some way. The latter group of traces was then

reported in considerable detail. An abstract was made of the variations and the main categories determined. Operational definitions of the categories were then set out, and their applicability tested by referring back to the traces.

After any necessary elision and refinement, final operational definitions were as follows:

1. Nonvariant electroencephalogram—the absence of any of the variants set out below.
2. Generalised and persistent background of >14 Hz waves.
3. Frontal or temporal 5–8 Hz. waves, occurring in runs: in the case of 8 Hz waves these were disregarded if the alpha rhythm was slow and approximated to that rate.
4. As category 3 but voltage persistently higher and runs more frequent on one or other side.
5. <5 Hz waves in runs, and occurring in the absence of drowsiness.

In some instances a patient might have more than one variant in the electroencephalogram and then his trace would be categorised as belonging to the most deviant of the groups suggested—that is, if a patient's trace contained asymmetrical 5–8 Hz waves and underlying activity of >14 Hz waves, it would be subsumed under category 4.

Patients were then divided into two groups according to the presence of major functional psychosis (schizophrenia or bipolar manic-depression, but excluding unipolar psychotic depressive reaction) in first or second degree relatives, or its absence; schizophrenia and manic-depression were taken together because occasionally manic-depression was offered as an alternative diagnosis in a relative's case notes, and it was inappropriate to impose my own criteria in deciding which designation was preferable. Those patients who had been adopted and had no knowledge whatsoever of blood relatives were excluded. There remained 249 patients.

One hundred consecutive records of the patients under review were examined to see if phenothiazine dosage levels correlated with the electroencephalographic findings, and they did not.

Results

The results are set out in the Table.

Table *Summary of results*

EEG category	*Family history positive*	*Family history negative*
(1) Non-variant	68	61
(2) >14 Hz	15	9
(3) 5–8 Hz symmetrical	9	38
(4) 5–8 Hz asymmetrical	3	24*
(5) <5 Hz	11	11
Totals	106	143

χ^2: $P < 0.001$.
*In 21 of these patients, the variant was more prominent on the left side.

Discussion

A correlation is demonstrated between EEG variants and heredity, such that the presence of psychotic heredity goes with a non-variant EEG (as defined: 68/106), and a negative heredity goes with a variant EEG (as defined: 82/143) (Fisher exact test: $P<0{\cdot}001$).

Some closely analogous work that is generally concordant may be cited.

Investigating mania, and using a very similar approach but with the refinement of studying perinatal hazards as well as electroencephalographic variants, Dalén (1965) reported that the presence of a family history of affective illness correlated negatively with paroxysmal theta activity and asymmetrical activity, while perinatal hazards correlated positively with 'abnormal or borderline' records. After detailed argument, he concluded, *inter alia*, that his data supported the hypothesis that a genetic propensity operated in some cases, and, in others, brain damage. Similar findings and the application of the same logic have engendered like conclusions in bipolar manic-depressive illness (Hays, 1976), and in the course of the same study the reliability of the method used here for reading electroencephalograms was tested and found adequate.

The tendency for asymmetry to be due to more prominent variation on the left side constitutes an interesting parallel with the consensus of those investigators of temporal lobe disorders reviewed by Bingley (1958), and with conclusions set out in a study by Flor-Henry (1969) of psychiatric syndromes associated with temporal lobe epilepsy, which included the finding that schizophrenia-like illnesses are most commonly found when the dominant lobe is involved.

The findings are also in accordance with Symonds' suggestion (1962), made after hearing the original account of the schizophrenia-like psychoses of epilepsy (Beard and Slater, 1962), that disorderly activity in the temporal lobe, reflected by electroencephalographic disturbance, might, in the absence of genetic predisposition, cause schizophrenia without also causing epilepsy.

From the foregoing, I draw the following conclusions: the schizophrenias are aetiologically heterogeneous; the classification of these illnesses into their components, therefore, presents a problem to which a solution must exist; and among the factors which must be considered in the course

of determining a natural classification, genetic factors and electroencephalographic status will both be relevant.

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