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THE IMPORTANCE OF EVENT-RELATED SLOW POTENTIALS IN THE DIAGNOSIS OF PSYCHOTICS.

M. TIMSIT-BERTHIER, J. DELAUNOY, B. XHENSEVAL &
+ M. TIMSIT

Clinical Neurophysiology Laboratory
Medical Psychology Department
153, Bd de la Constitution
4000 - LIEGE - BELGIUM

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The discovery of Contingent Negative Variation (CNV) by Grey Walter in 1964 triggered the study of Slow Potential Changes (SPCs) in human subjects and opened up an entire field of clinical neurophysiological research which promises results quite rewarding to psychologists as well psychiatrists.

In fact, during the ensuing decade, researches have defined other slow phenomena of varying polarity and topography which are notably characterized by their close correlations with complex psychological processes.

Since 1967, our research has centered on the study, in psychiatry, of two particular SPCs, the Contingent Negative Variation (CNV) and the Average Motor Potential (AMP).

The CNV is an observable occurence of negative polarity which develops when a temporal liaison occurs between two stimuli. The first stimulus is called the "warning stimulus" and the second the "imperative stimulus" The second stimulus directs the subject towards making a decision, usually but not exclusively, a movement. (G. Walter et al. 1964).

The AMP (described by Kornhuber and Deecke in 1965 then by Gilden et al. in 1966) is a slow complex potential which occurs when a spontaneous voluntary movement is performed. Three main components have been clearly identified when it is recorded from the contralateral rolandic area:
(a) a slow negative shift, called the readiness potential, begins about 1 sec. before onset of muscle contraction; (b) a sharp and fast negative wave arises about 80 mesc before the electromyogram; (c) a slow positive deflexion starts suddenly and accompanies the movement it self. When recorded from the vertex, the brief second component appears fuzzy and only the slow negative and positive shifts are clear.

The present paper will give a fuller account of the last 7 years' findings of the laboratory of the Department of Medical Psychology founded in liege by Prof. Dongier

MATERIAL.

This study was carried out 720 subjects but only 655 of them were included. Those retained met the precise clinical and electrophysiological criteria that we established:

Control group: This group was composed of 100 subjects (average age 28). These subjects (students, soldiers, technicians) were selected after having taken a psychological examination wich would reveal a psychotic structure.

Neurotic group: 200 subjects (average age 32), we recruited from the polyclinic of our departnent. or the open service of the general hospital. Neurotic symptoms were present in varying degrees: states of depression, phobias, mechanisms of conversion, and obsessions. These patients maintained a healthy social adaptation, intact cognitive functions and an undistorted contact with reality.

Personality disorder group: 70 subjects (average age 27) were recruited from the polyclinic, the open service of the general hospital and from the prison. This group is fairly heterogeneous, since it includes cases as dissimilar as criminal psychopaths (10) sexuel deviants (20) and border line (40).

Mentally retarded group: 30 subjects (average 22) were recruited from different municipal workshops for retarded adults. They were all tested with IQ (average IQ = 51,16 +/- 11,53; limits 30-73).

Psychotic group: There were 150 subjects (average age 30) recruited from the open and closed psychiatric services of Liege. They were adapted poorly to social situations. Their rational thought processes were frequently distorted by hallucinations and illusions. In this group, 100 subjects were schizophrenic and 50 presented an affective psychosis.

In all cases, electrophysiological evaluation and psychiatric diagnosis were made independently. In many cases projective tests were performed (Rorschach, TAT). It must be noted that a large proportion of the subjects hade undergone psychotropic treatment. In an effort to rectify this situation, we were obliged to test at least 20% of the subjects in each clinical category before

any pharmacological treatment was received and to systematically compare their curves with those obtained from patients already undergoing treatment.

Finally, CNVs were recorded from 570 subjects, AMP from 285, but only 210 were tested for both. 186 subjects were tested several time.

RECORDING TECHNIQUE.

The EEG data were recorded with Ag-AgCl disc electrodes fastened to the vertex and the left mastoid (used as reference) with collodion. The electrooculogram (EOG) was recorded from right infra and supra-orbital electrodes and the electrodermal response (EDR) from electrodes applied to the thenar eminence (active) and to the dorsal surface (inactive) of the left hand. All these electrodes were bridged to the skin by a special conducting paste (Beck Lee Corporation) and were connected to the input of an EEG pre-amplifier (ECEM D.C. - 16 channels) of which 8 channels had 11 sec time constants. Amplifier bandpass setting were 0.11-50 c/sec (20 dB/ octave). All the analogue data were stored in a Magnetic Tape Recorder (Precision Instruments 6208) and recording was done at 3.75 in./sec (Recording bandpass DC-1 kc/sec). These were summated (on line and off line) on an Enhancetron (Nuclear Data 1024 points). The impulses which triggered the different stimuli were delivered by a Digitimer. The results were visualized on an oscilloscope (Tektronix) and inscribed on an X-Y plotter (Hewlett Packard, 7000 AM). Calibration of the X-Y plottor allowed evaluation of the curve.

The base line was defined by visually establishing a best fit straight line on the EEG during the 1000 msec prior the beginning of the curve.

If the EEG record of a subject showed any eye movement or blinking during a trial, that trial was eliminated. If more than 25% of such trials occured, the subject was droppes from the study.

EXPERIMENTAL PROTOCOL.

The subject was placed in a darkened room, isolated by a double door from the recording room. He was comfortably seated in an armchair and everything was done to reassure and relax him before the recording.

The CNV paradign was the following: the warming stimulus (S1), a click; the imperative stimulus (S2), a serie of flashes that the subject turned off by pushing a button - 1,5 sec separated the first from the second stimulus. The CNV was obtained by averaging 20 trials.

For the AMP, the subject was requested to press a button approximatively every 4-5 sec. The AMP was obtained by averaging 100 trials.

During the different experimental sequences the subject kept his eyes closed.

RESULTS.

Our electrophysiological data has led us to establish an actual nomenclature concerning the different types of CNVs and AMPs which, at this juncture, is as follows.

a) As for CNV, aside from typical CNV already described elsewhere (G. WALTER et al.) and flat CNV of zero amplitude described by Small J. (1971), Mc Callum W.C. and Abraham P. (1973). We have found 3 types of CNVs of long duration.

- Type II CNV: the baseline return is delayed but the drop begins immediately after the imperative stimulus.
- Type III CNV: the baseline return is delayed but there is no drop after the imperative stimulus.
- Type IV CNV: not only is the baseline return delayed but also the negative deflexion increases in amplitude after the imperative stimulus.

(Table I).

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b) As for AMP, aside from the biphasic wave already described (Kornhuber and Deecke 1965) we have found another type of wave: it was most often a negative or flat phenomenon. When it was biphasic, its main characteristic was the inversion of polarity after the end of muscular contraction

(Table II)
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We have made certain that the phenomena that we are describing were not contamined by artefacts by simultaneously recording and summating EEG, EOG and GSR with the same time constant, and by eliminating the cases in which the three curves evolved in parallel. In addition, in several cases, we also performed rigorous topographical studies and systematically injected atropine (1%10 mg) under each electrode (reference and active) (TIMSIT-BERTHIER M. et al. 1974).

—— The study of the correlations between these various types of SPCs and the different clinical categories has led us to establish criteria and to define, for adults, normal curves (Type I CNV, typical AMP) and abnormal curves (Type III, IV and flat CNVs, variant AMPs). Type II CNVs appear with equal frequency among all of the clinical categories.

In effect, it appears quite evident ($P \leq .001$) that normal curves are characteristic of neurotic and control subjects and that abnormal curves occur mainly in psychotics. An abnormal curve, thus, may be encountered in all clinical categories (cf. Table I and II). And it should be noted that their distribution is the same among affective psychosis and schizophrenia without and with drug therapy (Timsit-Berthier M. et al. 1973). An abnormal curve thus appears to be a general index of non-specific morbidity. It can serve as a type of warning signal which would alert the clinician of a pathological state.

— A more thorough clinical study allowed us to compare 2 subgroup of psychoses: early schizophrenics, characterized by maladaptation to reality, delusion and/or hallucinations; and chronic schizophrenia, considered clinically stable (Timsit-Berthier M. 1972 _. Normal curves appears more frequently in chronic schizophrenia, whereas early schizophrenia yields curves whose majority exhibit at least one abnormal SPC. Same results were reported by Dubrovsky, B and Dongier M. (1974). The great practical applicability in the findings of such electrophysiological phenomena is readly apparent. In effect, eventhough the occurence of an abnormal curve does not provide precise diagnostic information since it is found in almost 35% of neurotic subjects and in a certain number of control subjects, nevertheless, a normal curve found in a subject suspect of early schizophrenia would almost conclusively rule out that diagnosis.

— The study of successive recordings taking at intervals of several weeks indicated that curves tended to be stable in control subjects but often underwent changes in mentally ill patients (Timsit-Berthier M. et al. 1973) CNVs were most labile than AMPs. Most patients who produced pathological curves during the evolutive stages of their illness, showed more normal curves after several weeks. Those psychotics who exhibited stable pathological curves over the course several recording sessions appeared particulary unresponsive to drug therapy and their disorders became chronic (Molders et al. 1974).

— Finally, the use of projective test, e;g; Rorschach, has allowed us to evaluate the significance of the combinations of anormalous CNVs and AMPs. Correlations were established between 2 quantitative indices of psychopathological disorganisation (Palem list and Thiesen pattern) and the occurence of abnormal CNVs and/or AMPs. It became apparent that the degree of electrophysiological abnormality reflects the extent of the schizophrenia disorganisation. Patients with abnormalities of both CNV and AMP exhibited the most pathology in projective testing; those with one abnormal curve showed loss disorganisation, while those giving normal curves gave the least pathological scores (Timsit M. et al., in press).

Thus, our findings, with respect to projective tests, suggest that our SPCs measurements do correlate with severity of psychopathology.

CONCLUSION.

The existence of abnormal CNVs and AMPs presents a considerable practical interest for the clinical physician and this method has been routinely utilized by our department for the last 2 years.

But a lot of work is yet to be done to interpret obviously the anomalous SPCs and numerous informations have to be sought by a variety of means and from several directions.

SUMMARY

- The CNV and the Motor Potential have been studied since 1968 in our laboratory.

- These SPCs were recorded from Vertex Cz (ears reference). EOG and GSR artefacted trials were eliminated. Averaging in blocks of 20 for CNV and 100 for Motor Potential was done with Enhancetron 1024. CNV and MP were drawn with an X-Y plotter for visual measurement (amplitude, duration, morphology).

- The recorded subjects were either mentally ill patients (psychotic, neurotic, retarded, psychopathic, borderline cases) or control subjects (students, soldiers and technicians). More than 1500 records were made 800 subjects.

- This study permitted us to establish a nomenclature based on different shapes of CNVs and MPs and to distinguish "normal" and"abnormal" curves. Thus, CNVs of an amplitude greater than 5 μv and of short duration and biphasic Motor Potential were considered normal. Flat CNVs, CNVs with normal amplitude but long duration and flat or monophasic MPs were considered abnormal.

- These results allow us to use this new technique as a means of getting more than routine information in psychiatric testing of mentally ill patients (principally for diagnosis of early schizophrenia).

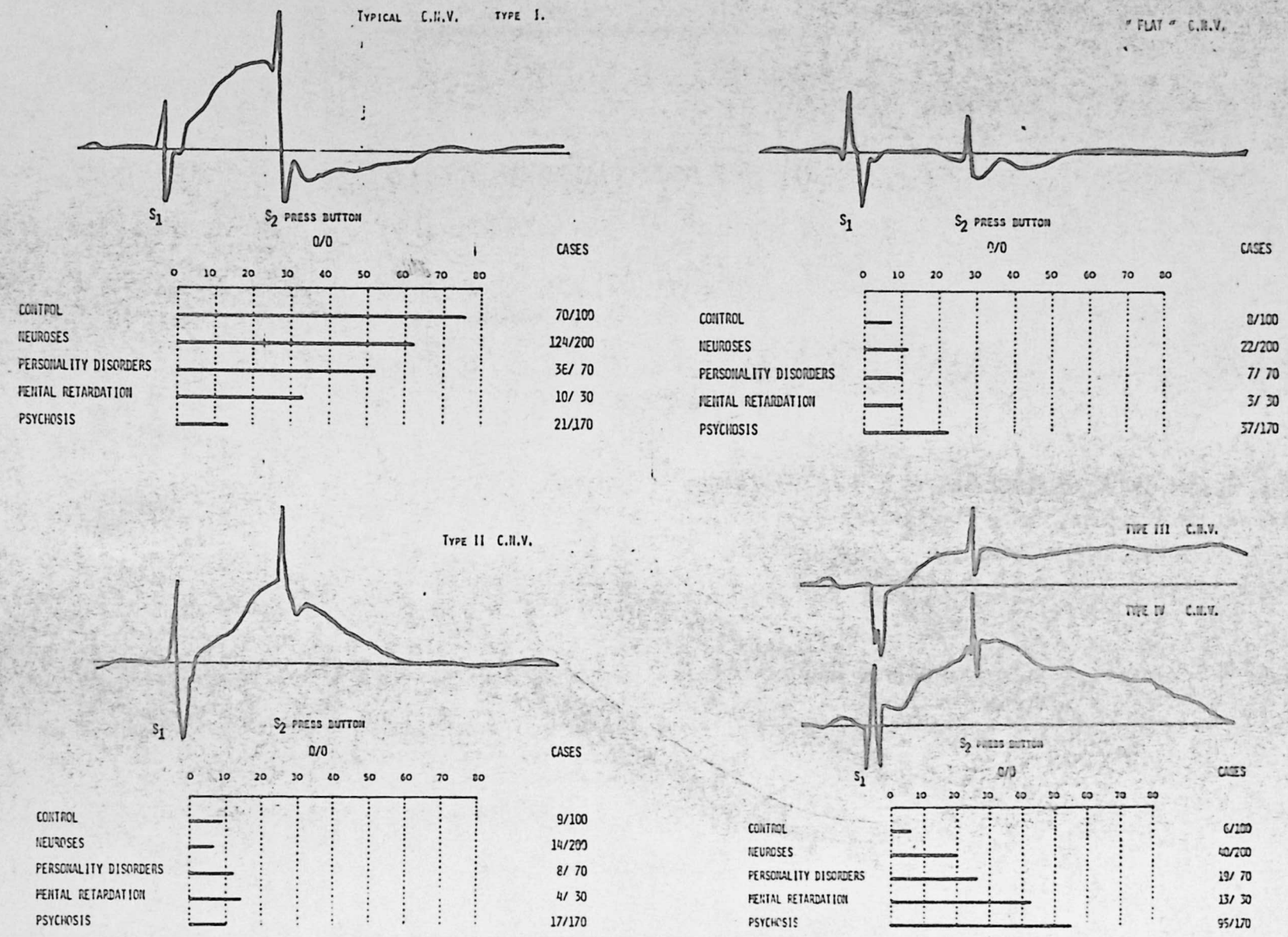

TABLE I. : The different shapes of CNVs and their distribution according to the clinical categories:

Control, Neuroses, Personality Disorders, Mental Retardation, Psychosis.

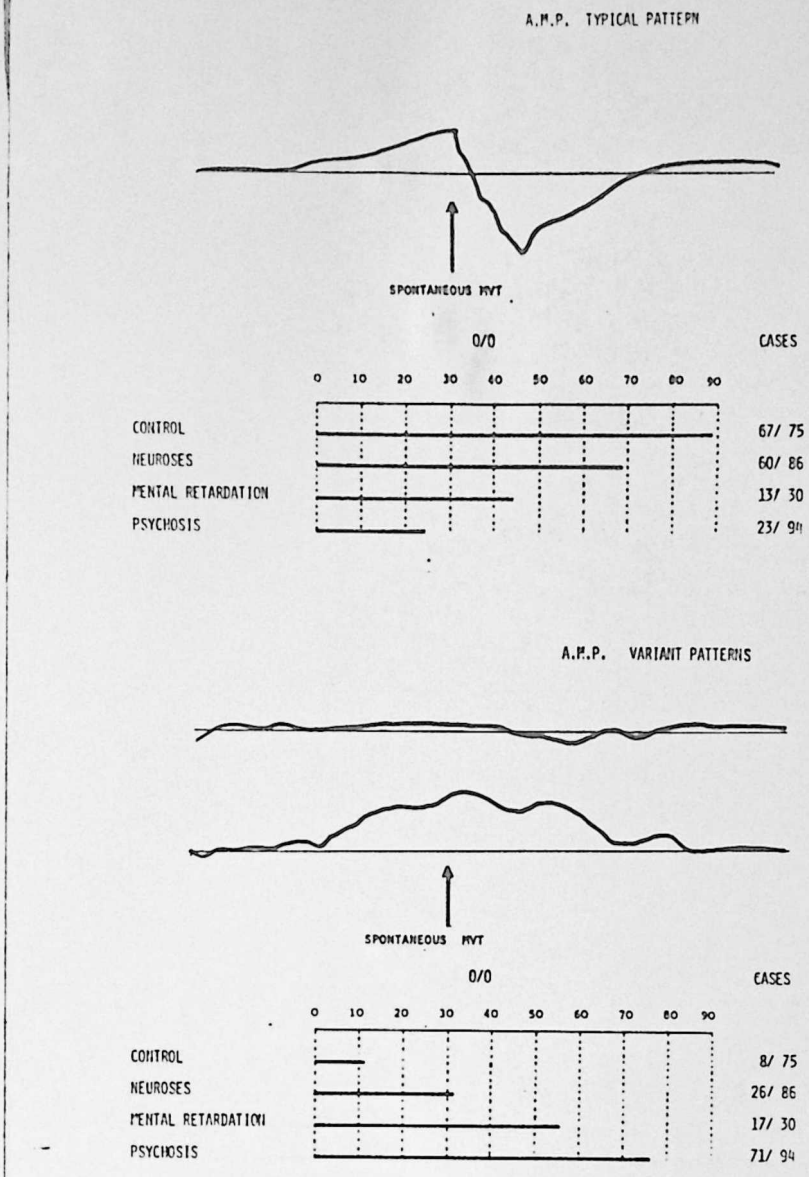

Table II: The different shapes of AMPs and their distribution according to the 4 clinical categories: Control, Neuroses, Mental Retardation and Psychosis.