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Some Electrophysiological Observations in Obsessional States

K. T. CIESIELSKI, H. R. BEECH and P. K. GORDON

Summary: Averaged evoked potentials were recorded from a group of obsessional patients and matched normal controls for three types of visual stimulation: passive monitoring of a light flash, a pattern consisting of gratings and a cognitive task involving discrimination of two similar shapes. As the complexity of information processing required by the tasks increased, differences in the evoked potentials of obsessionals became more marked. The main finding was of faster latency and reduced amplitude of the $N\overline{220}$ component in the cognitive task. The relevance of this finding to a theory of obsessional disorder is discussed.

Obsessional disorders have received considerable attention from psychologists over the last 10 to 15 years, although most of the effort has been directed towards the discovery of effective treatment techniques, while attempts to understand the mechanisms of the disorder have been less evident (Beech, 1974; Beech and Vaughan, 1979).

Current behavioural theories centre on the notion that an obsession is learned behaviour which becomes established through its anxiety relieving properties. However, this simple explanation fails to deal with many puzzling features of the disorder, such as why the performance of rituals often increases rather than decreases anxiety, or how altered mood, rather than environmental experience, serves to activate pathological behaviour.

An alternative approach to explaining the phenomena of obsessional disorder has involved the search for signs of physical abnormalities. The impetus to this view comes both from the intractable nature of the disorder and its resistance to traditional psychotherapy. For example, it has been reported that the type of electrical response of the brain to situations involving expectancy (known as the CNV) is abnormal in obsessionals (Walter, 1966; Dongier, 1973), that there is a higher incidence of neurological illness in obsessional than in other types of neurosis (Grimshaw, 1964), and a recent study of the EEG characteristics and neuropsychological test performance among obsessionals (Flor-Henry *et al*, 1979) has reported a left-frontal region defect in such patients.

On the one hand we have the view that obsessions are related to anxiety and learning, and on the other there is the suggestion of some basic organic dysfunction. A way may be open to reconciling these two viewpoints by postulating a CNS abnormality of a kind which leads to more rapid and fixed learning than would be seen in the normal conditioning process, and an abnormality which could affect learning in this way might involve instability of the arousal system.

The notion of an unstable arousal system making the obsessional vulnerable to rapid and fixed conditioning has been suggested previously (Beech and Perigault, 1974) and this was later developed in the context of alterations of mood state (Villa and Beech, 1977; 1978). The model implies that obsessionals would show altered information processing in the CNS, so that in the present study evidence of abnormalities of information processing was sought by examining evoked potential (EP) responses. A preliminary attempt was also made to identify the levels of processing complexity at which these abnormalities might appear, by eliciting EPs under differing stimulus conditions.

In the field of psychological abnormality evoked potential techniques have been used mainly to investigate psychotic disorders, both in an attempt to localize the brain areas implicated (e.g. Perris, 1974) and to identify the information processing failure which may characterize schizophrenia (Shagass *et al*, 1977). Shagass reports that in chronic schizophrenia early components of the EP are of high amplitude and low variability, and argues that this implies a deficit in the gating of input, leading to impaired information processing at a later stage, reflected in lower amplitude and more variable later components. Such work seems to emphasize the need to elicit visual evoked potentials (VEPs) in situations which provoke both early (peak latency up to 150 msec) and later components.

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Method

Subjects. Eight patients (5 female, 3 male) diagnosed as primary obsessional neurotics participated. Their mean age was 36.5 years, and all had experienced symptoms for at least one year. Four patients were taking tricyclic antidepressant medication. Lateralization was assessed using the hand and eye tests from the Harris tests of lateral dominance (Harris, 1958). Strong dextral lateralization was found in 7 patients, and left-handedness with ambivalent tendencies in one. The 8 controls were matched for sex, age and handedness. All had normal or corrected to normal vision.

Procedure and apparatus. Three types of VEP were recorded for each subject in two separate, 1 hour sessions. Flash and pattern-grating EPs were recorded during the first session. A photic stimulator, placed 50 cm before the subject's eyes was used to produce a brief (10 μsec) pulse of blue-white light for the flash EPs.

The vertical sinusoidal pattern gratings (initially used by Kulikowski and Kozak, 1967) were generated on an oscilloscope screen, with a mean luminance of 28 cd/m². Gratings were presented on-off at 2 Hz and spatial frequency of 5 cycles/degree. The subject sat facing the oscilloscope at a distance of 57 cm, the size of the screen being 10° × 8°. The task was passive. Subjects were required to concentrate on the centre of the screen, marked with 3 dots, from the moment the warning signal was given. If a subject wished to rest during recordings he could stop the stimulation by pressing a stop-button. All VEPs were recorded via Fylde Electronics amplifiers with low–high pass of 1–30 Hz and averaged using Medelec equipment. For each type of stimulation (flash, gratings) 64 brain signals were averaged. Silver-silver chloride cup electrodes were glued to the scalp using a fast-setting collodion. Electrode resistance was maintained around 5 K Ω. The EP signals were recorded binocularly. Two active electrodes on the inion and 5 cm above the inion were referred to a common mid-frontal electrode, 12 cm above the nasion (Halliday, 1978; Jeffreys, 1977).

Cognitive EPs were recorded during the second experimental session using a procedure standardized by Ciesielski and French (1980). Subjects faced a white screen (30° × 30°) positioned 171 cm from their eyes, the central spot on this screen being marked at all times by a red fixation spot. They were first trained to fix upon the central spot using apparatus for eye movement control (Abadi *et al*, 1979). Three amoeboid nonstructural figures of similar levels of perceptual difficulty (Nevskaya, 1974) were applied as the stimuli (non-verbal figures). They were combined in vertical pairs consisting of two identical figures ('same') or two different ones ('different'). The number of 'same' and 'different' pairs was equal. The pairs (size 1°30′ × 38′) were presented tachistoscopically in random order on the screen, the luminance of the screen and stimuli being 1.7 cd/m² and 4.1 cd/m² respectively. Sixty-four pairs of stimuli were presented either 3°30′ to the right (right visual field—RVF) or left (left visual field—LVF) of the fixation spot, with an exposure duration of 60 msec. With steady concentration on the red spot, the subject's task was to decide whether the presented pair were the same or different, indicating this as quickly as possible by pressing appropriate buttons. During the experiment verbal contact with the subject was reduced to a minimum, but short breaks were given after each 32 presentations of stimuli.

Silver-silver-chloride cup electrodes were placed at

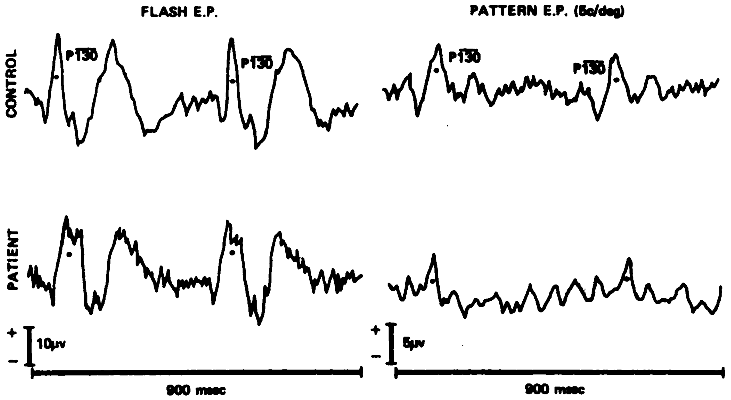

FIG 1.—Flash and pattern EP's for two representative subjects (one obsessional, one control) recorded binocularly from an active electrode at the inion, and drawn with positive deflections upward.

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P3 and P4 according to the 10–20 international system (Jasper, 1958) and were referenced to common linked earlobe electrodes. Resistance of the electrodes were maintained below 5 K Ω. Left and right homologous electrode pairs were equalized to within 1 K Ω. Thirty-two signals were averaged in each visual field of presentation.

Results

The most prominent feature of the averaged recordings in flash and gratings (pattern) stimulation (Fig 1) is the major positive component (P$\overline{130}$) with latency 100–140 msec similar to the P100 described in clinical studies (Halliday, 1975; 1978), which is preceded and followed by smaller negative peaks.

The peak latency of this component and its amplitude (measured from preceding peak opposite polarity, as determined by visual inspection) were submitted to statistical analysis, for recordings obtained with the active electrode at the inion.

Analysis of flash EPs did not reveal significant differences between the peak latencies and peak amplitudes recorded for patients and controls using the Mann Whitney U test. Similar analysis of the gratings EPs, however, revealed significantly lower P$\overline{130}$ amplitudes in the recordings of patients (P = 0.001). The differences in peak latencies were not significant (Table I).

On the cognitive task, the data were analysed for components N$\overline{220}$ (latency 190–245 msec) and P$\overline{340}$ (300–380 msec); see Fig 2. Data could only be analysed using six of the control subjects as enforced changes in equipment for the other two subjects may have rendered their records unreliable.

Table I

Group comparison for flash and pattern stimulation

	Obsessionals		Controls			
	Mean	s.d.	Mean	s.d.	U-Value	Significance
Flash EP						
Latency (msec)	123	15.8	113	10.3	17.5	n.s.
Amplitude (μv)	20.1	5.0	22.4	3.6	24	n.s.
Pattern EP						
Latency (msec)	137	9.2	132	5.9	23.5	n.s.
Amplitude (μv)	6.4	1.9	10.6	1.1	0	***

*** P = 0.001 (Mann Whitney U, 2 tailed test). n.s. = not significant.

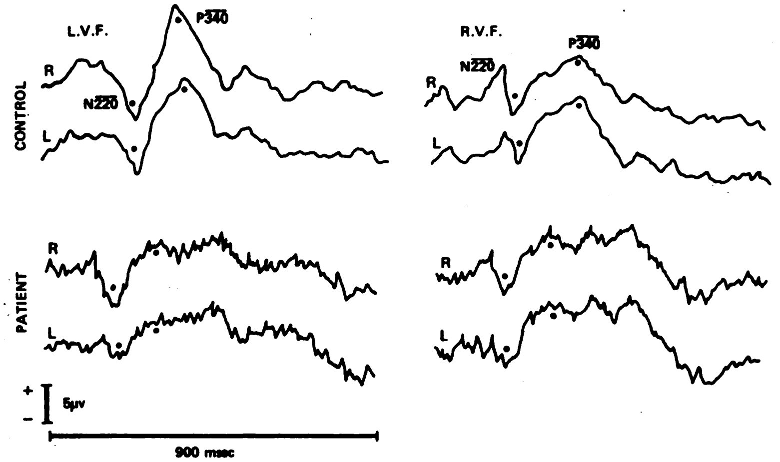

Fig 2.—Cognitive EP's for two representative subjects (one obsessional, one control) recorded binocularly from active electrodes at P3 (L) and P4 (R) for stimulation in the left (LVF) or right (RVF) visual field, drawn with positive deflections upward.

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TABLE II

Group comparison for cognitive EP, $\overline{N220}$ *component*

	Left visual field					Right visual field				
	Obsessionals		Controls			Obsessionals		Controls		
	Mean	s.d.	Mean	s.d.	U-Value	Mean	s.d.	Mean	s.d.	U-Value
Latency (msec)										
Contralateral	204	22.0	223	7.6	8 *	204	20.0	220	8.4	11 n.s.
Ipsilateral	217	16.7	236	8.6	8 *	217	23.8	235	7.1	12 n.s.
Amplitude (μv)										
Contralateral	6.4	2.3	10.5	1.0	2 **	5.4	2.7	8.8	1.2	6.5 *
Ipsilateral	3.9	2.0	7.3	0.8	4.5 *	4.0	1.9	7.7	2.1	4 **

* P = 0.05; ** P = 0.01; (Mann Whitney U, 2 tailed test). n.s. = not significant.

TABLE III

Group comparison for cognitive EP, $\overline{P340}$ *component*

	Left visual field					Right visual field				
	Obsessionals		Controls			Obsessionals		Controls		
	Mean	s.d.	Mean	s.d.	U-Value	Mean	s.d.	Mean	s.d.	U-Value
Latency (msec)										
Contralateral	335	23.5	345	10.5	13.5 n.s.	333	20.9	349	8.0	11 n.s.
Ipsilateral	349	22.1	360	12.6	14.5 n.s.	346	24.1	362	8.8	12 n.s.
Amplitude (μv)										
Contralateral	11.1	4.9	16.0	2.4	10 n.s.	10.8	4.6	14.0	2.8	13.5 n.s.
Ipsilateral	9.2	4.1	12.5	2.1	12.5 n.s.	8.7	4.2	12.2	1.8	11.5 n.s.

n.s. = not significant (Mann Whitney U, 2 tailed test).

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Obsessional patients demonstrated a significant tendency to reduced amplitude of the $N\overline{220}$ component (Table II). This component also revealed shorter latencies in this group, with the trend being significant for the right visual field. Similar findings occurred for the $P\overline{340}$ component respecting latency and amplitude, but these failed to reach statistically significant levels (Table III).

There was no effect of lateralization in either group in that there were no differences in the response recorded in each brain hemisphere for stimulation in the contralateral visual field. However, as expected, responses in the contralateral brain hemisphere were of significantly shorter latency and higher amplitude than those in the ipsilateral hemisphere. No significant correlations were found between electrophysiological data and age or length of illness. Medication did not appear to have influenced the results.

Discussion

The data reported here suggest that obsessional patients can be distinguished from normal subjects in certain aspects of their VEP records, and such differentiation may depend on the level of information processing complexity required by the experimental task. Abnormalities of EP recordings were thus not observed among obsessionals in the simplest (flash stimulation) condition. With increasing complexity (patterned stimulation) however, the amplitude of EPs was significantly lowered, although the latency of responses appeared to be unaffected.

The distinction between obsessionals and normals was clearest as task complexity was further increased to include cognitive processes. In pattern discrimination the patient group again showed a significant reduction in amplitude ($N\overline{220}$ component). The shorter latencies for obsessionals, which were also found, parallel those reported in psychotic patients (Shagass and Schwartz, 1965; Saletu *et al*, 1971) and this finding may add weight to the argument advanced (Flor-Henry *et al*, 1979) that a link exists between obsessional states and psychoses.

The data for the $P\overline{340}$ component showed a similar trend to those for $N\overline{220}$ but failed to achieve statistical significance, a finding that may be attributable to the task employed, which emphasizes the $N\overline{220}$ component (Ritter *et al*, 1979; Ciesielski and French, 1980). $P\overline{340}$ abnormalities on the other hand, might be more clearly revealed on a cognitive task requiring symbolization or verbal activity (Courchesne, 1978).

One of the few previous electrophysiological studies of obsessionals (Flor-Henry *et al*, 1979) suggests a disturbance in the verbal regulation of behaviour, associated with the left brain hemisphere. The results of our study, concentrating on pre-verbal stages of visual information processing, indicate that a problem may exist at an earlier stage than verbalization, although we would argue that the extent of the abnormality revealed increases with the information processing complexity involved.

In our view, an understanding of the vagaries and complexities of obsessional behaviour requires the postulation of some basic but variable abnormality of function. It has been suggested that the nature of this abnormality is that of a special potential for becoming aroused and exhibiting strong defensive reactions to minimal stimulation (Beech, 1971; 1974; 1978) which, in turn, implies a disorder of either excitatory or inhibitory processes. It is of interest to note, in this context, that significant decreases in the inhibitory neurohormone serotonin have been found in obsessionals (Yarura-Tobias *et al*, 1977). In relating this to our present findings we would postulate that the observed faster latencies might reflect this lack of inhibitory control. Given, however, that lateral inhibition of sensory signals has the function of reducing responses to competing, irrelevant stimuli (Hartline *et al*, 1956) our finding of lowered amplitude could arise from an attenuation of brain response to the experimental task due to the concurrent response to distracting stimuli (Jane *et al*, 1962). Future research may clarify this point by utilising distraction or secondary task interference in the EP recording paradigm.

Finally it is of note that two of the 8 obsessional subjects produced cognitive EPs which were very similar to those seen in normals, both in shape and amplitude. These two subjects did not appear to be differentiated from the remaining patients respecting age, clinical status or personal/social variables. However, this suggestion of individual differences in the clinical group emphasized the tentative nature of our current formulation of obsessional states, and perhaps indicates the need to take account of variables such as background EEG levels and subjective state at the time of recording. We consider that our present data demonstrate the utility of further research in this direction.

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