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EEG ALPHA RHYTHM AND EYELID FLUTTER[1]

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Summary.—A single case of one-to-one correspondence between eyelid flutter and EEG alpha rhythm is reported. It arose during a battery of experiments into possible personality correlates of eyelid conditioning, EEG evoked potential and skin potential habituation, involving over 400 subjects. The reported phenomenon lasted for one burst of 24 sec. and another of 6 sec. during 40 min. of recording on one subject. The observation is considered in the light of reported cases of links between EEG alpha and epileptic seizure and also between EEG alpha, Parkinsonism, and finger tremor. A time-keeping role for EEG alpha in the brain is postulated.

A relationship between EEG alpha rhythm and muscle tremor has been noted by several observers (Lippold, 1970). Indeed, Ennever, *et al.* (1971) argue that alpha arises from tremor in the extraocular muscles which modulates the standing potential across the eye, although this is contraindicated by the results of Cavonius (1974) and of Tait and Pavloski (1978). More recently there has been renewed interest in the general relationship between EEG alpha and muscle tremor. Semba, *et al.* (1980) in a study with rats report a correlation between rhythmical facial tremor and the rats' equivalents of alpha. They argue for a relationship between EEG alpha and Parkinsonian tremor. Isokawa and Komisaruk (1983) report a correlation in humans between EEG alpha and finger tremor.

The present paper reports an observation of a relationship between EEG alpha rhythm and muscle tremor in the eyelid (eyelid flutter). It arose during experiments looking at the human personality correlates of EEG evoked potential, skin conductance, and eyelid conditioning (Rust, 1975a, 1975b; Eysenck, *et al.*, 1975). It only occurred in one subject among a total sample of over 400 and lasted for 30 sec. out of a recording time of 40 min. for that subject.

METHOD

Subject

The subject was male, age 34 yr., and was an inmate of Wandsworth Prison.

Apparatus

The EEG was measured using a Mingograph EEG polygraph. Eyeblink responses were measured by a device constructed at the London Institute of

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Psychiatry, a pair of goggles which delivered puffs of air of short duration to the eye as unconditioned stimuli and recorded eyeblink by reflecting a light source within the goggles into a photometer, also within the goggles. Measures of EEG and eyeblink were therefore independent with no possibility of electrical artifact.

Procedure

As part of a large battery of experiments, the subject was seated in a soundproof dark room and was informed before the experiment about what to expect. For simplicity and to avoid disruption, all measuring apparatus was fitted at the beginning of the series of experiments, and measurement of all variables took place throughout. To look at habituation of skin-conductance response, each subject received 21 stimuli at 95 dB, 1000 Hz and of 1 sec. duration with an interstimulus interval of 33 sec. Skin resistance was measured from the first and second fingers of the left hand by an apparatus built at the Institute of Psychiatry and described by Venables and Martin (1967) (Model b1). Eyeblink conditioning was studied using as a CS a sinusoidal tonal stimulus of 75 dB and 1000 Hz, applied through stereophonic headphones. Puff intensity was 6 psi, with a CS-UCS interval of 640 msec., and UCS duration 60 msec. Interstimulus interval between CS-UCS pairs was predetermined random rectangular between limits of 8 and 15 sec. Finally, for the measurement of EEG averaged evoked potentials, the subject received 50 tones at 55 dB, followed by 50 tones at 75 dB after an interval of 1 min. One channel of EEG was measured from bipolar electrode placement to the Cz and T3 scalp positions. A time constant of 0.3 sec. and a frequency filter at 70 c/sec. were applied.

Results and Discussion

The observation which appears in Fig. 1 occurred during the initial GSR habituation phase of the experiment. The phenomenon occurred in two bursts, one of 24 sec. duration which is reproduced in its entirety for purposes of validation. The second burst was of 6 sec. duration and occurred after an interval of 21 sec. One stimulus of 95 dB was delivered during the illustrated period, about 8 sec. from its commencement at which point there is evidence on the EEG of the evoked potential. This does not, however, appear to have affected the phenomenon. The correlation between EEG alpha and eyelid tremor is quite clear from the illustration. It is largely one-to-one, but towards the end of the period eyelid tremor appears to coincide with alternate alpha rhythms and there is some evidence of a 1:3 relation.

This result represents a spontaneous occurrence within less than 1% of the observation period for one subject among in excess of 400 and is likely to find confirmation only among other single case studies. A computerized literature search yielded one relevant study carried out in 1975 by Nadel, *et al.*, who investigated a 25-yr.-old man who presented with seizures characterized by unconsciousness, automatic behaviour, and myoclonic jerks lasting 0.5 to 8 sec. They found, from videotape analysis of 300 simultaneously recorded EEGs and clinical attacks, that attack onset commenced with 8 to 9 Hz 150 to 200 μV sharp waves beginning in both medial temporal areas during eyelid flutters. They further reported that seizures only occurred during periods of normal alpha. The phenomenon illustrated in Fig. 1 quite clearly shows confirmatory evidence of a link in this individual between eyelid tremor/flutter and alpha but further shows that for this subject it takes the form of one-to-one correspondence between EEG alpha and muscle tremor. The origin of the link between eyelid tremor and alpha is not clear but might perhaps arise from the previously demonstrated connection between extraocular muscle tremor and

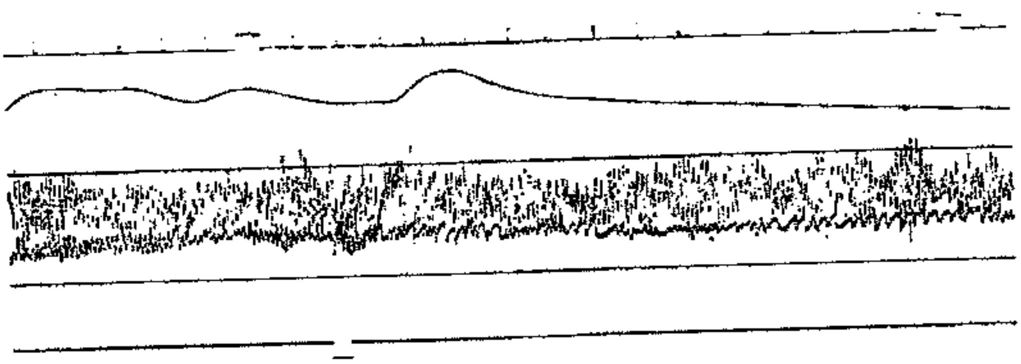

FIG. 1. Polygraph output showing a relationship between EEG alpha and eyelid flutter. Line 4 gives EEG (scalp placement: Cz-T3, time constant: 0.3, frequency filter: 70Hz). Line 5 shows eyelid movement (opening and closing) and was recorded from a photoelectric cell within a pair of goggles reflecting a light source from the eyelid. In this record the line is recording the relatively rare phenomenon of eyelid flutter. The more usual eyelid record, showing a flat line with occasional eyeblinks giving about 0.1 cm deflections of about .5-sec. duration as well as baseline shifts for eye movement, occurred immediately before and immediately after this record, but to conserve space is not shown here. Line 1 is the timer (seconds), line 2 gives GSR, lines 3 and 6 are null, and line 7 shows stimulus occurrence.

EEG alpha (Lippold, 1970). Although Lippold argues that EEG alpha is an artifact of muscle tremor, the evidence of Cavonius (1973) and Tait and Pavloski (1978), when taken with Isokawa and Komisaruk's results (1983) with finger tremor, argue against alpha as an artifact and suggest that alpha is capable of modulating muscle tremor in several parts of the body. The case reported by Nadel, *et al.* (1975) suggests that this modulation may be associated with some cases of epileptic seizure, while the relationship to muscle tremor indicates a link with Parkinsonism. While both the origin and function of EEG alpha are still matters for speculation, these results show that at the very least neuronal mechanisms must exist which enable either EEG alpha, or its source, to generate regular frequency modulated motor movement in the periphery. The generalized EEG alpha must have correlates at particular brain locations which either generate field activity or translate it into more specific neuronal discharges. Were brain science to develop models which require a time-keeping function for synchronizing brain activity, then the EEG alpha frequencies would be an obvious starting point for investigation. The results also suggest further lines of research into the causes of epilepsy and Parkinsonism.

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