EEG Changes During Perceptual Isolation

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Prolonged exposure to a monotonous environment appears to have marked effects on the behavior of the individual. Problem solving ability is reduced, hallucinations occur, and there are effects on perception which persist for some time after the subject has emerged from the experimental conditions. In view of this, it seemed worthwhile to find out whether there are any effects on the electrical activity of the brain which might be detected by using an electroencephalograph. Such an investigation might throw some light on the nature of the physiological processes involved, providing some check on the notions we entertained about what happens in the nervous system under our experimental conditions. In general, the idea has been that because of adaptation caused by prolonged exposure to a monotonous environment, the so-called brainstem activating system no longer exercises its normal regulatory influence on the upper parts of the brain.

Subject and Method: Nine subjects, all college students, were used. The method of inducing perceptual isolation used has already been described. Stick-on electrodes were attached to the subject with collodion before he entered the cubicle, and remained in place during the entire experimental session.

Records were taken immediately after the subject entered the cubicle, and twice daily thereafter. In addition, they were taken immediately before he finally emerged from isolation, and three and a half hours after emergence. Additional readings were also made during periods of hallucination. Records used for analysis were taken when the subject appeared to be fully awake; that is, he was able to carry on a conversation, and also reported that he did not feel tired in any way.

In the case of six subjects, a frequency analysis of the alpha rhythm was carried out in the way suggested by Engels and Romano, a wave count by current for 200 seconds of record. In the remaining three, through the kindness of Dr. Jasper we were able to use the electronic frequency analyser at the Montreal Neurological Institute for the records taken before the subject entered the

cubicle, before he emerged, and for the post emergence run. The effects of photic stimulation and benzedrine were also investigated in two of these subjects.

In addition to the EEG, other physiological measures were taken. Temperature, pulse rate and blood pressure were taken twice daily. The daily basal metabolic rate was measured as well, and a record of the amount of bodily activity was obtained from a tambour system attached to the bed in the cubicle.

Results

There were no consistent changes in the subjects temperature, or blood pressure during the experimental period, and the BMR remained unchanged, though activity increased as time went on. When we consider the EEG, however, the case is somewhat different. Table 1 shows mean number of waves per second before the subject entered the cubicle, at 24, 48 and 72 hourlater, continualy before he emerged, and 31 hours after emergence. Though the differences are small, it can be seen that there is considerable consistency in the results. The mean number of waves present in a one second period gradually appears to decrease as time goes on, and is at its lowest just before the subject emerges from isolation. It will be noticed that 31/2 hours after isolation, the frequency has not returned to its original level.

These findings are confirmed by the results obtained from the three subjects from whom electronic frequency analysis was available. It can be seen from the next table (Slide 2) that in two cases, the dominant frequency has changed from 10 cycles per second before the subject has been placed in isolation, to 9c/s just before emergence. The third subject does not show any change. Of the two subjects in whom change is apparent, in the test 31/2 hours after emergence one subject shows apparently full recovery, while one still has not recovered.

EEG during Hallucinations

During this study, we have had considerable opportunity for taking EEG records while the subject was hallucinating. In all cases, hallucinatory activity was

accompanied by tendency for there to be a decrease in the amplitude of the alpha rhythm, and for there to be an increase in the amount of time during which the alpha rhythm is blocked. Typically, a type of "spindling" would appear; short bursts of alpha would alternate with bursts of low-amplitude fast-frequency activity. (Slide). This reduction of amplitude of alpha during hallucinatory periods has also been reported by Endo as occurring during hallucinations induced by mescal.

There are two possible explanations as to why there should be a flattening of the EEG record while the subject is hallucinating; the first is that the subject is "roused" by seeing the hallucinatory activity, and attends to them; the second is that the flattening and spindling are indications of the type of electrical activity which is the basis of hallucinations. It is impossible, of course, to decide definitely which of these alternatives is the correct one. Some cases in which records have been taken before the subject has reported the first onset of hallucinatory activity, the typical hallucination record is present.

Effects of Benzedrine

Two of the three subjects for whom electronic frequency analysis is available were given 20 milligrams of benzedrine shortly before emergence. Records were taken half an hour and 1 hour after administration of the drug. There appears to be some increase in the amplitude of the record in both cases, but, as can be seen from slide , there is no increase in the frequency.

Effects of photic stimulation

Two subjects were subjected to photic stimulation of different frequencies before undergoing isolation, and shortly before they emerged. Bipolar recordings were taken from the occipital, parietal, temporal, central and frontal regions. The results indicate that in the occipital region, the alpha rhythm is more susceptible to photic driving after the period of isolation that before, the

harmonic responses particularly being more marked. There did not, however, appear to be any more tendency for there to be greater irradiation of effects of stimulation.

Discussion

The results then indicate that under the experimental conditions there is a tendency for slower rhythms to appear in the alpha band, suggesting that whatever mechanism is involved in regulating the alpha rhythm loses some of its influence, a suggestion that is also borne out from the results of photic stimulation. It is also clear that it takes some time after the subject has emerged from isolation before the cortical rhythms return to their normal condition. This may possibly be because different organisational patterns are developed in the brain during isolation and it takes some time before these can be broken down.

The fact that there is some slowing of brain rhythms appears to support the notion which we had previously held about the role played (or perhaps better, not played) by the activating system after a period of isolation. Not so easily reconcilable, however, are the results from some subjects, prolific hallucinators, who showed a persistently "activated" type record throughout the later part of the experiment. In addition, the increased motor activity found in all subjects does not fit in with this notion.