Electroencephalographic Features of the Blind in Response to Several Planned Stimulations

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YAMASHITA, E., KIKYO, S. and SASAKI, Y. Electroencephalographic Features of the Blind in Response to Several Planned Stimulations. Tohoku J. exp. Med., 1980, 132 (1), 43-47 — EEG records were obtained from 9 blinds under several types of stimulation. The occipital alpha rhythm was much reduced in them, whereas small parietal activity in the alpha range was often observed in the later blind. Any type of stimulation did not produce beta rhythm, but accelerated the background alpha rhythm.

Since blind persons receive no visual information, it is supposed that their brains are activated differently from those of normal-sighted persons. The electroencephalogram (EEG) of the blind is accordingly presumed to have unusual features. There were a number of studies on EEG of blind and weak-sighted persons, such as reported by Adrian and Matthews (1934), Drever (1955), Cohen et al. (1961), Jeavons (1964), Moriya and Fujita (1969) and others. But little attention was paid to changes of the EEG pattern in response to stimulation.

In this study the EEG of blind individuals was recorded under the several types of stimulation and the response patterns were investigated.

METHODS

EEG's were recorded from an 8-channel electroencephalographic machine (Nihon Kohden Co.) with bipolar recording. Subjects included 9 total blinds aged 15 to 20 years. Among them 3 were blind since birth and the other 6 were blind later in life (denoted as later blind). Except 1 later blind they were male. The causes of blindness were cataract and congenital malformation. Anomalies or deficiencies were not found in their organs except eyes.

As the stimulation, in addition to the usual stimulation of pure tone, the performance of mental calculation, weak heat radiation to the face and the order to recall visual imagery were employed. For the heat radiation, a 300 W lamp was turned on in front of the subject's face such that the subject felt as warm as receiving sunshine on his face. The onset of the radiation, which was made by the open of a hand-worked shutter, was indicated to the subject as "on" several times, or not indicated at other times; false indication was given at other times without radiation to investigate the effect of psychological strain on the subject.

The order to recall visual imagery meant that the subject who previously had visual experience was suggested to remember some sight or thing associated with visual impressions before becoming total blind.

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RESULTS

The most commonly obtained result by previous workers was that alpha rhythm was missing or greatly reduced in the blind. As to the partially sighted persons, it was reported that alpha rhythm became more abundant and clearer as their visual acuity was higher, although there were some cases having no better alpha rhythm than the total blind.

In our experiments the subjects were limited to totally blind persons because of too irregular responses of partially blind persons. EEG records from all 3 blind individuals since birth showed no alpha rhythm. In these subjects EEG was difficult to change in response to any stimulations. Among 6 later blinds 1 showed no alpha rhythm, whereas the other 5 exhibited the background activity higher in the parietal leads than in the occipital ones as reported by Lairy and Netchine (1962), though with low voltage. It had a tendency to appear intermittently with every train of 3–4 sec, and especially dominant in 2 among the 5 later blinds. A sound stimulus with pure tone of 1000–3000 Hz did not produce any beta rhythm in these subjects, but frequently produced alpha-like rhythm as shown in Fig. 2A. The same stimulus given in the period when the background activity was silent induced occasional alpha-like rhythm as shown in Fig. 2B. This rhythm was identical with that of background activity and had a little higher voltage. Other

Fig. 1. Resting EEG records from a later blind. Upward deflection on the lowermost line indicates calibrations of 1 sec and 50 μV. Relations of electrode to bipolar recording are indicated in the bottom form. The number in this form corresponds to each record from the top.
stimulations brought about similar results as mentioned below. Therefore, alpha-like rhythm seemed to result from the acceleration of background activity.

More examples of EEG patterns in response to planned stimulations were obtained in the following experiments. The EEG change in response to the performance of mental calculation was characterized by more abundant alpha-like rhythm. Fig. 3 illustrates the EEG in response to weak heat radiation on the subject's face. In this case, alpha-like rhythm appeared regardless of whether or not the stimulus onset was indicated to the subject. In response to the false indication of onset, however, alpha-like rhythm did not appear except at the

Fig. 2. EEG records in response to sound stimulus. The lowest thick lines indicate periods of given stimulus. Form of recording and calibrations are similar to those in Fig. 1.

Fig. 3. EEG records in response to weak heat radiation on the face.
first time. This observation illustrated that the change of response pattern resulted from sensation of the heat radiation, and not from psychological strain. A similar result was confirmed in another subject who happened to be found to have different wink behavior depending on the indication or non-indication as shown in Fig. 4. The intermittent upward large deflections seen on frontal EEG resulted from winks. The record showed that the winks did not stop during the radiation when its onset was not indicated. The appearance of alpha-like rhythm did not much differ from that in the above example. When the onset was indicated, however, the wink stopped for several sec following onset, even if the indication was false. In the case of false indication, alpha-like rhythm did not become similar to that in the above example. Therefore, it was seen that the response patterns of EEG were not associated with those of wink in response to identical stimulation. Fig. 5 is an EEG when another subject was suggested to recall visual imagery before becoming totally blind. Alpha-like rhythm was observed to become more abundant for several tens of second.

In normal-sighted persons, alpha rhythm slightly changed to beta one at the

![Fig. 4. Frontal EEG records accompanied by potential change caused by winks.](image)

![Fig. 5. EEG records on recalling past visual imagery.](image)
beginning of heat radiation and also in response to visual imagery. The false indication produced no beta rhythm.

In this study no spikes were recorded in EEG’s. Bergman and Jaffe (1961) and Akiyama et al. (1964) reported that in the EEG from the visually handicapped children caused by retrolental fibroplasia (RLF) occipital spikes and slow waves were frequently found. Our subjects did not include any blinds due to RLF.

**DISCUSSION**

The most characteristic feature in electroencephalograms of the blind was the lack of alpha waves, especially in those of the blind since birth. This was confirmed also by our experiments. Jeavons (1964) reported that alpha rhythm was seen in 30% of the blind since birth and in 60% of the later blind. In this study, however, the difference between the two blind groups was more remarkable. It is agreeable that the visual stimulation is important for the development of normal alpha activity as discussed by Cohen et al. (1961).

The second characteristic feature was that any stimulation failed to produce beta rhythm. The stimulations adopted in this study changed the background activity to beta rhythm in a normal-sighted person. In the blind, however, they induced alpha-like rhythm instead of beta one, and the induced rhythm seemed to be an accelerated background activity. Therefore, the behavior of background activity in response to the stimulation was quite different in the blind and the normal-sighted persons. So, it is unreliable to conclude that the background activity of alpha rhythm frequently seen in the parietal leads in the blind is identical with alpha rhythm in normal-sighted persons. This rhythm should be called alpha-like rhythm.

**References**