Evaluation of Likes and Dislikes during Visual Stimuli by Electroencephalography

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The purpose of this study is to investigate the characteristics of electroencephalogram (EEG) during emotional occurrence of likes and dislikes in humans subjected to visual stimuli. Fifteen healthy male subjects participated in the study. Portrayals of females and cars on a visual screen, one photographic display at a time, were used as the stimulus. The subjects, with their EEGs concomitantly monitored, were asked to record their likes and dislikes for each portrayal of a total of 50 sequential displays. The results indicated that beta(β)-wave was more prevalent with dislikes than likes, and the arousal level was higher when dislikes predominated over likes, implying that more cerebral information processing activity was involved in answering dislikes than likes. In the case of cars, the difference between likes and dislikes was focused within a frequency band of 15-20 Hz in the right cerebral hemisphere. Our findings suggest that the activity in the right brain predominates with increases in negative emotion.

Introduction

Likes and dislikes are important facets of emotion. It is believed that such facets of emotion influence and complement the rational functions in certain extremes with regard to survival and propagation of a living system (Endo, 1996). As such, emotion, an element blended with the human instinct, is essential for adaptation/evolution of humankind. Moreover, in cases involving purchasing of goods, the element of likes and dislikes - consciously or unconsciously - orientates our selection of specific item(s) or the final decision in making a purchase. The decision-making process in finalizing an action in making a purchase is very much molded and based on learning acquired through past experience and knowledge.

According to LeDoux J.E. (1989), the processing of information by amygadali of the limbic system and refinement by neocortexes of the cerebrum precede the molding of a certain emotion in mammals. It follows therefore that electrical activities of the neocortex of human brains, summated via electroencephalography, would provide an objective evaluation of emotion in humans.

With this in mind, we endeavored to investigate the contrasting facets of emotion, likes and dislikes, in humans by directing visual stimuli encompassing the elements of instinct and learning in this study.

Materials and Methods

Experiments were performed in a room maintained at 26 ℃ with relative humidity registering 60%. Fifteen male university students (age range: 20-24 years), who served as the subjects of study, were briefed on the purposes and contents of the study in detail.

Illustrations of cars (encompassing much of the element of learning) and portrayals of the facial looks of females (involving much the element of instinct cf with cars) were employed as the visual stimuli. Fifty of these portrayals, each displayed for a 15-sec period, were shown in a series lasting 50 min. During this portrayal, changes in the electroencephalogram (EEG), electrooculogram (EOG), electrocardiogram (ECG), electromyogram (EMG) and subjective evaluations were concomitantly monitored. Based on the international 10/20 electrode system, monopolar leads of EEGs were monitored at 13 sites (F7, T5, Fp1, C3, O1, Fx, Cz, Pz, Fp2, C4, O2, F8, T6) with two indifferent electrodes each placed on an earlobe. In addition, a Ag-AgCl plate electrode for measuring the EOG was placed on the upper and lower sites of the left eye to concomitantly monitor the EEG and to discriminate artifact inputs into EEG through saccade and blinking. The subjects were also consistently reminded not to elicit saccade and blinking during visual stimulation.

Subjective evaluations involved two parameters: Parameter I and II. The former involved the selection of one of the 3 choices by button pressing: like, dislike and neither, whereas Parameter II required the subject to score (with 1-decimal place) on a 0-100 range, where 'dislike most' and 'like best' equated to 0 and 100 respectively.

The sequential flow of the experiment is illustrated in Fig. 1. On completion of electrode placements by wearing the EEG-cap and fixation of electrodes for EOG, ECG and EMG, subjects were allowed to enter the experimental room. They were then briefed on the contents and cautioned on relevant matters of study inside the room, and practical acclimatization with sufficient adjustment to recording of experiments were sufficiently attained before experiments were initiated.

Subjects were allowed 5 min to acclimatize to a resting state, and the open-eye and closed-eye resting states were determined during this period. Exposure of subjects to visual stimulation ensued, and each condition for each stimulus was appropriated repetitively until the 50 portrayals were completed. For resting period I and II, the standard gray screen background was posted. After delivery of the visual stimuli, Parameter I and II were each performed at 15-sec intervals.

Statistical analyses of data were performed to verify the dispersion differences of various subjective feelings (like, dislike, neither) in Parameter I (t-test), and Student's t-test (t-test) was appropriated for evaluating the difference in mean values either for uniform dispersion or non-uniform dispersion.

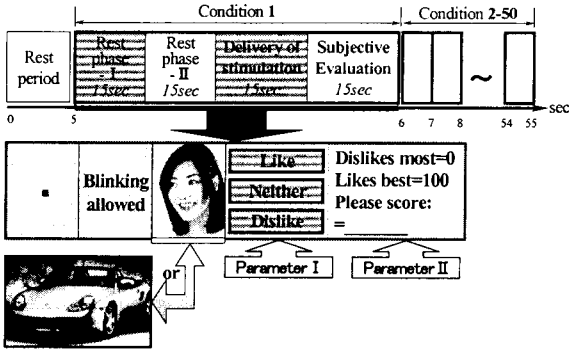

Fig.1 Experimental procedures(Measurement period)

Fig. 1: Experimental procedures with periods (▤) involving 2 visual stimuli that encompassed 50 conditional portrayals of either cars or female facial looks shown over a period of 50 min with each conditional portrayal lasting 1 min (or 4 x 15 sec). A resting period (5 min) was allowed for acclimatization before the initiation of any conditional portrayal. Each conditional portrayal was divided into 4 x 15 sec: resting phase-I (15 sec) followed by phase-II (15 sec) before emotion was input (15 sec) and scored (15sec; Parameter I & Parameter II) with the same visual stimulus portrayed.

Results

With the visual stimulus of car portrayals, analytical findings on the difference in mean values of δ (delta),

θ (theta), α (alpha) and β (beta) waves recorded at their respective sites (Fig.2) revealed that mean values of δ (Fz, Cz, Pz, C4, F8 T6), θ (T6) and spacing α (F7, Fp1, C3, Cz, Pz, Fp2, C4, F8, T6) waves were significantly higher when dislikes overwhelmed likes. However, the mean values of α wave (F7, T5, Fp1, O1, Fp2, O2) manifested significantly lower readings with similar feeling tendencies.

Moreover, with facial portrayals of females, analytical results of differences in the mean values of δ , θ , α and β waves at their respective recording sites elicited by the visual stimulus (Fig.3) indicated that mean values of δ (F7, Cz), θ (F7, Fp1, C3, Fz, Cz, Fp2, C4, F8) and β (F7, Fp1, O1, O2) waves were significantly higher when dislikes predominated over likes.

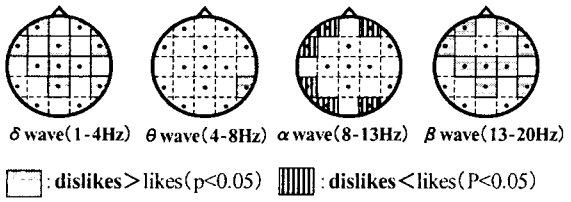

Fig.2:Results of **t-test** verifying the difference between dislikes and likes when **car** portrayals were employed as the visual stimulus

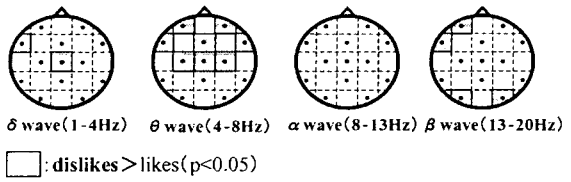

Fig.3:Results of **t-test** verification the difference between dislikes and likes when facial looks of **females** were projected as the visual stimulus

On further investigation of the likes-dislikes difference, values of δ, θ, α and β waves were analyzed at 1-Hz intervals. Differences in the likes-dislikes mean value at the recorded sites of the field ranging from 1-20 Hz (Fig.4, 5) with car portrayals as the visual stimulus revealed that frequencies of 1-2 Hz (C3, Fz, Cz, Pz, C4, F8, T6), 2-3 Hz (Fz, Pz, C4, F8, T6), 3-4 Hz (C4), 4-5 Hz (Fp1, Fz, Cz, C4, T6), 6-7 Hz (O2), 12-13 Hz (Pz, F8, T6), 13-14 Hz (O2), 15-16 Hz (Fp2, F8, T6), 16-17 Hz (F7, Fp1, C3, Cz, Pz, Fp2, C4, F8, T6), 17-18 Hz (except T5 and O1, others coincided with 18-19 Hz) and 19-20 Hz (F7, Fp1, Fp2, F8, T6) displayed significantly higher values that correlated with predominance of dislikes over likes. However, frequencies of 8-9 Hz (F7, T5, Fp1, C3, O1, Pz), 9-10 Hz (except F8 , T6) and 10-11 Hz (F7, T5, Fp1, O1, Fz, Pz, Fp2, O2) showed the reversed trend of attaining significantly lower values with a similar dislikes>likes tendency in emotion.

When portrayals with the facial looks of females were used as the visual stimulus, frequencies of 1-2 Hz (F7, Cz), 2-3 Hz (F7), 3-4 Hz (F7, T5), 4-5 Hz (except at T5, O1, Pz, O2), 5-6 Hz (all sites), 6-7 Hz (Cz), 11-12 Hz (Fp1, Fz, Fp2), 12-13 Hz (F7, Fp1, O1, Fp2, O2), 13-14 Hz (O1), 15-16 Hz (F7, T5, Fp1, O1, Pz, O2), 16-17 Hz (F7, Fp1, C3, Pz, O2), 18-19 Hz (F7, Fp1, O2) and 19-20 Hz (F7, Fp1) displayed significantly higher values that correlated with dislikes >likes emotion. However, with a similar emotional tendency, the frequency at 10-11 Hz (O1) manifested a significantly lower value.

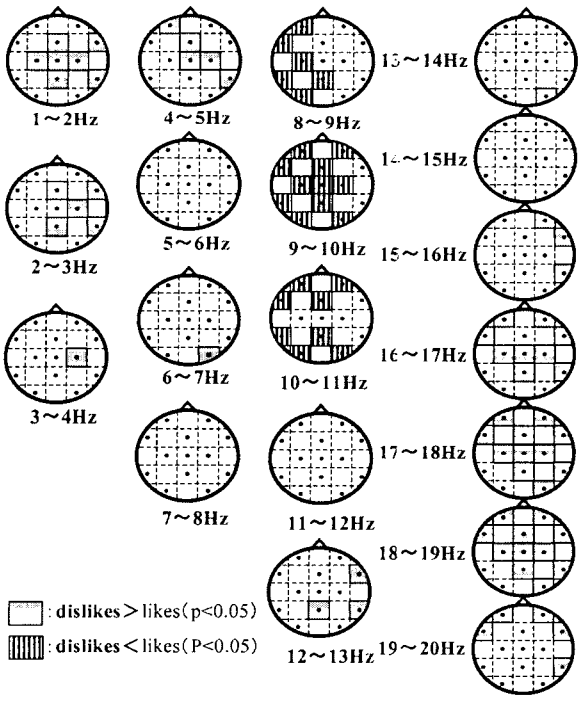

Fig.4: Analytical results of **t-test** on the differences between dislikes and likes when **car** portrayal was used as the visual stimulus

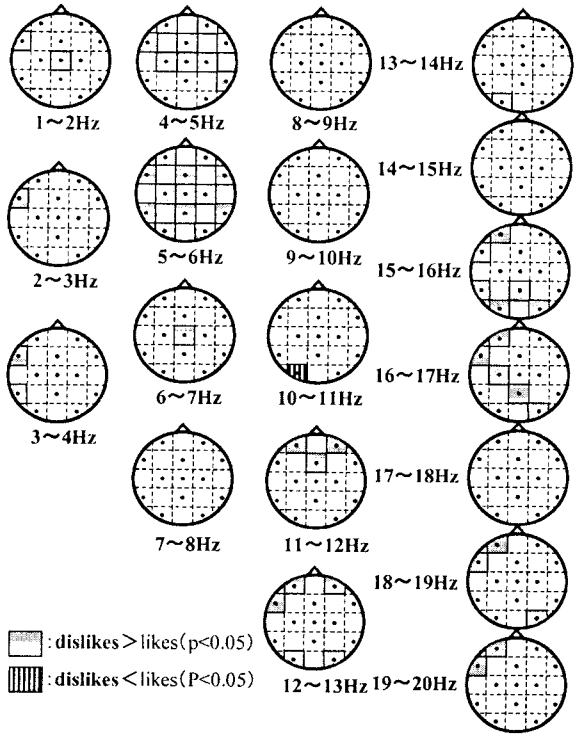

Fig.5:Analytical results of **t-test** on the differences between dislikes and likes when facial looks of **females** were used as the visual stimulus

Discussion

Results of analyzing 1-Hz to 20-Hz EEG at 1-Hz intervals based on concomitant subjective scores revealed that the dislike>likes difference in emotion on car portrayals was expressed in the low-frequency regions of δ (1-2 Hz), θ (4-5 Hz) and α (8-11Hz) waves but in the high-frequency region (15-20 Hz) of β wave. As such, it is strongly suggested that dislikes>likes on cars may be expressed in these frequency ranges of electroencephalogram (EEG).

Moreover, as for the dislike>likes difference in emotion on facial portrayals of females, the non-accommodating feeling was expressed at a specific site, F7, where regions at all frequencies of δ, but low-frequency (4-6 Hz) fields of α and high-frequency (15-17 Hz) areas of β waves predominated. These findings advocate that emotion associated with dislikes-likes on facial looks may be molded in these respective areas with the relevant frequencies

The common change in EEG with both visual stimuli was an increase in β waves when dislikes predominated. The frequency of EEG elevates with an increase and declines with a decrease in the arousal level. If β waves were enhanced with an increase in the arousal level, dislikes-molded emotion would trigger an elevated arousal level in EEG compared with likes-emotion. In other words, information processing is more complex in emotions associated with dislikes than likes. In the case using car portrayal as the visual stimulus, high-frequency (15-20 Hz) regions with β–wave dislikes were manifested more in the right hemisphere. However, such was also the case when facial looks were employed as the visual stimulus. In short, in relation with factors encompassing the major learning element, exacerbation of negative emotion was accompanied with predominant activities in the right hemisphere. On the contrary, generation of positive emotion in the case using car portrayals as the visual stimulus enhanced activities in the low-frequency (8-11 Hz) regions of the left hemisphere. These findings suggest that the decision-making process involving emotion related with dislikes and likes is closely related with activities of the left-right cerebral hemispheres of the brain in humans.

References

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