

# An EEG Study of Emotion Using the International Affective Picture System

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## 국제정서사진체계(IAPS)를 사용하여 유발된 정서의 뇌파 연구

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### Abstract

The International Affective Picture System (IAPS) developed by Lang and colleagues[1] is a world-widely adopted tool in studies relating a variety of physiological indices to subjective emotions induced by the presentation of standardized pictures of which subjective ratings are well established in the three dimensions of pleasure, arousal and dominance. In the present study we investigated whether distinctive EEG characteristics for six discrete emotions can be discernible using 12 IAPS pictures that scored highest subjective ratings for one of the 6 categorical emotions, i.e., happiness, sadness, fear, anger, disgust, and surprise (Two slides for each emotion). These pictures as visual stimuli were randomly given to 38 right-handed college students (20-26 years old) with 30 sec of exposure time and 30 sec of inter-stimulus interval for each picture while EEG signals were recorded from F3, F4, O1, and O2 referenced to linked ears. The FFT technique were used to analyze the acquired EEG data. There were significant differences in RP value changes of EEG bands, most

prominent in theta, between positive and negative emotions, and partial also among negative emotions. This result is in agreement with previous studies[2, 3]. However, it requires further studied to decided whether IAPS could be a useful tool for categorical approaches to emotion in addition to its traditional use, namely dimensional approaches to emotion.

### Introduction

The International Affective Picture System (IAPS) developed by Lang and colleagues[1] is widely used in studies relating a variety of physiological indices to subjective emotions. It currently contains about 500 standardized pictures of which subjective ratings are completely documented in the three dimensions of pleasure, arousal and dominance[1].

The IAPS has great utility compared to other research methods containing verbal and/or written reports when used in non-English speaking countries since its Self-Assessment Manikin (SAM) doesn't need verbal or written reports from subjects

[4]. However, cultural differences in affective reactions to same IAPS pictures would appear when the pictures are used in Korea, which requires a validation study of the IAPS prior to its introduction. In our previous study Korean students showed some cultural differences in their 3 dimensional ratings of the IAPS pictures[5].

Meanwhile, the IAPS was developed for dimensional approaches to emotion(Lang, 1994). However, it would be a great help if such a well-established system can be used in studies adopting categorical approaches to emotion despite some cultural difference in dimensional measures.

In this study we investigated if there are distinctive differences in EEG characteristics in response to discrete emotions induced by 12 IAPS pictures which were evaluated as being highly associated with 6 representative emotions in our preliminary study.

## Methods

### Subjects

Subjects had to be in good health, without history of neurological disease, and without chronic or current medication. Thirty-eight right-handed college students, ranged in age between 20 and 26 years, voluntarily participated in this study.

### Categorical emotions and pictures used

In one of our previous studies[1] 60 IAPS pictures were rated by 94 college students for their 3 dimensional values (pleasure, arousal and dominance) and subjectively induced emotions. Of the 60 pictures, 12 pictures for 6 discrete emotions were selected based on their rating scores. (2 slides with highest rating scores were selected for each emotion.)

The IAPS numbers of the slides used for each categorical emotion are as follows:

Happiness : #2340, #2040 Sadness : #2800, #3350

Anger : #6540, #9250 Fear : #3130, #1300  
Disgust : #3140, #3071 Surprise : #3170, #3051

### Procedure

Subjects were given a brief description of the measurement method and some instruction how to minimize common artifacts, while electrodes were applied to scalp in the laboratory. The subjects with eyes open were seated in an electrically shielded, sound attenuating room with dim lighting in a slightly reclining armchair facing away from the experimenter, who was the only person present.

The 12 slides were sequentially presented in random order. For each slide, prior resting time was 30 s, exposal time 30 s and rating time for induced emotions 120 s. Basic structure of stimuli presentation and EEG recording is illustrated in Figure 1.

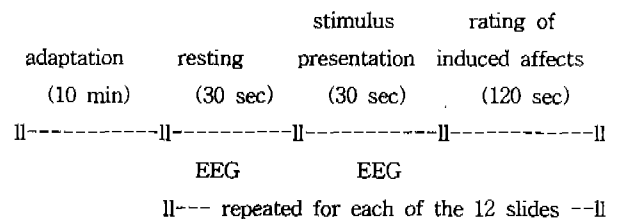


Figure 1. Schematic representation of the schedule of stimuli presentation and EEG recording

### EEG recording and Analysis

The EEG was recorded, using a Grass Neuroacquisition System, from 4 electrodes at O1, O2, F3 and F4 with reference electrode on the earlobe at ipsilateral side (A1 and A2) using 10-20 Electrode System[6]. Thirty seconds were given for recording at resting state prior to 30 second-long visual stimulus. This recording protocol was identical for all 12 slides.

EEG power values were processed, using Fast Fourier Transformation, for normality within eight frequency bands: delta: 0.5-3.9 Hz; theta: 4.0-7.9 Hz;

alpha: 8.0-12.9 Hz (slow alpha: 8.0-9.9 Hz; fast alpha: 10.0-12.9 Hz); beta: 13.0-30.0 Hz (slow beta: 13.0-19.9 Hz; fast beta: 20.0-30.0 Hz). The relative powers (RP) of each band or the ratio of each band power to the total wave (0.5-30 Hz) power at each recording site were compared among the 6 discrete emotions induced by their corresponding slides.

Differences in EEG RP values among the 6 emotional states at each recording sites were analyzed using one-way ANOVA following the statistical routines of the SPSS. If ANOVA analysis showed a significant main effect ( $P < 0.05$ ), subsequent comparisons of groups were done with a Post-hoc Tukey test.

## Results and discussion

There were significant differences in percent relative power values of each EEG band between resting and IAPS picture-induced emotional states (all  $P_s < 0.05$ ). Theta RP value changes showed significant group differences among most of experienced affective states at all recording sites of F3, F4, O1 and O2 (Figure 2). This result is in partial agreement with previous studies reported that theta wave occur during states of displeasure, pleasure in young adults[2], and when experiencing pleasurable events in babies[3]. RP value changes of fast alpha, slow beta and fast beta also showed significant differences among a few of affective states at less recording sites (Figures 3-5, respectively). However with present data, it seems unlikely to identify distinctive EEG characteristics associated with each discrete emotion.

It is suggested that More EEG parameters (and some emotion-related autonomic indices such as EDA and EKG) should be included for psychophysiological characterization of discrete emotions in future studies adopting categorical approaches to emotion.

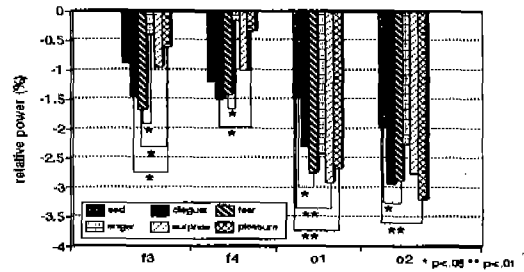


Figure 2. Changes in theta relative power values associated with IAPS picture-induced emotions. (rest-stimulation)

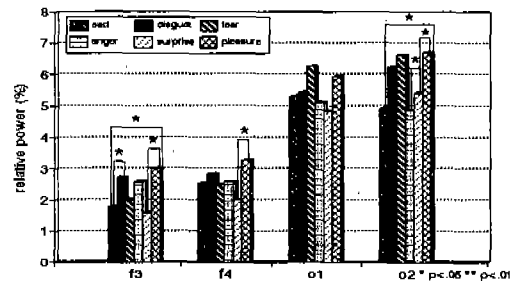


Figure 3. Changes in fast alpha relative power values associated with IAPS picture-induced emotions. (rest-stimulation)

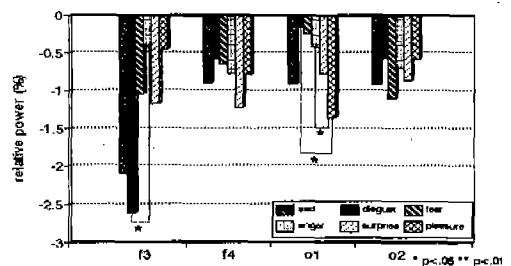


Figure 4. Changes in slow beta relative power values associated with IAPS picture-induced emotions. (rest-stimulation)

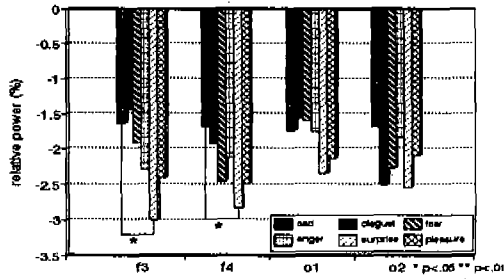


Figure 5. Changes in fast beta relative power values associated with IAPS picture-induced emotions. (rest-stimulation)

### Conclusions

There were significant differences in RP value changes of EEG bands, most prominent in theta, between positive and negative emotions, and also among negative emotions. These results are in partial agreement with previous studies[2,3]. However, More EEG parameters autonomic indices should be carefully considered in order to decide whether IAPS could be a useful tool for categorical approaches to emotion in addition to its traditional use, namely dimensional approaches to emotion.

### Acknowledgement

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