Research Article
A Study on Psychological and Physiological Responses to Emotions Evoked by Clothing Styles Using SAM Model and ERPs

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Abstract: The research target of this study was visual emotions evoked by sportswear of female college students. The main purpose of this study was explored the interaction of human psychological emotion and physiological Event-Related Potentials (ERPs) response through SAM model and ERPs instrument in clothing field. The results indicated that: 1. Pleasure of emotion dimension could be as the index of assessing consumption desire. 2. For pleasure and arousal, the most obviously changes of brainwaves were observed from 200 ms to the end of stimulate in forehead area. 3. High pleasure and arousal caused great ERPs amplitudes in the middle of forehead area. 4. Psychology and physiology had consistency in the dimension of clothing styles.

Keywords: Clothing, emotion dimensions, ergonomics, ERPs, visual evoke

INTRODUCTION

Clothing is a symbol of human civilization and essentially in human life. People have used clothes as a form of communication for expressing their individuality, emotion, status, social position and information surrounding their circumstances. Therefore, it is necessary that use rational, systematic, scientific methods to do clothing creation and assess psychological and physiological responses to emotions evoked by clothing style. Clothing emotions included two aspects: emotions evoked by visual appreciation (external stimulation) and emotion evoked by clothing comfort (internal stimulation). This study was mainly focus on the emotion evoked by visual appreciation.

Emotion is a psycho-physiological process triggered by conscious and /or unconscious perception of an object or situation. It is a complex phenomenon having at least three basic levels of description: neurophysiologic-biochemical, motor or behavioral and mental (Aaron, 1987). Therefore, occurrence of emotions were not independent, they were accompanied by corresponding peripheral nervous system, central nervous system, endocrine system, external behavior and psychological changes. Although the heart rate, skin electrical, blood pressure, endocrine changes and other factors could provide effective index of emotion responses, the occurrence of emotions mainly referred to the brain's functions. In other words, any subjective experiences and external behaviors of emotion had them neurophysiologic basis that dominated by the central nervous system.

With the development of brain computer science, ergonomics and psychophysiology, it is known that the physiological variables caused by emotion could be measured by physical instruments, such as Electroencephalogram (EEG), Event-Related Potentials (ERPs), Positron Emission Tomography (PET), Functional Magnetic Resonance Imaging (FMRI). PET and FMRI investigate brain activity area mainly through radioactive electronic or magnetic fields. Compare with EEG, ERPs provide a voltage measurement of neural activity that can be recorded noninvasively from multiple scalp regions (Birbaumer et al., 1990). Existing research shows that ERPs were well established as powerful tools for studying physiological and cognitive functions of the brain (Louis and Sidney, 2007; Steven, 2005). It was associated with brain potential changes of certain mental activities (e.g., different emotion evoked by different event) and reflected brain potentials changes recording from the scalp surface through electrophysiology technique (including time accuracy and spatial distribution).

Therefore, the present study associated with brain computer science and psychophysiology to assess emotion evoked by clothing style quantitatively. The study aims at examining the interactions of human psychological emotion and their brainwaves which indicate physiological activities of the Central Nervous System (CNS) through SAM model and ERPs instrument. This theory is similar to the study of "biofeedback technology" in psychiatry.

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LITERATURE REVIEW

The emotional ERPs is a kind of aspects of ERPs studies, the researchers gradually had paid more attention in recent years, such as brain activity process of dealing with emotional pictures or ERPs component evoked by emotional pictures. Jonas outlined findings from 40 years of event-related potentials studies using pictures that differ in valence (unpleasant-to-pleasant) and arousal (low-to-high) and that are used to elicit emotional processing (Jonas *et al*., 2008). Classic ERPs studies had found that neuroelectric responses were influenced by whether the participants were required to respond to the stimulus or not.

So far, there were numerous researches focused on identifying various cognitive ERPs components and developed methods for recording and analyzing ERPs in cognitive experiments. But most of these researches were focused on discovering and understanding ERPs components rather than using them to address questions of broaden scientific fields. In addition, most of these studies generally focused on attention, signal perception, analytical, decision-making, memory and other cognitive processes associated with event-related potential components.

MATRIALS AND METHODS

Subjects: Subjects were fifteen healthy female college students (aged 19-23 years, mean age: 20.2 years) from different majors (e.g., design, finance, psychology, marketing, management, electronic, etc.) in Minjiang University. All subjects were asked to abstain from drinking, eating, smoking, exercise for at least three hours before the experiment and keep good rests.

Stimuli materials: Fifteen different uniforms of Minjiang University had been used. To ensure the comparability, the basic style was 165/84XL sportswear with cotton/ polyester fabric. Long-sleeved coat with zipper in the front and straight sports pants. We took the front photograph by one model whose height was 165 cm and wore white shoes. The background was white wall. The brightness, contrast, pixel size and other attributes of stimulus materials were set to the same value use Photoshop CS and numbered 1-15 and used mosaic with the model's face. Stimulus materials saved as bmp file. The size of each file was 800×1200 pixel.

Procedure:
The self-assessment manikin model: Base on the theory of Osgood that emotional assessment was accounted for three major dimensions: pleasure, arousal, dominance (Osgood *et al*., 1957). To assess the three dimensions, we used the Self-Assessment Manikin (SAM), an affective rating system devised by Lang *et al*. (1997). The SAM is a non-verbal pictorial assessment technique that directly measures the pleasure, arousal and dominance with a person's affective reaction to a wide variety of stimuli.

Explained the definition of three dimensions to the subjects before the experiment and make sure they fully understood the concept and evaluation criteria for each dimension. The present experiment used 9 -point rating scale for each dimension. Rating was scored such that 9 represents a high rating on each dimension (e.g., high pleasure, high arousal, high dominance) and 1 represents a low rating on each dimension (e.g., low pleasure, low arousal, low dominance), Five representing the center segment of the scale. In order to ensure the effectiveness of results, the subjects assessed each dimension in order from high scores to low scores and to rate each picture while viewing it. This experiment emphasized the first feeling of them. There was no right or wrong answers. It should not take too long time on SAM model.

ERPs recording: Real-time brainwaves were recorded using EEG/ERP recording and analysis system of Neuroscan Company on a dedicated recording computer. The stimuli pictures presented through another dedicated stimulus computer with E-prime software for time and stimuli control. Each picture was perceptually random within a sequence, lasted 2000 ms and occurred 10 times. Each stimuli picture made mark in E-prime software and then sent synchronization makers directly to the recording computer (Fig. 1).

Make sure the subject was sat at the center of the screen before experiment. The subjects were told that a series of slides would be presented and they should attend to each picture the entire time it appeared on the screen. They do not judge their emotional reactions while viewing the pictures, just concentrated on each picture.

The amplifier collected the stimulate codes and brainwaves at the same time. ERPs were recorded using an electrode cap from nine key sites (F3, Fz, F4, C3, Cz, C4, P3, Pz, P4) according to the International 10-20 Electrode system. All channels were recorded use both mastoids (A1, A2) as a reference electrode and Gnd channel as a ground electrode. Vertical and horizontal eye movements (VEOG, VHOG) were recorded also. All electrodes impedances were maintained below 5 kΩ. DC mode sample data, sample rate at 1000 Hz/channel, high pass was 0 Hz and low pass was 100 Hz.

Date analysis: Mean factor scores for each picture (averaged all subjects) on each of the factors of pleasure, arousal and dominance were calculated using statistics analysis, off-line analysis of the recorded brainwaves data using Scan 4.3 software. The analysis course began 100 ms before onset of stimulus and continued until 1900 ms after the onset of the stimuli. Set 20 blinks of vertical EOG and each blink continued 400 ms and horizontal EOG continued 800 ms to remove the electric current of eye's activities in the experiment. After eye movement correction procedure, corrected baseline and
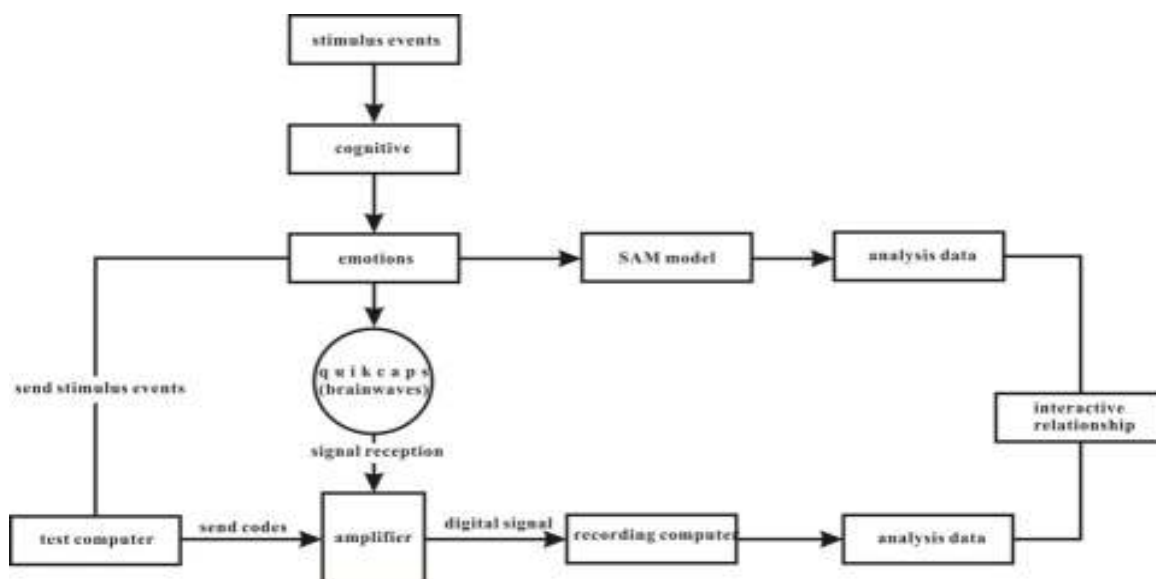
Fig. 1: Illustration of ERPs evoked by visual emotion

rejected artifact. Then, averaged and flitted ERPs waveforms separately for each electrode site, then, grouped average ERPs waveforms of all subjects for each electrode site.

RESULTS

Descriptive statistics analysis of SAM: The data from descriptive statistics analysis for pleasure, arousal and dominance are present in Table 1. After average each dimension value of all subjects, we can see that No. 3 had the highest value in emotion dimensions and No. 9 was the lowest. The mean value of pleasure was higher than the other dimensions (mean = 6.11). The standard deviation of pleasure and arousal were less than dominance. That means the results of pleasure and arousal were more unified than dominance. The value ranges of dominance were wider than the others.

In order to analysis the relationship of three dimensions clearly, we present line chart of three dimensions as shown in Fig. 2, when the value of pleasure was high, the value of dominance was high also, oppositely, the value of pleasure was low with the decrease of dominance. The standard deviation of this two dimensions were approximated, it is demonstrate that pleasant and dominance were positive correlation, pleasant rises with increasing dominance.

The relationship between pleasure and arousal presents two kinds of trends. One was pleasant and arousal had positive correlation, the other was negative correlation. In addition, the result shown that No. 9 had the lowest pleasure, arousal and dominance, No. 3 had the highest three dimension, it demonstrated that this style had higher wearing and consuming desire.

Table 1: Descriptive statistics analysis of three dimensions

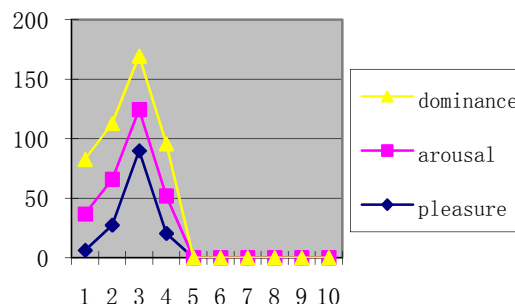| Dimension	Amount	Min.	Max.	Mean	S.D.
Pleasure	15	4.20	7.36	6.11	0.72
Arousal	15	4.17	6.87	5.89	0.67
Dominance	15	3.72	6.55	5.44	0.74

Fig. 2: Line chart of SAM model assessment

ERPs data: The process of emotional information could be acquired through analysis amplitudes and latent periods of ERPs. Amplitudes reflected the excited extent of brain; latent periods reflected the speed and time of emotional activity and process. Choose the highest and the lowest value in SAM model to analysis ERPs data (No. 3 and No. 9). The brainwaves data which had averaged emotion response of all subjects with Scan 4.3 software from Frontal (Fz), Central (Cz) and Parietal sites (Pz) were shown in Fig. 3.

For all area measures, different pleasure and arousal influenced amplitudes from 150 ms after different styles appearance. The largest change of brainwave was observed at Fz, intermediate at Cz and the least at Pz. The style with the highest value in SAM model presented Last Slow Potentials (LSP) from 200 ms to
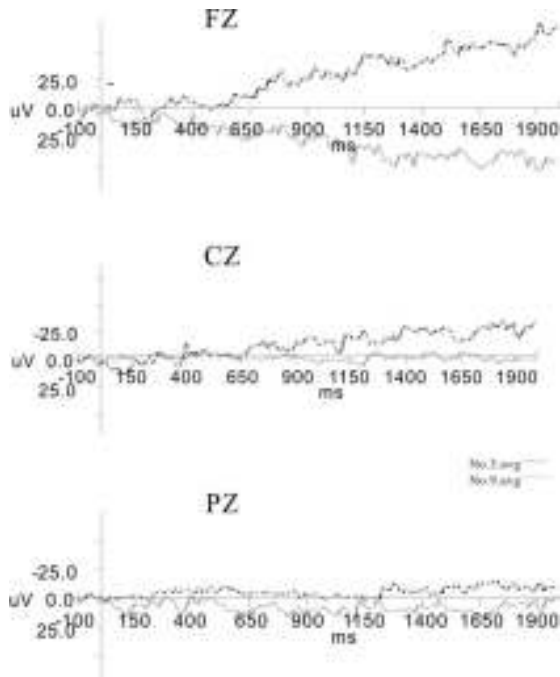
Fig. 3: Grand average ERPs at Fz, Cz and Pz for all subjects

the end of stimulate in forehead area. The biggest amplitude (baseline to peak) was nearly 50 UV; it was correlated with its high pleasure and arousal. Different pleasure and arousal presented different going of amplitude from 650 ms in the middle of brain. Lower value in SAM model presented an early negative peak at 100 ms and subsequent negative going lasted to the end of stimuli. At Parietal area, high pleasure and arousal brought obvious amplitude.

DISCUSSION

Analysis of emotion dimension: When the value of pleasure was high, the value of dominance was high also, oppositely, the value of pleasure was low with the decrease of dominance. It is demonstrated that emotion dimensions showed positive correlation between pleasant and dominance evoked by clothing styles. Therefore, pleasure of emotion could be as an index for evaluating the consume desire.

Analysis of ERPs data: Pleasure stimulus factors primarily modulated ERPs component amplitudes, with little changes in peak latency observed. Arousal effects were consistently obtained and generally occurred at longer latencies. Valence effects were inconsistently reported at several latency ranges, including very early components. For pleasure and arousal, the largest change of brainwave was observed at Fz, intermediate at Cz and the least at Pz. The style with the highest value in SAM model presented a late, slow positive voltage changes, which was significantly larger for affective than neutral stimulus.

The relationship between SAM and ERPs data: From the comparison between three dimensions of visual emotion evoked by clothing and real-time recording brainwaves, we can find that self-access of emotion can provide effectively reference for physiological measurement of emotion. Higher pleasant and arousal reflected the higher excited extent of brain and the bigger amplitude of ERPs in the middle of forehead area. The interactive relationship between SAM model and real-time changes of brainwaves were shown that there was consistency between psychology and physiology in the dimension of clothing styles.

Style analysis of clothing: From the experimental analysis, we can see that the changes of three dimensions basically consistency with the ERPs amplitudes. For female college students, they paid more attention on the style which had the color of red match white, green match white and focus on simple styles, looks neatly, comfortably and youthfully.

CONCLUSION

This study was the first empirical research to quantize the physiological reactions of visual emotions evoked by clothing style using ERPs technique and SAM model. Based on this study, visual evoked emotion in clothing style could demonstrate through combine the interactive relationship between self-assessment and real-time brain potentials data. The research could fill the research blank of clothing field and also could provide more references for clothing designers, clothing consumers and clothing manufacturers.

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