

# How people are affected by emoticons: An ERP study

Qiang Wei<sup>1\*</sup>, Jingxuan Huang<sup>1</sup>, Yu Han<sup>1</sup>, Yixin Lin<sup>2</sup>

<sup>1</sup> School of Education, Jiangnan University, China

<sup>2</sup> School of Energy and Power Engineering, Huazhong University of Science and Technology, China)

\*weiqiang@jhun.edu.cn

## Abstract

The aim of this study was to investigate the ERP component evoked by emoticons with different attributes and the reaction times during the LDT. The behavioral results demonstrated the significant promoting effect of emoticon for language processing with shorter reaction time under both a positive emoticon and a negative emoticon compared to participants under a nonsense emoticon. The greater amplitude on N170, P300 provided more evidence for the promoting effect of emoticons.

*Keywords:* emoticon, Lexical decision task, ERP, language processing

## 1. Introduction

Emotion is an essential project in psychological research. It is generally considered to be the subjectively experienced and conscious mental reaction of individuals to the relationship between external events and internal needs which usually directed toward a specific object and typically accompanied by psychological and behavioral changes in the body.<sup>[1]</sup> Furthermore, in the field of Man-machine dialog and network information mining, the emotions of network users and publishers have been trying to be predicted by researchers through several different means such as models establishment and text analysis. According to this, effects arising from emotion-related information in the network gain more and more interests.

Emoticons, as a new kind of emotion-related text punctuation, became increasingly popular and were commonly used on internet forums with the development and widespread of internet. Different from stylized pictures (such as Emoji, QQ face), emoticons are consist of characters including punctuation marks, numbers and letters to express a person's feelings or mood. This resulted in that emoticon combined advantages of stylized pictures and text messages. On the one hand, it holds a natural salience as face pictures did, which means

that it is an stimulus that attracts more attention and expresses more emotion-related information than normal text stimuli<sup>[2]</sup>. On the other hand, it can be easily retrieved, summarized and analyzed within different social networks and forms.

The LDT is a common instrument to measure implicit emotional processing which commonly used in affective priming paradigms to evaluate the emotional state of subjects. Previous studies showed shorter RT of participants for emotion-related targets when compared to neutral targets.

In this study, we used the emoticons of different attributes for prime stimuli on Lexical Decision Task, in order to reveal a corresponding relationship between emoticons and behavioral results of LDT. And then, reveal the specific impact of emoticons during language processing by compare the amplitude and regions within EEG data.

## 2. Experiment

### 2.1. Participants

Seventeen right-handed healthy undergraduates (9 males and 8 females) from Jiangnan University were recruited to participate in the study. All of the participants were

native Chinese speakers free from any history of mental diseases or neurological disorders. Their visual acuity was normal or corrected-to-normal. Their age ranged from 18 to 22 years with mean age of 19.42 years. All participants provided written informed consent and were compensated for their participation.

## 2.2. Stimulus materials

The entire experiment consisted of 150 emoticons as prime stimuli and 300 words as target stimuli. The emoticons contained three conditions: 50 emoticons of positive mood (e.g.,  $\smile$  ( $\bar{\smile}$   $\nabla$   $\bar{\smile}$ )/), 50 emoticons of negative mood (e.g.,  $\text{(\text{π})}^\wedge \text{(\text{π})}$ ) and 50 random characters without any mood (e.g., (=’+)). For the LDT a set of 300 target stimuli were used. 150 neutral words were extracted from the Modern Chinese Dictionary (e.g., “桌子(table)” “药品(medicine)”). 150 Pseudo-words were also generated out of a words listed which composed of those neutral words in this study. Here, neutral words with a length of two Chinese ideograph were manipulated by changing single Chinese ideograph with another word (e.g., “桌药”). Additionally, the selected emoticons in this study were based on the SOHO Pinyin IME 7.5.

The stimuli and recording triggers were presented using the E-prime 2.0 software package.

## 2.3. Procedure

The subjects were asked to sit in a sound-attenuated room 200 cm away from a computer-controlled screen, on which the stimuli were presented centrally. Before the ERP experiment formally started, they were requested to look at a fixation cross in the centre of the screen.

As shown in Fig.1, each trial began with a fixation cross against a black background for 1000 ms, followed by a black screen for 800ms. Then, an emoticon with different moods appeared for 500ms followed by a black screen for 300 ms. In this step, there is no need to do any button pressing for subjects but staring at the screen. The written stimulus was then shown, and the participants had to determine whether that written stimulus was a Real-Word or not by pressing a keypad (key “Z” for Real-words, key “X” for Pseudo-words) within 3000ms. The stimuli would then disappear as soon as the subjects pressed button. After that, a black screen

appeared for 800 ms again. This experiment consisted of 300 trials and include 4 breaks after each 60 trials.

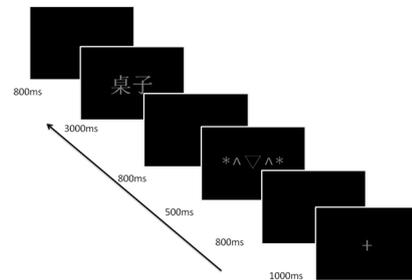


Fig.1. Experimental design

## 2.4. Electroencephalogram (EEG) recording and analysis

An EEG was continuously recorded for each participant during the task. The reference electrodes were placed on the left and right mastoid, whereas the ground electrode was placed on the center point between Fpz and Fz. An electrooculogram (EOG) was recorded from electrodes placed at 10 mm from the lateral canthi of right eye. Only when the electrode impedances were maintained below 5 k $\Omega$  would this experiment started. The high pass filter of the EEG signal was set to 0.5 Hz, and the low pass filter was set to 100 Hz with a sample rate of 500Hz. Data were transferred off-line and vertical electrooculogram and horizontal electrooculogram were corrected.

EEG data sets were segmented for the epoch from 200 ms before the onset of the target appearing on the video monitor to 1000 ms after the onset, with the first 200 ms pre-targets as a baseline. Trials containing amplifier clipping, bursts of electromyography activity, or peak-to-peak deflection exceeding  $\pm 50\mu\text{V}$  were excluded.

## 3. Results

### 3.1. Behavioral results of LDT

The results of 3 $\times$ 2 two-way ANOVA on emoticons (positive/negative/random characters) and written stimuli (real-word/pseudo-word) showed a significant main effect of the emoticons [ $F(2,5) = 3.302$ ;  $p < 0.05$ ]; a significant main effect of the written stimuli. The [ $F(1,2) = 531.471$ ;  $p < 0.0001$ ]; and no significant emoticons  $\times$  written stimuli interaction [ $F(2,2) = 0.748$ ;  $p > 0.05$ ]. The results of ANOVA on emoticons revealed shorter RT for the subjects under the positive stimuli ( $p = 0.017 < 0.05$ ) and

the negative stimuli( $p=0.047<0.05$ ) compared to random character. However, there are no significant difference between the RT of the positive stimuli and the negative stimuli( $p=0.56$ ).

### 3.2. Electrophysiological data

There were clearly N170 component at all positions , P300 and LPP(Late Positive Potential) at centro-parietal region, N300 component at frontal region during the LDT.

According to the GFP (Global field power) curve on Figure 2, the event-related potential data at the three time windows including: 140ms-180ms, 230ms-300ms, 300ms-330ms were analyzed. The value of global field power were obtained by computing the quadratic sum of electrical activity over chosen electrodes [Centro-parietal(Cz,CP1,CP2,P3,P4);Frontal(Fp1,Fp2,Fz)] at the time windows.

A repeated measures ANOVA on mean amplitude for 140-180ms time window at centro-parietal region showed a significant greater amplitude for positive-emoticons and negative-emoticons when compared to random characters. [positive( $p=0.000<0.0001$ ), negative( $p=0.000<0.0001$ )]. However, there are no significant differences between the positive condition and negative condition.( $p=0.115 > 0.05$ )

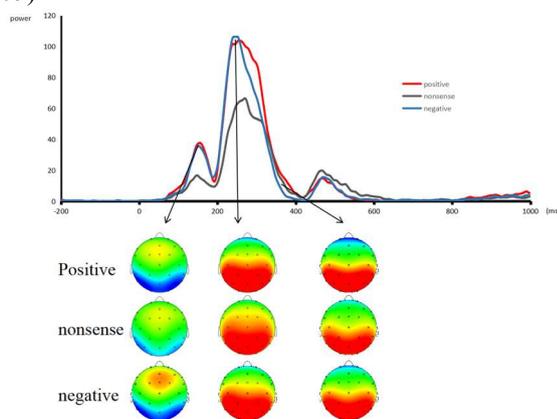


Fig.2 Global field power and amplitude topographies (Cz,Cp1,Cp2,P3,P4) for positive emoticons, nonsense emoticons and negative emoticons.

A repeated-measures ANOVA on mean amplitude for 230-300ms time window showed a significant greater amplitude for positive-emoticons than random characters[ $p=0.009<0.05$ ], a significant greater amplitude for negative-emoticons than random characters( $p=0.040 < 0.05$ ) and no significant differences between the

positive condition and negative condition( $p=0.586 > 0.05$ ).

Further analysis showed no significant differences between the amplitude of responses to positive-mood target, negative mood target and nonsense target in 300ms-330ms time window at frontal region.

## 4. Discussion

In this study, the participants browsed emoticons that expressed either the positive, negative or neural mood, and then recorded their reaction time and EEG data of lexical decision task. The behavioral results of LDT showed that the participants had a significant longer response time for nonsense target compared to emotion-related targets.

The difference of the reaction time on LDT could be further interpreted by evidences from EEG data. In the 140-180ms time window identified as N170 component, difference be detected and emotion-related target elicited significant larger amplitude responses than nonsense target, whereas the similar pattern of results was observed in the 230ms-300ms time window.

The results suggests that emotion-related target exert an influence to the visual-orthographic processing and working memory in Lexical decision task<sup>3</sup>, which may be related to more effort have been devoted in these two processing<sup>4</sup>. Compared to the nonsense characters, emoticons hold more emotional information and semantic information<sup>1</sup>, which might initiate affective priming effect or semantic priming effect.

Different emotional types showed a general consistent trend in these two part. More research is needed to further detect the relationship between emotion types and vocabulary processing.

## References

1. Lane R D , Reiman E M , Bradley M M , et al. Neuroanatomical correlates of pleasant and unpleasant emotion[J]. *Neuropsychologia*, 1997, 35(11):1437-1444.
2. Wagenbreth C , Rieger J , Heinze H J , et al. Seeing emotions in the eyes – inverse priming effects induced by eyes expressing mental states[J]. *Frontiers in Psychology*, 2014, 5(3):1039.
3. L. Carretié, et al. "N300, P300 and the emotional processing of visual stimuli." *Electroencephalography and Clinical Neurophysiology* 103.2(1997):0-303
4. Van H S , Seyffarth S , Pexman P M , et al. An ERP Investigation of Vertical Reading Fluency in Scrabble(®) Experts.[J]. *Brain Research*, 2017, 1667:1-10.