Emotional Facial Expression Processing of Emoticon: an ERP Study

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Abstract

This study examined the processing of emotional facial expression of emoticon compared to those of human. With pictures of emoticon faces and human faces expressing happy, angry, fearful, and neutral emotions along with pictures of houses and scrambled faces, 24 participants were required to do location-judgment about two gaps on contour of facial and control stimuli (non-attention) or were required to do pleasantness-judgment about the stimuli (focused attention). Face-specific N170 to ignored facial expressions showed emotion effect only for fearful expression of human face and showed no emotion effect for all emoticon facial expressions at both hemispheres. But, to attended facial expressions, N170 showed emotion effect for all emoticon expressions as well as for all human expressions at right hemisphere, and showed limited emotion effect for emoticon and human expressions at left hemisphere. These results suggest that attended facial expressions of emoticon are processed in a similar way as those of human, but, ignored facial expressions of emoticon can hardly be processed, suggesting the processing of emotional facial expression of emoticon depends on more attentional resources than those of human face.

Keywords: facial expression; emoticon; attention; N170

Introduction

Human facial stimuli convey important emotional information in social exchange. Recordings at the scalp have demonstrated ERP components reflecting face-specific responses peaking at around 170 ms post-stimulus at lateral occipito-temporal electrodes (Bentin et al., 1996). N170 has shown substantial specificity for faces, typically demonstrating a smaller or absent N170 response for non-face stimuli (Itier & Taylor, 2004). N170 component clearly distinguishes faces from non-face visual stimuli and is therefore considered to be an index of the configural processing of the face (Bentin et al., 1996; Rossion et al., 2003; Itier & Taylor, 2004). Source localization studies have localized the generators of the N170 to the fusiform gyrus which has been termed the "fusiform face area" (Kanwisher, McDermott, & Chun, 1997; Itier and Taylor, 2004).

There is conflicting evidence regarding whether N170 is responsive to emotional expression. Some researchers have found that N170 does not discriminate emotional expression (Eimer, Holmes, & McGlone, 2003), while others have found that expression modulates N170 amplitude (Batty & Taylor, Blau et al., 2007; Luo et al., 2010; Williams et al, 2006), showing a larger amplitude for fearful relative to neutral faces (Batty & Taylor, 2003). These discrepancies in experimental findings might be related to differences in design and stimuli.

Previous studies examining the effect of attention during emotional facial perception on ERPs have shown that correlates of facial expression processing are modulated by spatial attention (Pessoa et al., 2002; Eimer et al., 2003; Holmes et al., 2003). Facial expression effects were eliminated when attention was directed away from the location of peripherally presented emotional faces, indicating that facial expressions are not processed preattentively (Eimer et al., 2003). But, when faces presented within foveal vision were unattended, early emotional expression effects in the 160-220 ms post-stimulus interval were still preserved and were eliminated beyond 220 ms post-stimulus (Holmes, Kiss, & Eimer, 2006). These results demonstrate that when faces are presented foveally, the initial rapid stage of emotional expression processing is unaffected by attention. But, using attentional blink procedure, a recent study demonstrates that amplitude of N170 is dependent on attentional resources even when faces are presented within foveal vision (Luo et al., 2010). The controversy about attentional dependency of facial emotional processing is still unresolved.

Facial expressions of emoticon have been widely used as substitutes for those of human. But, whether the facial expression processing of emoticon is similar to those of human or not remains unknown.

The aim of this study was to examine electro-physiological correlates of emotional expressions of emoticon face and compare them to those of human face. Another aim of this study was to examine attentional dependency of facial expression processing of emoticon and compare them to those of human. Specifically, I was interested in whether the emotion effect observable for the N170 elicited by emoticon would be distinguishable from those elicited by human and whether the emotion effect of emoticon face would be modulated by selective attention to the same extent as those of human face.

Method

Participants. As paid individuals, 24 undergraduates from Chonnam National University participated in the experiment. All participants in this study were healthy, right-handed individuals with normal or corrected-to-normal vision. They gave a written informed consent for participating in the study. The study was approved by the ethics committee at Chonnam National University.

Stimuli and Procedure. Pictures of emoticon faces and human faces expressing happy, angry, fearful, and neutral emotions along with pictures of houses and scrambled faces were used (Fig. 1). Each of them had contours with two gaps on left and right side which were located at different height. Participants were required to judge which side of gaps was located higher (non-attention) by pressing one of two keys, or were required to judge the pleasantness of facial stimuli (focused attention) by pressing one of three keys (pleasant, neutral, unpleasant).

ERP recording and analysis. ERPs were recorded from 40 scalp electrodes according to the international 10-20 system. Horizontal and vertical EOGs were recorded for EOG artifact correction. The impedance for all electrodes was kept below 5 kΩ. Presentation of stimuli was controlled via a PC running E-Prime software. EEG was sampled at 250 Hz with the vertex electrode as the online reference. Offline, the continuous EEG record was segmented into epochs of 1000 ms, starting 200 ms prior to stimulus onset, and transformed to average reference, and referred to a 200 ms prestimulus baseline. Face-specific N170 ERP component at inferior occipito-temporal sites (PO7 at left hemisphere and PO8 at right hemisphere) was analyzed.

Fig. 1. Experimental stimuli (except human faces)

Results

When comparing two control pictures (house and scrambled face) with neutral faces of emoticon and human, the amplitudes of N170 in response to emoticon face and human face were significantly larger than those to two control stimuli at both of non-attention condition and focused attention condition, suggesting that N170 is sensitive to emoticon face as well as human face.

To elucidate the emotion effect of facial expressions, amplitudes of N170 in response to emotional expressions were compared to those to neutral expression. In response to ignored facial expressions (non-attention condition), amplitude of N170 showed significant emotion effect for fearful expression of human face (enhanced amplitude to fearful expression rather than neutral expression), but showed no emotion effect for all facial expressions of emoticon at both hemispheres. These results suggest that the processing of fearful expression of human face is unaffected by attention, but, on the other hand, all emotional expressions of emoticon cannot be processed without enough attentional resource.

In response to attended facial expressions (focused

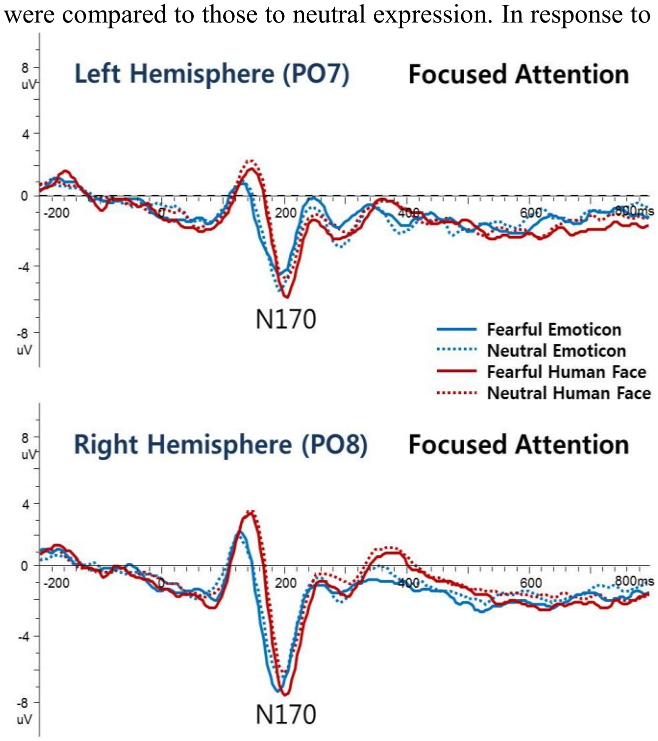

Fig. 2. Grand average ERPs at focused attention condition

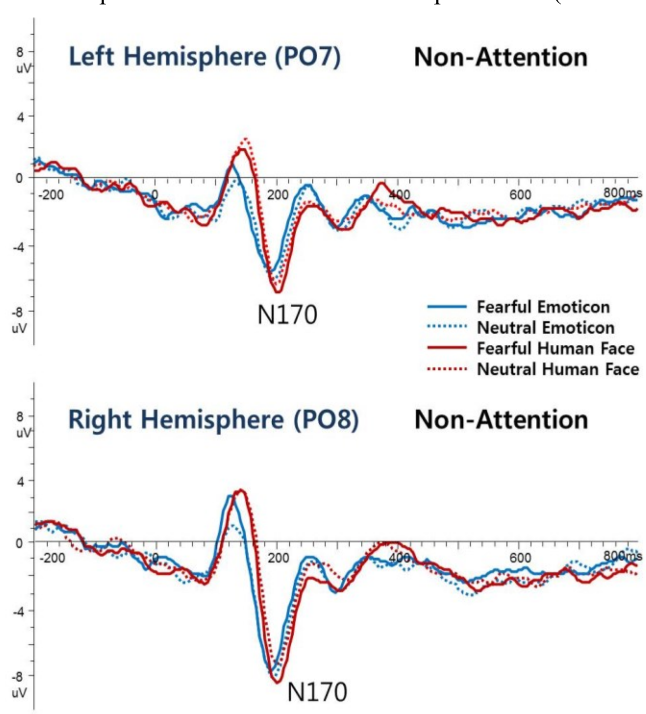

Fig. 3. Grand average ERPs at non-attention condition

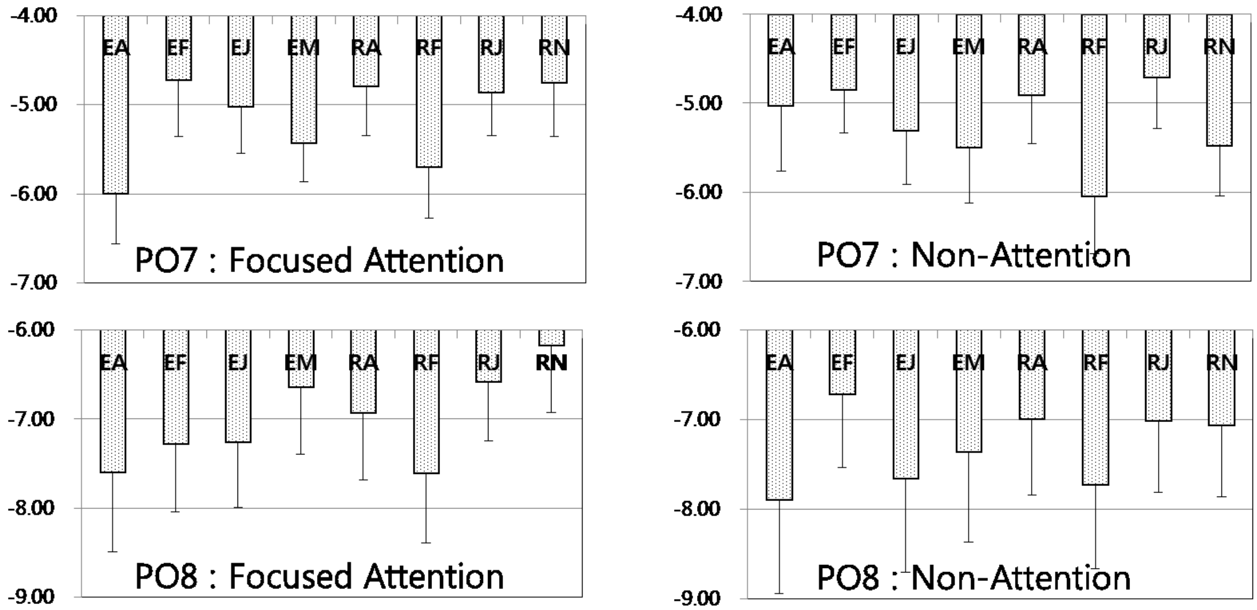

Fig. 4. Average amplitudes (μV) of N170 (E, Emoticon; R, Real human face; A, Angry; F, Fear; J, Joy; N, Neutral) (Error bars indicate standard error)

attention condition), amplitude of N170 showed significant emotion effect for all emoticon expressions as well as human expressions at right hemisphere, and showed significant emotion effect for angry emoticon face and fearful human face at left hemisphere, suggesting right hemisphere dominance for emotional face processing. ERP waveforms for fearful and neutral expressions of emoticon and human face were shown in <Fig. 2> and <Fig. 3>. Average amplitudes of all expressions of emoticon and human face were shown in <Fig. 4>.

These results suggest that facial expressions of emoticon are processed in a similar way as those of human when they are fully attended. But, when emoticons are ignored, their facial expressions can hardly be processed even in case where they are presented within foveal vision, suggesting that the processing of facial expression of emoticon demands more attentional resources than those of human.

Acknowledgments

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