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Priming emotional facial expressions as evidenced by event-related brain potentials

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Abstract

As human faces are important social signals in everyday life, processing of facial affect has recently entered into the focus of neuroscientific research. In the present study, priming of faces showing the same emotional expression was measured with the help of event-related potentials (ERPs) in order to investigate the temporal characteristics of processing facial expressions. Participants classified portraits of unfamiliar persons according to their emotional expression (happy or angry). The portraits were either preceded by the face of a different person expressing the same affect (primed) or the opposite affect (unprimed). ERPs revealed both early and late priming effects, independent of stimulus valence. The early priming effect was characterized by attenuated frontal ERP amplitudes between 100 and 200 ms in response to primed targets. Its dipole sources were localised in the inferior occipitotemporal cortex, possibly related to the detection of expression-specific facial configurations, and in the insular cortex, considered to be involved in affective processes. The late priming effect, an enhancement of the late positive potential (LPP) following unprimed targets, may evidence greater relevance attributed to a change of emotional expressions. Our results (i) point to the view that a change of affect-related facial configuration can be detected very early during face perception and (ii) support previous findings on the amplitude of the late positive potential being rather related to arousal than to the specific valence of an emotional signal.

Keywords: Faces; Emotion; Occipitotemporal cortex; Insula

1. Introduction

Facial expressions are among the most significant social signals in personal communication, as they convey information about ourselves and influence the affective states of others. The influential model of face processing by Bruce and Young (1986) postulates several subsequent stages of face recognition. According to this model, structural encoding of a face-specific configuration is followed by the recognition of a familiar face by activating stored face representations and by

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retrieving semantic knowledge about the person perceived.

Evidence from imaging research suggests that processing of facial affect relies on the interplay of several distinct brain areas. The inferior occipitotemporal cortex, especially the fusiform gyrus, plays a key role for the detection of facial configurations (Kanwisher et al., 1997). Further analysis of facial affect has been shown to be related to activation of the superior temporal sulcus, the amygdala, the orbitofrontal cortex and the insular cortex (for a review, see Haxby et al., 2000).

Research on event-related potentials (ERPs) has repeatedly demonstrated that the stage of structural encoding is related to a face-specific negativity (N170; Bentin et al., 1996) observed at occipitotemporal electrodes in response to faces, and to its positive frontocentral counterpart in the same latency range, the vertex positivity (Bötzel and Grüsser, 1989). The Bruce and Young (1986) model postulates that processing of facial expressions is independent of face recognition. This issue has been addressed by a series of studies measuring ERPs, a majority of which reported the N170 component to be unaffected by the presence or type of emotional facial expression (Carretié and Iglesias, 1995; Eimer and Holmes, 2002; Herrmann et al., 2002; Streit et al., 1999; but see also Marinkovic and Halgren, 1998).

However, recent ERP research indicates that the N170 may not be the earliest component which is sensitive to faces (Itier and Taylor, 2004), and several studies showed ERP correlates of processing emotional expressions preceding the N170. Eimer and Holmes (2002) reported a frontocentral positivity as early as 120 ms after the presentation of fearful faces as compared to neutral faces, and concluded that processing of facial affect starts before face identification. Using magnetoencephalographic recordings, Streit et al. (1999) observed an activation of the superior temporal cortex at 140–170 ms during affect recognition, but not during identity recognition. Eger et al. (2003) demonstrated that emotional expression even affected visually evoked potentials at 85 ms. Pizzagalli et al. (2002) detected differences between faces judged as 'likable' or 'not likable', starting 112 ms after stimulus presentation. In this study, stimuli were not standardized with respect to facial expression, and a number of faces in the 'not likable' condition were characterized by facial distortions. Consequently, this finding may provide further support for the view that a configuration of facial features which deviates from a configuration perceived as 'normal' or 'neutral' may be already detected during the early stage of visual processing (cf. Halgren et al., 2000).

In recent ERP research, the priming technique has proven to be a valuable method for the temporal localisation of processing stages. Repetition priming has been employed by several studies investigating the recognition of familiar faces. Most notably, two repetition-sensitive ERP components have been shown, that is, alterations of the ERP waveform in response to primed as compared to unprimed faces. The 'early repetition effect' or N250r is characterized by attenuated potentials at frontal and temporal sites about 200–350 ms after the presentation of primed as compared to unprimed target faces (Schweinberger et al., 1995). Recent findings indicate that this priming effect reflects the activation of face recognition units (Schweinberger and Burton, 2003, for review). The second repetition-sensitive component, the so-called 'late repetition effect', consists in an enhanced late positive potential (LPP) following the presentation of repeated (primed) as compared to unprimed faces. This effect also appears when semantically related faces are presented consecutively and is considered to result from a diminished superimposed N400 component when semantically related or identical faces follow each other. Similar results were reported by several studies employing matching tasks, in which participants compared two consecutive portraits with respect to congruence of facial expressions or identities (Bobes et al., 2000; Münte et al., 1998). Priming of stimuli which evoke similar affective attitudes has up to now only been demonstrated by behavioral studies showing that reaction times to words and pictures are shortened if their affective valence is primed by a preceding stimulus of similar valence (e.g. Fazio et al., 1986). As these affective priming effects decay rapidly, they can be observed best for stimulus onset asynchronies (SOAs) shorter than 300 ms (Hermans et al., 2001).

In another line of research, ERP studies on processing of emotional words and pictures reported