Biological Psychology 135 (2018) 47–64

Contents lists available at ScienceDirect

Biological Psychology

journal homepage: www.elsevier.com/locate/biopsycho

# Is it about me? Time-course of self-relevance and valence effects on the perception of neutral faces with direct and averted gaze

Sarah D. McCrackin*, Roxane J. Itier

*Department of Psychology, University of Waterloo, Waterloo, Canada*

ARTICLE INFO

*Keywords:*
Face processing
Self-relevance
Valence
Gaze
Context
ERP
N170
EPN
LPP

ABSTRACT

Most face processing research has investigated how we perceive faces presented by themselves, but we view faces everyday within a rich social context. Recent ERP research has demonstrated that context cues, including self-relevance and valence, impact electrocortical and emotional responses to neutral faces. However, the time-course of these effects is still unclear, and it is unknown whether these effects interact with the face gaze direction, a cue that inherently contains self-referential information and triggers emotional responses. We primed direct and averted gaze neutral faces (gaze manipulation) with contextual sentences that contained positive or negative opinions (valence manipulation) about the participants or someone else (self-relevance manipulation). In each trial, participants rated how positive or negative, and how affectively aroused, the face made them feel. Eye-tracking ensured sentence reading and face fixation while ERPs were recorded to face presentations. Faces put into self-relevant contexts were more arousing than those in other-relevant contexts, and elicited ERP differences from 150 to 750 ms post-face, encompassing EPN and LPP components. Self-relevance interacted with valence at both the behavioural and ERP level starting 150 ms post-face. Finally, faces put into positive, self-referential contexts elicited different N170 ERP amplitudes depending on gaze direction. Behaviourally, direct gaze elicited more positive valence ratings than averted gaze during positive, self-referential contexts. Thus, self-relevance and valence contextual cues impact visual perception of neutral faces and interact with gaze direction during the earliest stages of face processing. The results highlight the importance of studying face processing within contexts mimicking the complexities of real world interactions.

## 1. Introduction

Faces are the most important and richest social stimuli we encounter daily, and the information that we extract from them is critical for our social interactions. A growing body of evidence supports the view that our perception of faces is strongly influenced by the context under which we view them, including cultural context, body language, visual scene, and simultaneously presented auditory or visual words (see Barrett, Mesquita, & Gendron, 2011; Wieser & Brosch, 2012 for reviews).

The bulk of the research investigating context effects on face perception has primarily focused on how emotional context cues impact facial expressions of emotion. For example, emotional faces paired with emotion labels tend to be perceived as displaying the labelled emotion (Halberstadt and Niedenthal, 2001) and vocal cues have been similarly shown to bias perceived facial expressions (Massaro and Egan, 1996). However, as noted by Wieser and Brosch (2012), context is likely more important in altering an observer's perception in the absence of overt emotional face information, i.e. when the facial expression is ambiguous (Trope, 1986; Massaro & Egan, 1996) or when the expression is neutral, as neutral faces can mean very different things depending on the context (Carrera-Levillain & Fernandez-Dols, 1994). Recent studies support the view that context can impact the processing of neutral faces. For instance, neutral faces are rated as more arousing after being systematically paired with positive or negative, relative to neutral, statements such as "He thinks you're smart/stupid" (Davis, Johnstone, Mazzulla, Oler, & Whalen, 2009). It is important to note that this type of statement is relevant to the person who is processing it. This so called self-relevant information, which engages introspective processes including self-evaluation and reflection (Schmitz & Johnson, 2007), can act as a powerful context cue.

Indeed, self-relevance biases information processing and affects many domains of cognition, such that self-relevant stimuli are more attention grabbing (Humphreys & Sui, 2016), memorable (Conway, 2005; Turk, Cunningham, & Macrae, 2008; Symons & Johnson, 1997) and receive enhanced emotional processing (Herbert, Pauli, & Herbert,

* Corresponding author at: Department of Psychology, University of Waterloo, 200 University Ave W, Waterloo, ON, N2L 3G1 Canada.
*E-mail addresses:* sdmccrac@uwaterloo.ca (S.D. McCrackin), ritier@uwaterloo.ca (R.J. Itier).

https://doi.org/10.1016/j.biopsycho.2018.03.003
Received 17 October 2017; Received in revised form 14 February 2018; Accepted 5 March 2018
Available online 07 March 2018

2010) compared to stimuli that are relevant to other people (hereafter other-relevant stimuli). It has been proposed that self-referential processing is adaptive during social situations because reflecting on the self allows an observer to draw upon their own experience to infer the mental states of others (Frith & Frith, 2001; Mitchell, Banaji, & Macrae, 2005), and recent studies have shown that self-relevance interacts with other contextual cues to impact the processing of neutral faces (Schwarz, Wieser, Gerdes, Mühlberger, & Pauli, 2012; Wieser et al., 2014). In these studies, participants reported their emotional response (arousal and valence ratings) to neutral faces primed by contextual sentences varying in self-relevance (referring to the participant or someone else) and valence (positive or negative sentences). They found that faces preceded by negative statements were responded to even more negatively if the statement was self-relevant instead of other-relevant. Similarly, faces preceded by positive statements were responded to more positively if the statement was self-relevant. Both studies also found general main effects of valence and self-relevance. Faces preceded by negative sentences made participants feel more negative than those preceded by positive sentences, and faces preceded by self-relevant statements were rated as more arousing than those preceded by other-relevant statements. The present study follows up on these two seminal studies to further assess the impact of self-relevance and contextual valence on the processing of neutral faces, at the behavioural and neural levels, using Event related potentials (ERPs).

ERPs involved in early face perception and emotional processing can indeed be used to track the time-course of these context effects on face processing. The N170 is the earliest reliable face sensitive component, occurring over occipitotemporal sites between 130 and 200 ms after face presentation (Bentin, Allison, Puce, Perez, & McCarthy, 1996). It is sensitive to face configuration and is thought to reflect the initial process of integrating facial features into a holistic percept (Eimer, 2000; Sagiv & Bentin, 2001). In contrast, the Early Posterior Negativity (EPN) and Late Positive Potential (LPP, or Late Positive Complex/LPC in some studies), are thought to reflect later, more elaborate cognitive processes and are sensitive to the emotional content of stimuli, including faces. The EPN is characterized by an enhanced negativity over occipitotemporal sites that starts around 150 ms but is typically maximal around 180–350 ms following the presentation of positive or negative stimuli relative to neutral stimuli, (e.g., Herbert, Junghofer, & Kissler, 2008; Kissler, Herbert, Winkler, & Junghofer, 2009; Sato, Kochiyama, Yoshikawa, & Matsumura, 2001; Schupp, Flaisch, Stockburger, & Junghöfer, 2006; Neath & Itier, 2015; Neath-Tavares & Itier, 2016) or negative stimuli relative to positive stimuli (Rellecke, Palazova, Sommer, & Schacht, 2011; Rellecke, Sommer, & Schact, 2013; Schupp, Junghöfer, Weike, & Hamm, 2004a). This enhanced negativity has been found with a variety of stimuli including emotional faces (Neath & Itier, 2015; Neath-Tavares & Itier, 2016; Itier & Neath-Tavares, 2017; Schupp, Öhman et al., 2004), verbal material (Herbert et al., 2008; Kissler et al., 2009; Schacht & Sommer, 2009) and visual scenes (Junghöfer, Bradley, Elbert, & Lang, 2001; Schupp, Markus, Weike, & Hamm, 2003; Schupp, Junghöfer, Weike, & Hamm, 2004). Recent studies suggest that the emotion effects often reported on the N170 (Hinojosa, Mercado, Carretié, 2015; Calvo & Nummenmaa, 2016) might even be due to EPN activity superimposed onto the structural encoding of neutral faces (Rellecke et al., 2011; Rellecke, Sommer, & Schacht, 2012; Schacht & Sommer, 2009; Neath-Tavares & Itier, 2016). The LPP, most often measured around 400–600 ms (but sometimes lasting up to 1000–1200 ms) over frontocental and centroparietal sites, is similarly enhanced for positive and negative stimuli relative to neutral stimuli (Dillon, Cooper, Grent, Woldorff, & LaBar, 2006; Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000; Schacht & Sommer, 2009; Schupp et al., 2003). The current view is that the EPN reflects enhanced processing of the emotional stimulus linked to attentional effects while the LPP reflects more elaborate cognitive appraisal of the emotional content and its meaning.

The recent studies focusing on context effects on neutral faces have reported that the N170, and thus the early extraction of face configuration, was unaffected by the valence and self-relevance of the context in which those faces were presented (Wieser et al., 2014; Wieser & Moscovitch, 2015; Klein, Iffland, Schindler, Wabnitz, & Neuner, 2015). While the EPN modulation by valence is still unclear, with some reporting greater EPN for negative relative to neutral contexts (Wieser et al., 2014; Wieser & Moscovitch, 2015) whereas others found no such modulation (e.g. Klein et al., 2015), the EPN seems reliably enhanced by self-relevance (Wieser et al., 2014; Klein et al., 2015). Similarly, the LPP is sometimes modulated by contextual valence (Wieser & Moscovitch, 2015; Klein et al., 2015), and sometimes not (Wieser et al., 2014), but seems more reliably modulated by self-relevance (Wieser et al., 2014; Klein et al., 2015). Thus, although those faces have no explicit affective cues (neutral expressions), the valence and self-referential context they are placed into enhance several stages of cognitive processing.

However, despite self-relevance and valence interacting with each other at the behavioural level (Schwarz et al., 2012; Wieser et al., 2014), no early interaction was found at the ERP level, leading Wieser et al. (2014) to conclude that contextual valence and self-relevance are first processed independently in the brain (see Klein et al., 2015 for an interaction between 700 and 1000 ms). It is possible that self-relevance and valence interacted within a time window that was not analyzed. In particular, a visual examination of the ERP waveforms in this study (Wieser et al., 2014, Fig. 6) suggests that self-relevance might actually impact face processing earlier than 220 ms (the lower limit of their earliest time-window). Furthermore, possible N170 context effects might have been eliminated as a result of where participants were fixating. The N170 is indeed influenced by where participants look on the face (de Lissa et al., 2014; Nemrodov, Anderson, Preston, & Itier, 2014; Neath & Itier, 2015; Neath-Tavares & Itier, 2016), and it is possible that context cues may influence where participants visually sample information. For example, Aviezer et al. (2008) demonstrated that even the first face fixation was affected by visual context cues presented at the same time as the face; faces placed on a body with angry body language received more initial fixations on the eyes than on the mouth, while faces placed on a body holding a soiled object received similar amounts of initial eye and mouth fixations. It is possible that situational context cues presented before the face impact face fixations in a similar manner, hereby modulating N170 responses.

The studies by Schwarz et al. (2012) and Wieser et al. (2014) were instrumental in beginning to understand when important contextual cues such as self-relevance and valence impact face processing. How these context cues might interact with specific facial cues, however, remains to be determined. In particular, these studies used faces with a direct gaze, an important social cue itself implicated in self-referential processing (see Conty, George, & Hietanen, 2016 and Hamilton, 2016 for relevant reviews). For example, Kampe, Frith, & Frith (2003) showed that making eye-contact actually activates similar brain regions as hearing one's own name. Similar to hearing someone say our name, we can infer, from someone's gaze direction, that the object of their attention is us (making their face self-relevant) or someone else (making their face other-relevant). Gaze has also been associated with emotional processing. Direct gaze is associated with increased activation in brain areas implicated in reward processing (e.g., Strick, Holland, & van Knippenberg, 2008; Kampe, Frith, Ddan, & Frith, 2002), and faces with direct gaze are rated as more affectively arousing (Nichols & Champness, 1971; Conty et al., 2010), attractive (Jones, DeBruine, Little, Conway, & Feinberg, 2006; Kampe et al., 2002) and as having happier facial expressions (Adams and Kleck, 2003, 2005) than faces with averted gaze.

To summarize, the gaze literature suggests that direct gaze is a positive, self-referential cue, suggesting that it might interact with contextual self-relevance and valence to impact face processing. The present study adapted the contextual sentence paradigm (Schwarz et al., 2012; Wieser et al., 2014; Wieser & Moscovitch, 2015) to include