



# Facing two faces: Defense activation varies as a function of personal relevance



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## ABSTRACT

It can be unsettling to be watched by a group of people, and when they express anger or hostility, this can prime defensive behavior. In contrast, when others smile at us, this may be comforting. This study tested to which degree the impact of facial expressions (happy, neutral, and angry) varies with the personal relevance of a social situation. Modelling a triadic situation, two faces looked either directly at the participant, faced each other, or they were back to back. Results confirmed that this variation constitutes a gradient of personal relevance (directed frontally > towards > away), as reflected by corresponding defensive startle modulation and autonomic nervous system activity. This gradient was particularly pronounced for angry faces and it was steeper in participants with higher levels of social anxiety. Thus, sender-recipient constellations modulate the processing of facial emotions in favor of adequate behavioral responding (e.g., avoidance) in group settings.

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## 1. Introduction

Pictures of facial expressions are well suited to investigate the social functions of emotion: faces convey abundant information about the identity and intentions of others. Most importantly, facial emotions help to discriminate friendly from hostile social situations. This notion received much support from studies showing preferential neural processing, especially when threatening facial expressions are processed (relative to neutral ones; Alpers & Gerdes, 2007; Calder & Young, 2005; Schupp, Öhman et al., 2004; Vuilleumier & Pourtois, 2007). However, when we encounter an angry person, it depends on the social context and our attribution about personal relevance (e.g., Sander, Grafman, & Zalla, 2003; Scherer et al., 2001), whether a defensive response is actually required or not.

In face and person perception, social context includes features of the face itself (e.g., gaze direction) as well as accompanying faces (e.g., their constellation towards each other). Both aspects have been shown to impact face processing (for a review see Wieser & Brosch, 2012). Critically, for an observer, the meaning of an emotional expression changes depending on who is the target of an emotion. For instance, both fearful and angry faces can indicate

danger; however, the source of danger is reflected by the direction of facial threat (i.e., averted fearful and frontal angry faces are rated as most unpleasant; Hess, Adams, & Kleck, 2007; Sander, Grandjean, Kaiser, Wehrle, & Scherer, 2007). Recent neuroimaging studies complemented these findings in showing that amygdala activation varies as a function of facial expression and orientation (Sauer, Mothes-Lasch, Miltner, & Straube, 2014), as well as gaze direction (Adams, Gordon, Baird, Ambady, & Kleck, 2003; N'Diaye, Sander, & Vuilleumier, 2009; Sato, Yoshikawa, Kochiyama, & Matsumura, 2004). In this regard, the amygdala has been suggested as a relevance detector specialized to extract survival relevant information (Sander et al., 2003) and differentially guide attention to facial emotion as a function of their perceived personal relevance to an observer (Bublatzky et al., 2017). This notion is closely related to other theories emphasizing the self-referential and attributional aspects in social perception and action (e.g. Herbert, Pauli, & Herbert, 2011; Northoff et al., 2006; Sander et al., 2007; Scherer et al., 2001). Moreover, rather than being watched by a single person, the simultaneous presentation of two or more faces models a group situation (Puce et al., 2013; Ulloa, Puce, Hugueville, & George, 2014), which is likely to increase personal relevance to an observer. Thus, in direct reference to the observer, the orientation of multiple faces may critically change their impact: facial emotions target either the observer, another person (i.e., observing others in an emotional situation), or somewhere else (i.e., no visible target). However, little is known about defensive responding to (emotional) group situations which are more or less relevant for an observer.

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The human startle reflex is a sensitive measure of defense activation. Its amplitudes are potentiated when participants view aversive scenes, such as pictures of threat and affliction. In contrast, seeing a pleasant situation induces an appetitive context and inhibits defensive reflexes (for a review see Bradley, Codispoti, Cuthbert, & Lang, 2001). This affective modulation of the startle reflex has been interpreted as motivational priming, suggested to reflect the workings of basic motivational systems (appetitive and defensive) which organize approach or defense behavior (Bradley et al., 2001; Lang, Bradley, & Cuthbert, 1997). This model received much support from studies using various affective stimulus materials in healthy and patient samples; but, regarding defensive reflex activity in face and person perception, evidence is surprisingly scarce and mixed.

Some studies report potentiated startle reflexes to angry or fearful faces (Anokhin & Golosheykin, 2010; Springer, Rosas, McGetrick, & Bowers, 2007), that may depend on the gender of the expresser (i.e., potentiation for angry male faces; Hess et al., 2007) or the intensity of the threatening expression (Dunning, Auriemma, Castille, & Hajcak, 2010). Another study observed defense activation to fearful faces, but only when participants anticipated aversive events (i.e., electric shocks; Grillon & Charney, 2011). Finally, we found potentiated reflexes while viewing angry and also happy compared to neutral facial expressions (Alpers, Adolph, & Pauli, 2011). Interestingly, a similar pattern of enhanced defense activation to happy facial expressions has been observed in high socially anxious participants, although no startle modulation was found for non-anxious individuals (Garner, Clarke, Graystone, & Baldwin, 2011; Wangelin, Bradley, Kastner, & Lang, 2012). These findings may relate to hyper-reactivity to personalized fear stimuli (McTeague, Lang, Laplante, Cuthbert, Strauss, & Bradley, 2009), (mis-)attribution of personal relevance (Sander et al., 2003), and/or perceived ambiguity of pleasant facial emotions (Gerdes, Wieser, Alpers, Strack, & Pauli, 2012), reflecting threat-related biases in social anxiety (e.g., attentional and interpretation biases; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007; Heinrichs & Hofmann, 2001). Thus, when confronting facial emotions, defensive reflex modulation seems to strongly depend on individual differences (i.e., level of social anxiety) and contextual settings (i.e., perceived personal relevance of a triadic group situation).

The present study examined the impact of personal relevance – as mediated by emotional facial expressions and social context – on the defensive startle reflex. Social context was varied by the direction of two face pictures which were presented simultaneously and displayed happy, neutral, or angry expressions. To this end, faces were either directed at the observer (frontal view), towards, or away from each other. This manipulation has recently been shown to gradually change perceived personal relevance of triadic group situations (frontal > toward > away oriented others). Moreover, this gradient was particularly pronounced for face pairs displaying emotional expressions (Bublatzky et al., 2017). Building upon this we predicted that defensive responding varies as a function of perceived personal relevance (emotional and social) showing a gradual increase of startle reflex amplitudes and sympathetic system activation (frontal > toward > away).

Specifically, being confronted with two frontally-directed faces should be most relevant to an observer and lead to most pronounced affective modulation of the startle reflex. Furthermore, observing toward-oriented others in an (emotional) interaction situation is particularly informative about social relationships in which the observer participates, however, should be less relevant compared to people who directly confront the observer. In contrast, faces directed away from each other and from the observer are predicted to be least relevant. Even though away-directed emotions are certainly more relevant than neutral faces back to back, how-

ever, facial expressions not directed at a particular person remain unspecific (Bublatzky et al., 2017). Moreover, as a threat-advantage has been suggested in face processing (Öhman et al., 2001; Schupp, Öhman et al., 2004; but see Becker, Anderson, Mortensen, Neufeld, & Neel, 2011; Craig, Becker, & Lipp, 2014), this gradient is assumed to be particularly pronounced for angry faces. Finally, facial stimuli are particularly (threat-) relevant for participants high in social anxiety (Bar-Haim et al., 2007; Heinrichs & Hofman, 2001), thus, more pronounced startle potentiation was expected for angry facial expression when directed at the observer (Wangelin et al., 2012). The opposite pattern – with most pronounced defense inhibition for the frontal direction – was predicted for happy faces signaling safety to the observer.

## 2. Methods

### 2.1. Participants

Forty-four healthy participants (11 males) were recruited from the students of the University of Mannheim. Age was between 19 and 32 ( $M = 21.6$ ,  $SD = 2.8$ ). Participants were fully informed about the study protocol before providing informed consent according to University of Mannheim ethical guidelines. Participants received course credit for participation. Sample size was chosen similar to other studies that tested startle reflex modulation as a function of facial emotions (Alpers et al., 2011; Anokhin & Golosheykin, 2010).

### 2.2. Materials and design

Happy, neutral, and angry face pictures, displaying eight actors<sup>1</sup> (four females), were selected from the Karolinska Directed Emotional Faces (KDEF; Lundqvist, Flykt, & Öhman, 1998) a well-established picture set (Adolph & Alpers, 2010). We presented 30 pairs of a female and a male actor, each with the same emotional expression (Fig. 1A; cf. Bublatzky et al., 2017). Faces were either directed at the observer (frontal view), or in profile views (90°) directed toward or away from each other. Pictures (1024 × 768 pixels) were presented in pseudo-random order, with the restrictions of no more than three repetitions of the same facial expression or orientation, and equal transition probabilities of conditions. In total 90 trials consisted of a picture presentation (6 s) and an inter-trial interval (10 s) to allow for response recovery. In half of the trials an auditory startle probe (white noise, 105 dB, for 50 ms) was presented 4, 4.5, 5, or 5.5 s after picture onset; five additional probes were presented during the ITI (mean distance between probes was 28.8 s). Pictures were presented on a 22-inch computer screen approximately 1 m in front of the participant.

### 2.3. Procedure

Participants completed questionnaires on state and trait anxiety (State-Trait Anxiety Inventory, Spielberger, 2010) and social anxiety (Social Interaction Anxiety Scale, SIAS, Heimberg, Mueller, Holt, Hope, & Liebowitz, 1993). The experiment started with a practice run depicting 12 picture trials (8 startle probes) to familiarize participants with the procedure and allow for initial startle response habituation. Then, participants were instructed to attend to each pair of face pictures on the screen. At the end of the experiment, participants ranked the different face orientations and facial expressions for perceived personal relevance (each ranking from 1 “least relevant” to 3 “most relevant”) and were debriefed.

<sup>1</sup> KDEF identifiers: f01, f20, f25, f26, m05, m10, m23, m34

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