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Adapting another person's affective state modulates brain potentials to unpleasant pictures

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ABSTRACT

Emotional processing is influenced by top-down processes such as reappraisal of emotion-inducing events. Besides one's own stimulus appraisal, information from the social environment can be used to modify the stimulus' meaning. This study investigated whether perspective taking changes participants' brain potentials to unpleasant pictures. Event-related potentials (ERPs) were measured while twenty-nine participants evaluated arousal of neutral or negative pictures. Subsequently, they received bogus feedback about another person's picture evaluation. Then, the same picture was presented again and participants were instructed to view the picture from the other person's perspective. Higher bogus- versus self-ratings of picture arousal increased P300 and late positive potential (LPP) amplitudes to unpleasant stimuli, whereas lower bogus- versus self-ratings did not influence ERPs. Thus, perspective taking only modulated ERPs when bogus ratings signaled potential underestimation of arousal. Resulting increases in responsiveness might constitute an adaptive mechanism preparing the organism against harm.

Emotions organize and motivate behavior when encountering situations that should be approached or avoided, depending on the consequences for the individuals' well-being (Frijda, 2004). Thus, emotions can guide and facilitate adaptive behavior. According to cognitive theories, the interpretation of events rather than the event itself determines emotion generation (Ellsworth & Scherer, 2003; Roseman, 1984). Accordingly, cognitive change strategies are very effective in regulating emotion (Webb, Miles, & Sheeran, 2012). There are different methods, strongly relying on the individual, to implement cognitive reappraisal such as distancing oneself from the situation or changing future consequences (for an overview see McRae, Ciesielski, & Gross, 2012). Importantly, how other people evaluate and respond to potentially emotional events can influence one's own interpretation (Manstead & Fischer, 2001). For example, imagine being confronted with an apparently friendly dog, but another person appears to be frightened. Based on this observation you may conclude that the other person might have had negative experience with the dog or even got bitten. Consequently, you may reconsider your decision to pet the dog and may change your initial sympathetic feelings towards the dog into fear. Thus, in social appraisal theories of emotion, behaviors, thoughts, or feelings of another person in response to an emotional event are appraised in addition to that event itself (Manstead & Fischer, 2001).

Quickly conceiving another person's state in an emotional situation requires the understanding that other people (as well as oneself) have internal mental states (e.g., intentions or emotions) that can differ from one's own. This ability, termed mentalizing (Frith & Frith, 2003; Premack & Woodruff, 1978), can be even implicit (i.e., automatic and unconscious) (Choi-Kain & Gunderson, 2008). Whereas the inference of cognitive states (e.g., beliefs or intentions) is referred to as cognitive mentalizing, affective mentalizing encompasses inferences regarding other people's emotions (Harari, Shamay-Tsoory, Ravid, & Levkovitz, 2010). In contrast, "feeling in" another person's affective state is referred to as empathy. Affective mentalizing enables the individual to take another person's emotional perspective and can help to gather new or additional information, which might change the appraisal of a certain situation and concomitant psychophysiological responses accordingly. Therefore, the current study aimed at investigating whether one's cognitive-affective response to an emotional stimulus changes through perspective taking.

Event-related potentials (ERPs) are highly sensitive to internal or external events and have the advantage of high time resolution. A late positive complex that can be observed from 300 ms post-

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stimulus onwards over centro-parietal recording sites has been shown to be not only sensitive to the emotional content of visual stimuli but also to how this emotional content is appraised (for a review see Hajcak, MacNamara, & Olvet, 2010). The early portion of this positive-going ERP corresponds to the P300 (Olofsson, Nordin, Sequeira, & Polich, 2008) that peaks between 300 and 500 ms post-stimulus onset. The P300 is thought to reflect selective attention to task-relevant stimuli (Donchin & Coles, 1988). Because of their inherent significance for survival and reproduction, emotional stimuli represent "natural targets" (Hajcak et al., 2010) that receive increased processing resources, which is reflected in the P300 enhancement (e.g., Johnston, Miller, & Burleson, 1986; Mini, Palomba, Angrilli, & Bravi, 1996; Palomba, Angrilli, & Mini, 1997). Extending beyond the time range of the P300, facilitated processing of emotional stimuli is reflected in a sustained positive deflection in the ERP called the late positive potential (LPP). Emotional modulation of the LPP has been shown to be related to increased hemodynamic responses in cortical areas involved in visual attention as well as subcortical brain structures implicated in emotional processing (Liu, Huang, McGinnis-Deweese, Keil, & Ding, 2012; Sabatinelli, Keil, Frank, & Lang, 2013; Sabatinelli, Lang, Keil, & Bradley, 2007). Thus, the pronounced positivity in response to emotional stimuli is thought to reflect increased perceptual processing of motivationally relevant stimuli (Lang, Bradley, & Cuthbert, 1997; Schupp et al., 2000; Schupp et al., 2004).

Importantly, the LPP is sensitive to changes in perceived emotional intensity. According to the process model of emotion regulation, time course and intensity of an emotional response critically depend on the allocation of attention to a potentially emotional situation and how this situation is interpreted (Gross, 1998). Thus, directing participants' visual attention away from emotional picture aspects reduced the LPP (e.g., Dunning & Hajcak, 2009; Hajcak, Dunning, & Foti, 2009; Hajcak, Moser, & Simons, 2006). Similar LPP reductions were observed when participants distracted themselves by thinking of something else during affective picture viewing (e.g., Paul, Simon, Kniesche, Kathmann, & Endrass, 2013; Thiruchselvam, Blechert, Sheppes, Rydstrom, & Gross, 2011). Negative pictures also elicited a smaller LPP when they were preceded by neutral instead of negative picture descriptions (Foti & Hajcak, 2008; MacNamara, Ochsner, & Hajcak, 2011) or when participants reappraised pictures as less negative for example by taking the perspective of a detached observer or assuming that the situation improves over time (e.g., Hajcak & Nieuwenhuis, 2006; Paul et al., 2013; Schönfelder, Kanske, Heissler, & Wessa, 2013; Thiruchselvam et al., 2011). Studies asking participants to increase their emotional response to negative pictures yielded mixed results with studies reporting either increased LPP amplitudes (Moser, Krompinger, Dietz, & Simons, 2009; Moser, Most, & Simons, 2010) or no effect (Moser, Hajcak, Bukay, & Simons, 2006).

While the above-mentioned strategies focus on the individual that is regulating the emotion, it remains to be investigated whether other people's emotional response can influence electrocortical indices of emotional processing. Therefore, this study examined whether other people's evaluations of unpleasant scenes affect electrocortical responses to these stimuli when taking the other person's affective state. To this end, neutral and unpleasant pictures were presented and participants evaluated arousal of the depicted scene. Thereafter, a bogus rating was presented indicating how another person had evaluated the same picture. The picture was then presented a second time during which participants were asked to take the other person's perspective and see the picture through his or her eyes. We expected that when participants were instructed to adopt the perspective of another person who supposedly evaluated the picture to be higher or lower in arousal compared to participants' own ratings, ERP amplitudes would be modulated accordingly (increased and decreased, respectively) relative to the first picture presentation.

1. Method

1.1. Participants

Thirty-one healthy undergraduate students completed the study after giving written informed consent approved by the local ethics committee. All participants were native German speakers and reported normal or corrected-to-normal vision. They reported to be free of past or present psychiatric diagnoses or treatment, neurological illness, and use of psychotropic medication. Participants received course credit or monetary compensation for their participation. Data of two participants were excluded from the analysis due to technical problems or insufficient number of trials in one experimental condition ($n < 10$), resulting in an analysis sample of 29 participants (15 females; age (in years): $M = 23.2$, $SD = 3.4$).

1.2. Stimuli

Stimulus presentation was controlled using *Presentation* software (Neurobehavioral Systems, San Francisco, CA). All stimuli were presented against the black background of a 19-in. computer monitor. Twenty neutral and 80 moderately unpleasant pictures were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008, see Supplementary Appendix A). At a viewing distance of 80 cm, stimuli subtended a horizontal visual angle of 10.6° and a vertical visual angle of 8.4°.

1.3. Task and procedure

The experimental design is illustrated in Fig. 1. A white fixation cross indicated the beginning of a new trial and was presented for 5 s at the center of the screen. Then, a neutral or unpleasant IAPS picture was presented in pseudorandom order for 3 s and participants were required to attend to the picture and permit all upcoming emotions. After each picture, participants evaluated arousal elicited by the presented picture on a 9-point rating scale (where 1 represented *low arousal* and 9 represented *high arousal*). Thereafter, a bogus rating was presented for 2 s indicating whether another person who supposedly participated in a similar experiment had evaluated this picture to be higher, lower, or equal in arousal, or no bogus evaluation was presented. Beforehand, participants were told that in general picture evaluations can vary depending on prior experiences (e.g., being in a car accident oneself when seeing a picture of a car crash) and individual preferences or anxieties (e.g., suffering from spider phobia when seeing a picture of a spider) and may thus deviate from their own picture evaluation. Unbeknown to participants, the other person's evaluation was generated by the computer depending on participants' own ratings. An adaptive algorithm was used to obtain a comparable number of trials for each condition (for more information see Supplementary Appendix B). Neutral pictures were presented in the no bogus evaluation condition only, yielding five experimental conditions: neutral – no (bogus rating), unpleasant – no (bogus rating), unpleasant – equal (bogus- and self-rating), unpleasant – lower (bogus- vs. self-rating), unpleasant – higher (bogus- vs. self-rating). Following the bogus evaluation, a white dot was presented for 3 s at the center of the screen, after which the same picture was presented a second time for 3 s. Participants were then instructed to view the picture from the perspective of the other person. The task was divided in two blocks of 50 trials each. Prior to the experiment, participants performed 10 practice trials to get familiar with the task. At the end of the experiment, participants were asked whether they