Consciousness and Cognition 60 (2018) 52–61

Contents lists available at ScienceDirect

Consciousness and Cognition

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

I see neither your Fear, nor your Sadness – Interoception in adolescents

Eleana Georgiou[a,*], Sandra Mai[a], Katya C. Fernandez[b], Olga Pollatos[a]

[a] *Clinical and Health Psychology, Institute of Psychology and Education, Ulm University, Albert-Einstein-Allee 41, 89069 Ulm, Germany*
[b] *Department of Psychology, Stanford University, Jordan Hall, 450 Serra Mall, Stanford, CA 94305, USA*

ARTICLE INFO

Keywords:
Emotion
Face recognition
Interoception
Adolescence
Cognition

ABSTRACT

Interoception describes the mapping of the body's internal landscape and has been connected to greater intensity of emotional experience. The goal of the current study was to explore the relationship between interoception and emotion face recognition in healthy adolescents. The heartbeat perception task was used to assess interoceptive accuracy(IAC) and participants were asked to recognize different facial expressions. EEG activity was recorded, providing data for the P100, the N170 and the P300 ERP components. Results indicated high sensitivity to negative affect, as well as low accuracy in the recognition of fear and sadness among adolescents high in IAC, reflected by amplitude modulations in the N170 and the P300. The interpretation of these results focus on the intensity experienced in negative facial emotions, modified by IAC, as well as on emotional valence and arousal. These findings emphasize the dynamic integration of body and mind for shaping emotion recognition in adolescence.

1. Introduction

Merlaue-Ponty (1962) said that we live in our world through our bodies. But what role do emotions play? Previous research suggests that our bodily changes can affect our emotional experiences (James, 1884; Schachter & Singer, 1962). More specifically, our emotional experiences can be influenced by cognitions and beliefs regarding the causes of our physiological changes (Gendron & Feldman Barrett, 2009; Seth, 2013). These dynamics are important because emotions are essential for forming attitudes and judgments about interpersonal interactions (Forgas, 2003). A common way through which individuals can use emotions to form attitudes and judgments about others is by trying to read facial expressions. Prior research has found that reading facial expressions plays a key role in normative social development (Rodger, Vizioli, Ouyang, & Caldara, 2015) and can be seen as a precondition for socializing (Suzuki, Poon, Kumari, & Cleare, 2015). In the current study, we aim to better understand the role of interoception in emotion processing, specifically emotion processing via reading facial expressions of others.

The dynamic integration of brain and body plays a determining role in emotion processing (Garfinkel & Critchley, 2013). Accordingly, interoception can be described as the perception and processing of our own internal bodily signals (Georgiou et al., 2015; Pollatos, Herbert, Mai, & Kammer, 2016), which are connected to the central nervous system and play an important role in maintaining homeostasis (Ceunen, Vlaeyen, & Van Diest, 2016). An individual's accuracy in perceiving these signals is known as interoceptive accuracy (IAC) and can be assessed by the heartbeat perception task, a task in which participants are asked to estimate their heartbeats in given time intervals (Garfinkel, Seth, Barrett, Suzuki, & Critchley, 2015; Schandry, 1981). It is worth noting that IAC is separate from the self-perceived tendency to be sensible/sensitive towards own bodily sensations, which is termed interoceptive

* Corresponding author.
E-mail address: eleana.georgiou@uni-ulm.de (E. Georgiou).

https://doi.org/10.1016/j.concog.2018.02.011
Received 11 September 2017; Received in revised form 23 February 2018; Accepted 25 February 2018

sensibility and can be assessed via self-report (Critchley & Garfinkel, 2017). IAC is related to emotion processing; more specifically, it has been connected to greater intensity of emotional experience (Herbert, Herbert, & Pollatos, 2011) and emotion regulation (Ceunen et al., 2016; Füstös, Gramann, Herbert, & Pollatos, 2013; Terasawa, Moriguchi, Tochizawa, & Umeda, 2014). Previous studies demonstrated that IAC can be determinable and diverse among children (Eley, Gregory, Clark, & Ehlers, 2007; Eley, Stirling, Ehlers, Gregory, & Clark, 2004; Georgiou et al., 2015; Koch & Pollatos, 2014a, 2014b; Murphy, Brewer, Catmur, & Bird, 2017) and adolescents (Mata, Verdejo-Roman, Soriano-Mas, & Verdejo-Garcia, 2015; Murphy et al., 2017; Schauder, Mash, Bryant, & Cascio, 2015). Nevertheless, in this field, there is a lack of studies on how interoception develops and remains stable in childhood and adolescence, as the sense of identity, establishment of a social role (Georgiou, Mai, & Pollatos, 2016), and social skills (Berenschot et al., 2014) are under constant development in these transitional stages.

To our knowledge, no study to date has explored the relationship between IAC and emotion face recognition among adults and adolescents. Terasawa et al. (2014) studied the interaction between IAC and emotional experience in a social context. In that study, participants were asked to judge whether a morphed emotion stimulus elicited an emotion, rather than naming/recognizing this emotion. Results indicated a close link between high IAC and greater sensitivity to happy and sad facial expressions, but not to angry or disgusted faces. Prior research also suggests that individuals high in IAC experience emotions more intensely (Wiens, Mezzacappa, & Katkin, 2000), place more emphasis on the dimension of arousal when describing emotion processing (Barrett, Quigley, Bliss-Moreau, & Aronson, 2004; Cali, Ambrosini, Picconi, Mehling, & Committeri, 2015), and demonstrate more successful cognitive reappraisal of unpleasant images, which is related to better regulation of negative affect (Füstös et al., 2013; Muir, Madill, & Brown, 2017). Overall, studies on IAC and emotional experience in adults suggest that activity in the anterior insula reflects the functional overlap of bodily and emotional experiences, suggesting a close link between bodily and emotion awareness (Craig, 2009; Critchley, Wiens, Rotshtein, Ohman, & Dolan, 2004; Harrison, Grey, Gianaros, & Critchley, 2010; Seth, Suzuki, & Critchley, 2011; Zaki, Davis, & Ochsner, 2012). This is also reflected in the predictive coding model proposed by Seth et al. (2011), which describes subjective feeling states as a result of the prediction of the interoceptive state of the body. Taken together, these studies show that experimental psychology has taken the body as a starting point for understanding the self (Tsakiris, 2017) and how we perceive emotions.

Furthermore, the use of electroencephalography (EEG) can provide us with important information concerning cognitive and attentional processing, by examining the event-related-potentials (ERPs) (Mai et al., 2015). Therefore, different ERP components, such as the P100, the N170 and the P300, can give an insight into the underlying neuronal mechanisms occurring when analyzing patterns of emotion recognition (Earls, Curran, & Mittal, 2016). The P100 component is an index of early visual processing and is defined as a positive deflection peaking ~100 ms post-stimulus onset (Neuhaus, Kresse, Faja, Bernier, & Webb, 2016). The N170 refers to a negative deflection at occipitotemporal brain areas between 140 and 220 ms post stimulus-onset and is connected to facial processing (Earls et al., 2016; Mai et al., 2015). Lastly, the P300 is an indicator of attention, detection, and evaluation of relevant information based on cognitive resources and is related to cognitive processing performance. Previous studies have found that the P300 amplitude is associated with arousal and peripheral indices of cardiovascular reactivity in response to emotional stimuli (Pollatos, Herbert, Schandry, & Gramann, 2008), as well as that the P300 is connected to cognitive processing during emotion discrimination tasks (Cavanagh & Geisler, 2006; Sanger & Dorjee, 2015).

Prior EEG studies about visual emotion face processing showed that the N170 amplitude in response to angry and happy faces in children was related to anxiety (O'Toole, DeCicco, Berthod, & Dennis, 2013); however, other findings suggested that the N170 amplitude was found not to be sensitive to emotional faces in preschoolers (Batty & Taylor, 2006) and in primary school children (Dennis, Malone, & Chen, 2009). In general, the modulation of the N170 can depend on the task and on the on-going developmental neural system maturation in emotional processing (O'Toole et al., 2013). In terms of the P300 and IAC, former studies on adults have shown that after rating images with an unpleasant effect, IAC was reflected through modulations of the P300 peak amplitudes, demonstrating a close link between the P300 and the experienced intensity of emotions (Füstös et al., 2013; Pollatos, Herbert, Kaufmann, Auer, & Schandry, 2007). Nonetheless, there is a lack of studies concerning the modulation of ERP components in visual emotion face recognition among children and adolescents.

Bearing these in mind, there are several studies observing the relationship between interoception and emotions in adults, but to our knowledge, no study to date has examined the interaction between interoceptive processing and emotion face recognition in adolescents. In the current study, we sought to elucidate the relationship between IAC and emotion face recognition in adolescents via the use of electrophysiological and behavioural data. Taking into account the fact that interoception can determine how intensely we experience and process emotions (Terasawa et al., 2014), we hypothesize that higher IAC would be associated with better emotion face recognition in adolescents. Taking this into account, we further postulated that the N170 and P300 modulations would be more profound (i.e., indicating better emotion recognition) among good heartbeat perceivers.

2. Materials and methods

2.1. Participants

Our sample consisted of 54 healthy adolescents (28 girls, 26 boys) between 12 and 17 years of age without a diagnosed psychological disorder or other medical condition (e.g., cardiovascular disease, bronchial asthma, diabetes etc.). The average age was 14.00 years (SD = 1.55), and the mean BMI was 19.7 (SD = 2.8). Recruitment occurred via the use of flyers and advertisements placed in local newspapers. All experiments were conducted in accordance with the Declaration of Helsinki and were approved by the ethics committee of Ulm University.