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Attentional biases in healthy adults: Exploring the impact of temperament and gender

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ABSTRACT

Background: Attentional biases such as faster attentional orienting toward negative information were consistently replicated in high-anxious and depressive individuals, but findings in healthy individuals are inconsistent so far.
Methods: Using a dot-probe paradigm, we investigated whether temperament traits and gender, which are linked to (sub)clinical symptoms and attentional processing, influenced attentional biases in healthy adults.
Results: All participants showed protective attentional biases in terms of orienting their attention away from negative information. In both genders higher values of negative affect were compensated with stronger attentional engagement with positive stimuli. This effect was more pronounced in men than in women. Effortful control fulfilled its regulative function in terms of stronger avoidance of negative stimuli only among men.
Limitations: Reaction times after probe detection provide only a snapshot of attention and allow only for an indirect assessment of visual attention. Future research should emphasize methods that allow for continuous monitoring of attention allocation, therefore results of the present study await replication in psychophysiological or eye-tracking studies.
Conclusion: Our results highlight the importance of considering influencing factors such as gender and temperament traits for attentional biases in healthy adults.

1. Introduction

Human attention is particularly captured by environmental stimuli which are congruent with actual mood state or concern (Yiend, 2010), and it is assumed that this preoccupation correlates with biased attentional processes (Williams, Mathews, & MacLeod, 1996). Attentional biases are characterized by facilitated attentional orientation toward relevant (e.g., threat-related) information and have mostly been described in relation to psychiatric disorders or subclinical symptoms of anxiety and depression (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007; Kaur, Butow, & Sharpe, 2013; Leyman, De Raedt, Schacht, & Koster, 2007). Given that humans in general are well-equipped with an automatic threat-detection system (i.e., the fight or flight system), it seems surprising that the few extant studies specifically investigating healthy participants (i.e., with anxiety levels comparable with normative data of non-clinical adult samples or screened to confirm absence of psychopathology) did not consistently reveal threat-related attentional bias tendencies. For example, Holmes, Bradley, Kragh Nielsen, and Mogg (2009) reported a general attentional bias toward emotional faces (happy, angry) relative to neutral faces, whereas Mueller et al. (2009) found no bias tendencies toward angry or happy faces. Findings by Santesso et al.

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(2008) in turn indicated a higher vigilance for angry faces and avoidance of happy faces. Koster, Crombez, Verschuere, and De Houwer (2004) detected delayed attentional disengagement from negative pictures, i.e., that participants did not initially orient their attention toward negative pictures, but they needed more time to shift their attention away from negative pictures. Some of these findings were corroborated in studies on low-anxious participants, who were often selected as control groups for non-clinical high-anxious participants. Both Massar, Mol, Kenemans, and Baas (2011) and Sagliano, Trojano, Amoriello, Migliozzi, and D'Olimpio (2014) observed difficulties in attentional disengaging from threatening stimuli. Furthermore, Koster, Crombez, Verschuere, Van Damme, and Wiersema (2006) and Sagliano et al. (2014) found that low-anxious participants avoided negative stimuli. The observation that attentional biases well-known in clinical populations were also present, but not consistently replicated in healthy participants suggests that attentional bias tendencies might be influenced by factors other than clinical symptoms. In the present study, we intended to address two factors, which are both strongly linked to clinical symptoms and attentional processing: Gender and temperament. First, recent studies reported gender-related differences in attentional biases in terms of a threat-related attentional bias that may occur in women rather than in men (Sass et al., 2010; Tran, Lamplmayr, Pintzinger, & Pfabigan, 2013). Relatedly, women show significantly higher prevalence rates of depression and anxiety disorders than men (McLean, Asnaani, Litza, & Hofmann, 2011; Van de Velde, Bracke, & Levecque, 2010) and both depression and anxiety disorders are characterized by attentional biases toward negative information (Bar-Haim et al., 2007; Mingtian, Xiongzhao, Jinyao, Shuqiao, & Atchley, 2011). Second, there is evidence for a meaningful overlap between research on temperament, (sub)clinical anxiety and attentional processes (Lonigan, Vasey, Phillips, & Hazen, 2004). Biased attentional processes are not only strongly linked to anxiety and depression but also characterize temperament factors like negative affectivity and effortful control (Lonigan et al., 2004; Vervoort et al., 2011). Those temperament factors, in turn, have been found to activate similar underlying neurobiological processes like anxiety and depressive symptoms (for an overview see Derryberry & Rothbart, 1997) and are therefore considered to be involved in development and maintenance of depression and anxiety disorders (Clark, Watson, & Mineka, 1994). Therefore we assume that in the absence of (sub)clinical anxiety and depressive symptoms temperament factors might be involved in the regulation of attentional processes.

Gender as an important contributing factor in the processing of emotional stimuli (Cahill, 2006) has not been considered sufficiently in attentional bias research. Although previous findings (Sass et al., 2010; Tran et al., 2013) point in a similar direction, they differ slightly in the time course of selective attention: A recent study by Tran et al. (2013) revealed that faster attentional engagement with threat-related stimuli occurred only in women and was positively correlated with individual levels of anxiety. Men, on the contrary, showed a difficulty to disengage from negative stimuli, which was not related to anxiety. In an event-related potential study Sass et al. (2010) found that in the healthy control group men displayed higher initial attentional engagement toward threatening rather than toward pleasant stimuli, reflected in enhanced P100 amplitudes to threat words. Women, on the contrary, showed more elaborate processing of threat stimuli at later processing stages (prolonged P300 latency). Gender differences have not only been reported in attention allocation tendencies, but also in the temperament domains. Wiltink, Vogelsang, and Beutel (2006) found significantly higher scores of negative affect in adult women than in adult men. In children, Else-Quest, Shibley Hyde, Hill Goldsmith, and Van Hulle (2006) reported higher effortful control in girls than in boys.

Rothbart and Bates (1998) defined temperament as "constitutionally based individual differences in emotional, motor, and attentional reactivity and self-regulation" (p. 109). Temperament is considered to be partly mediated by automatic attention allocation mechanisms (Lonigan et al., 2004) and contains reactive and regulative factors: Reactive temperament factors comprise high emotionality of negative affectivity; regulative factors relate to effortful control which involves the ability to focus attention and to control behavior (Derryberry & Rothbart, 1997) and regulates attention and motivation, planning abilities, as well as response activation or inhibition (Derryberry & Rothbart, 1997; Rothbart, Derryberry, & Posner, 1994). Moreover, Schäfer et al. (2015) reported that the ability to control attention, a process subordinated to effortful control, might influence trait resilience.

The few studies in healthy participants that experimentally investigated the relationship between attentional bias tendencies and temperament revealed inconclusive results: According to Field (2006) and Mauer and Borkenau (2007) more pronounced temperamental reactivity (i.e., negative affect) facilitates threat-related attentional biases in both children and adults. In adolescents, Vervoort et al. (2011) investigated the influence of temperamental traits on initial (measured with a picture presentation duration of 500 ms) and strategic (measured with a picture presentation duration of 1250 ms) attentional processes. Contrary to their assumptions, they found no relation between initial threat-related attentional processes and negative affect, but observed that higher levels of effortful control were associated with a stronger strategic avoidance of threat (attentional bias away from threat). Previous studies on the influence of temperament traits on attentional processes applied different experimental paradigms, which all assessed a general bias in attentional processing and did not allow for the differentiation between orienting and disengaging attentional processes.

In the present study attentional biases were captured with a modified version (Koster et al., 2004; Salemink, van den Hout, & Kindt, 2007) of a dot-probe task (MacLeod, Mathews, & Tata, 1986), an established and well investigated paradigm to measure attentional processes. In this task an emotional and a neutral stimulus are presented simultaneously on a computer screen. After stimulus offset a small dot probe appears either at the location of the emotional stimulus (congruent condition) or at the location of the neutral stimulus (incongruent condition). Participants should detect the side of the dot as quickly as possible and respond via button-press. It is assumed that participants respond faster to probes replacing stimuli which have been attended to before (MacLeod et al., 1986). The original version of the dot-probe task (MacLeod et al., 1986) allows for the calculation of the well-established bias index by subtracting reaction times of congruent trials (dot appears at the location of the emotional stimulus) from incongruent trials (dot appears at the location of the neutral stimulus). Positive scores indicate general and unspecific orienting toward emotional stimuli, whereas negative scores represent avoidance of emotional stimuli. The modified version of the task (Koster et al., 2004; Salemink et al., 2007) contained also picture pairs depicting two neutral social scenes (neutral trials), which served as a baseline measure for reaction times and allowed for differentiating between attentional orienting and disengaging processes in attentional bias tendencies. Attentional orienting is reflected in faster reaction times in congruent than in neutral trials, attentional avoidance is indicated by faster reaction times in neutral compared to congruent trials. Difficulties in attentional disengaging are considered as response slowing in the presence of an emotional stimulus (Salemink et al., 2007) and are reflected in faster reaction times in neutral than in incongruent trials.