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Impact of fearful expression on danger processing: The influence of the level of trait anxiety

Estelle Longin *, Gilles Rautureau, Fernando Perez-Diaz, Roland Jouvent, Stéphanie Dubal

CNRS USR 3246, Centre Emotion, Paris, France

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ABSTRACT

Threat estimation is crucial for the adaptation of behavior to a dangerous situation. In anxiety, a bias to threat has been described as a core feature. Therefore, the sensitivity for threatening information in anxious individuals may have consequences for danger estimation. In this study, we used the affective priming paradigm to test the assumption that fearful expressions would facilitate danger detection in natural scenes in anxious individuals. Twenty-three high trait anxious individuals and 22 low trait anxious individuals participated in the study. They had to detect the potential threat of a target scene (neutral or threatening) following neutral or fearful face primes. High trait anxious participants detected threat more rapidly than low trait anxious participants, consistent with previous reports of emotional hypervigilance in anxiety. Furthermore, this effect was enhanced when the target scene followed a fearful expression: Only in anxious participants were reaction times shorter to detect danger following a fearful prime than a neutral prime. Our results tend to show that in anxiety, the hypervigilance to threat may be of an important value such as increasing the detection of a subsequent potential danger. Implication of attentional processes and attentional control is discussed.

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1. Introduction

Cognitive models of anxiety assume that the etiology and maintenance of anxiety disorders are related to individual differences in the processing of threat-related material (Beck & Clark, 1997; Eysenck & Calvo, 1992; Mathews & MacLeod, 2002). According to these models, anxiety would be dependent on distorted perceptions of danger. Research findings have provided strong support for the hypothesis that anxiety is associated with cognitive biases for threatening information.

Anxious individuals selectively attend to potentially threatening stimuli. Such attentional biases for threat have been widely observed both in clinical anxiety and in non clinical high trait anxiety and replicated using a variety of paradigms (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). Those biases may appear at different stages of information processing: In the early stages, an automatic attentional orienting to threat has been shown in paradigms such as the dot probe, the visual search and the spatial cueing paradigms (Carlson & Reinke, 2008; Juth, Lundqvist, Karlsson, & Ohman, 2005; Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006; Rinck, Becker, Kellermann, & Roth, 2003). For example, dot probe tasks showed that high trait anxious individuals (HTA) are quicker at responding to probes in the location of a threat stimulus than a neutral stimulus (Mogg & Bradley, 1999). This tendency for threatening stimuli to attract attention to a greater extent in anxious individuals also results in a later difficulty in disengaging attention from such stimuli (Amir, Elias, Klumpp, & Przeworski, 2003; Lipp & Waters, 2007; Salemink, van den Hout, & Kindt, 2007; Van Damme, Crombez, Hermans, Koster, & Eccleston, 2006). Globally, compared to controls, anxious individuals orient their attention to threatening stimuli more than to neutral stimuli (Cisler & Koster, 2010).

Consistent with this attentional bias for threat, anxious individuals show enhanced processing of threat related information. Using the face in the crowd paradigm (Hansen & Hansen, 1988), some data established that HTA individuals were faster than low-trait anxious (LTA) individuals to detect angry faces in a neutral crowd (Byrne & Eysenck, 1995). Anxious individuals not only detect threat more quickly than do LTA individuals, they also recognize fear more accurately (Surcinelli, Codispoti, Montebarocci, Rossi, & Baldaro, 2006). Besides, fearful faces may influence attentional processes in high anxious individuals (Georgiou et al., 2005; Ladouceur et al., 2009) and previous studies showed a bias towards facilitated processing of fearful faces in anxiety (Avram, Balteş, Miclea, & Miu, 2010).

Although fearful faces are not threatening in their appearance, they may be interpreted as such by anxious individuals since fear expression is considered to indicate danger in the environment. Emotional facial expressions act as functions of signalization; they

* Corresponding author. Address: CNRS USR 3246, CHU Pitié-Salpêtrière, 47 bd de l'Hôpital, 75651 Paris Cedex 13, France. Tel.: +33 1 44 23 07 50; fax: +33 1 53 79 07 70.

E-mail address: estellelongin@gmail.com (E. Longin).

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are recognized as an important fundamental social phenomenon (Kaiser, Wehrle, & Schenkel, 2009). According to LeDoux (1996), fearful expressions may facilitate danger detection. For Frijda (1953, 1986), emotional facial expressions are similar to a way of action preparation. Frijda distinguishes three possible reactions of an observer in front of a facial expression, of which "environmental expectation". This behavior is defined by the allocation of attention on a particular object or by arousing expectation of this object. The perception of fear expression, for example, may induce such a reaction by indicating the presence of a threat in the environment.

Recently, Browning and Harmer (2012) found that threat expectation may influence deployment of attention to threat. Their results suggest that expectancy-based processes are involved in the control of attention to threatening information and that these processes are perturbed in anxiety. Indeed, they obtain a negative correlation between high levels of trait anxiety of the participants and the threat-expectation signal measured in attentional control and visual cortical structures. However, this relationship was not observed in their behavioral data. The present study is based on this idea that threat expectation influences the control of attention, and that perturbed expectancy based processes may lead to attentional biases in anxious individuals. As described above, fearful facial expressions represent a signal of potential danger and arouse threat expectation. We suggest therefore that perception of a fearful expression involves a lack of attentional control in anxious individuals, by increasing threat expectation. To test this assumption we used a behavioral task based on the affective priming paradigm. Specifically, we analyzed the effect of a neutral or fearful face prime on the detection of danger in complex scenes representing physically dangerous real situations, as a function of trait anxiety level.

Traditionally, the affective priming paradigm implies that participants evaluate the emotion depicted by a target stimulus of either positive or negative valence preceded by an emotional prime stimulus (Fazio, Sanbonmatsu, Powell, & Kardes, 1986). Such studies using the affective priming paradigm have evidenced facilitation for the processing of emotional information. The affective priming effect thus relates to shorter reaction time recorded when the prime and target have the same valence than for incongruent prime-target pairs (Aguado, García-Gutierrez, Castañeda, & Saugar, 2007; Calvo & Avero, 2008; Carroll & Young, 2005; Storbeck & Clore, 2008). The spreading of activation in memory has been proposed to be the mechanism responsible for the affective priming effect: the presentation of the prime was presumed to temporarily enhance the activation level of the associated affective evaluation (Fazio, 2001). More precisely, a recent ERP study showed that two mechanisms participate to the affective priming effect in an evaluation task: semantic priming and response priming (i.e. automatic activation of the evaluative response through the affective prime) (Eder, Leuthold, Rothermund, & Schweinberger, 2012). Besides, other authors underline the importance of attention for the appearance of the affective priming effect (Calvo & Nummenmaa, 2007; De Houwer & Randell, 2002).

Using face material, Li, Zinbarg, Boehm, and Paller (2008) found that affective ratings of emotional faces were more influenced by the expression of a subliminal fearful face prime the higher the individual's trait anxiety level. That is, surprised faces were more often rated as negative when preceded by a subliminal fearful prime with anxiety level increasing. This result goes along with the notion that the processing of fearful faces is facilitated or enhanced in anxiety. In the present study, we aim to test the hypothesis that a threat stimulus, such as a fearful expression, would modulate differently the subsequent detection of danger in anxious individuals compared to controls. Taking into account the arguments demonstrating an enhanced processing of threat in anxiety, we presume that, in the context of the affective priming paradigm, the detection of dangerous target scenes will be facilitated in anxious individuals compared to non anxious participants when preceded by a fearful face prime.

2. Method

2.1. Participants

We selected 45 volunteers from a larger pool of University Pierre & Marie Curie students according to their score on the French version of the State-Trait Anxiety Inventory (STAI: Schweitzer & Paulhan, 1990; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). Twenty-three participants (12 women, 11 men) were included in the HTA group, with a mean score on the STAI of 55.74 (SD = 5.45). The LTA group was constituted of 22 participants (11 women, 11 men) and the mean trait anxiety score on the STAI was 29.41 (SD = 4.20). Mean age was 19.87 years (SD = 2.28) for the HTA group, and 21.18 (SD = 2.34) for the LTA group. All participants reported normal vision or vision corrected to normal.

Participants were administered the Mini International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1997) to check for any current or past Axis I psychiatric diagnoses according to Statistical Manual of Mental Disorders criteria for affective disorders (DSM-IV: American Psychiatric Association) or a history of neurological illness. Written informed consent was obtained from all participants.

2.2. Material

The prime stimuli were pictures of faces selected from the NimStim Face Stimulus Set (Tottenham et al., 2009). Sixty images of the faces of 15 women and 15 men displaying a fearful expression (negative primes) and of the same 30 individuals with a neutral expression (neutral primes) were used.

The target stimuli were neutral pictures or pictures depicting danger in various situations, such as a fire, physical attack, and extreme sports. The pictures were selected from the IAPS (Lang, Bradley, & Cuthbert, 2005) or internet websites and personal databases. The 104 scenes (1067 × 800 pixels) included in the test had previously been rated for danger intensity, by 101 individuals, on a scale of one to four: 1 (no danger at all) to 4 (extreme danger). The 30 pictures with the highest danger ratings, all with a score greater than 2, were used as dangerous scenes (negative targets). Thirty neutral pictures, with a score no higher than 2, were used as neutral targets. The mean ratings were 1.17 ± 0.18 for neutral pictures and 3.65 ± 0.16 for dangerous pictures.

2.3. Procedure

All stimuli were presented on a 15-inch monitor screen positioned 0.5 m from the participant. Pictures and fixation cross stimuli were centered on a black background Fig. 1.

Participants were presented with 120 prime-target pairs. These 120 trials corresponded to 30 repeats of the four conditions created by a full crossing of the prime valence and target valence factors. Consequently, each face prime appeared twice: once followed by a neutral scene and once followed by a dangerous scene. Similarly, each scene appeared twice: once immediately after a neutral face and once after a fearful expression. The presentation of the prime-target pairs was randomized across trials and participants.

The prime stimulus was presented for 200 ms and was directly followed by the target scene, which remained on the screen for 700 ms. Between trials, a white fixation cross was displayed on a black background for 3500–4000 ms.

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