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Lack of startle blink potentiation to mutilation pictures irrespective of fearfulness

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ABSTRACT

Previous research has shown that in healthy individuals blood-related stimuli elicit a distinctive autonomic response pattern and heightened processing as compared with other unpleasant and arousing visual stimuli. In addition, growing evidence suggests that information processing of disorder-related stimuli is also different in blood phobia as compared with other specific phobias. In the present study, the magnitude of the startle eyeblink reflex elicited during the viewing of mutilation, human attack, erotica and neutral pictures was recorded in 22 blood phobics and 25 healthy controls. Startle eyeblink responses were measured at 300, 1500, 3500 and 4500-ms time intervals after picture onset in order to assess the attentional/affective modulation and its temporal course. Reliable startle inhibition to erotic pictures and startle potentiation to human attack scenes were found relative to neutral pictures. However, while both groups rated mutilations as the most unpleasant and arousing content, no blink facilitation relative to neutral contents was found at either early or late probe times. Crucially, such effect occurred independently of fear levels, as no difference between phobics and controls was found in the size of the startle blinks elicited throughout the viewing of blood pictures.

1. Introduction

Studies investigating psychophysiological response patterns of non-fearful individuals to stimuli depicting blood, injuries and mutilations consistently demonstrate that these contents elicit a distinctive autonomic response pattern and heightened processing as compared with other unpleasant and arousing visual stimuli. In particular, larger and longer heart rate decreases are displayed during the viewing of this emotional material (Palomba et al., 2000). This specific reaction is viewed as an index of increased attention and/or motor inhibition, and is in fact associated with larger slow wave positivity of the event-related potentials (ERPs) (Schupp et al., 2004), longer reaction times to a probe presented during picture viewing (Buodo et al., 2002), greater reduction in alpha EEG activity (Sarlo et al., 2005) and in spontaneous blink rate during film viewing (Palomba et al., 2000). Overall, these findings suggest increased attentional engagement rather than clear-cut preparation for defensive action. Thus, there seems to be something special about blood-related information that results in distinctive emotional processing and responding.

Importantly, blood–injection–injury phobia has been repeatedly shown to differ from other specific phobias with regard to several clinical features. Most notably, blood phobics exposed to blood stimuli respond with a conflicting activation of both the sympathetic and the parasympathetic nervous system (Graham et al., 1961; Engel, 1978; Öst et al., 1984) or, possibly, a dysregulation intrinsic to the sympathetic system resulting in enhanced cardiac activity along with vasodilation and blood pressure decrease (Sarlo et al., 2002, 2008). Such abnormal response contrasts with the coherent sympathetic activation that in other specific phobics supports preparation for motor activity (i.e., avoidance or escape), and often leads to fainting upon exposure to blood-related stimuli (see Öst, 1992). Such reaction to the feared stimuli is virtually absent in other specific phobias (Connolly et al., 1976). In addition, growing evidence suggests that information processing of disorder-related stimuli is also different in blood phobia as compared with other specific phobias. Indeed, a "between-groups" attentional bias (i.e., the assignment of greater attentional resources to phobic stimuli as compared to nonphobic individuals) can be effectively highlighted in other specific phobics just by presenting single phobia-related stimuli (Kolassa et al., 2005; Miltner et al., 2005; Schienle et al., 2008; Michalowski et al., 2009), but not in blood phobics (Buodo et al., 2006, 2007). Moreover, a "within-conditions" attentional bias (i.e., the assignment of greater attentional resources to phobic stimuli as compared to unpleasant disorder-unrelated stimuli) is most often observed in other specific phobics (Miltner et al., 2005; Schienle et al., 2008; but see also Michalowski et al., 2009), and, again, not in blood phobics (Buodo et al., 2006, 2007). A genuine attentional bias seems to emerge in blood phobics only when the cognitive system is forced to distribute spatial attention among multiple discrete stimuli in the visual field (Buodo et al., 2010). A possible explanation of such findings is that blood stimuli seem-

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ingly saturate available attentional resources already in healthy individuals (Buodo et al., 2002, 2006), so that fear of blood does not (or perhaps cannot) further increase attentional allocation in passive viewing conditions. Another difference between blood phobia and other specific phobias is related to the extent of overt avoidance of disorder-related cues. Free viewing time (a behavioral index of interest/avoidance) of blood-related stimuli was found to be comparable in blood phobics and controls (Hamm et al., 1997), or reliably shorter in blood phobics than controls, but not truly suppressed compared to other unpleasant contents, suggesting the lack of an overt avoidant response (Buodo et al., 2006). Taken together, these findings suggest that blood phobics do not respond to their feared stimuli with the activation of a clear-cut defensive cognitive and motivational set.

Over the last two decades, the understanding of motivational/attentional interplay in emotional responding has increasingly profited from the measurement of the startle eyeblink. As part of a defensive response, the amplitude of the startle eyeblink is modulated by the organism's ongoing emotional state, with relative potentiation and inhibition occurring during unpleasant and pleasant affective states, respectively (motivational priming effect, e.g., Lang, 1995; Lang et al., 1997). In addition to motivational states, attentional allocation modulates the amplitude of the startle reflex. The presentation of a weak, non-startling stimulus (prepulse) closely before a startle-eliciting stimulus (probe) transiently reduces the amplitude of the startle reflex (see Graham, 1992, for a thorough account of prepulse inhibition). The function of this phenomenon would be to "protect" sensory processing of the prepulse, acting as a gating mechanism (Anthony, 1985; Filion et al., 1998). Assuming a limited capacity model of attention, the greater the amount of attentional resources commanded by the prepulse, the stronger the inhibition of startle amplitude.

When emotional pictures are presented as prepulses, the strongest inhibitory effect on eyeblink amplitude is observed around 300 ms after picture onset, particularly for emotional (both pleasant and unpleasant) as compared with neutral pictures. This effect indicates that greater attentional resources are allocated to the initial processing of motivationally relevant stimuli, either appetitive or aversive, with correspondingly fewer available for processing the startle probe (Bradley et al., 1999). Beyond this early prepulse region, the usual motivational modulation (i.e., potentiation during unpleasant pictures, inhibition during pleasant pictures) develops throughout picture viewing, with reflex magnitude appearing to asymptote for all picture contents around 3000 ms (Bradley et al., 1999). This pattern suggests that although the encoding of motivationally relevant information is indeed rapid, motivational disposition takes time to develop (Lang et al., 1997; Bradley et al., 1999). Therefore, the startle reflex methodology can be considered as a dependable measure for probing the activation of an aversive motivational disposition and, most importantly, it uniquely allows the investigation of the complex relationship between attentional and motivational processes.

In contrast with what has been observed with other categories of unpleasant stimuli, some literature data indicate that non-fearful individuals do not show the expected startle blink potentiation during the viewing of stimuli depicting mutilated bodies, surgeries and injuries, at both early (Stanley and Knight, 2004) and late (Kaviani et al., 1999; Bradley et al., 2001; Schupp et al., 2004) probe times, supporting the idea that the typical defensive set is not activated. With regard to investigations on specific phobias, an exaggerated fear-potentiated startle effect has been consistently demonstrated in snake or spider phobics when confronted with their phobic object. As expected, startle potentiation was found to be greater during the viewing of pictures of fear-relevant than fear-irrelevant unpleasant objects, whereas these differences were absent in the control group. Also, potentiation of the startle response in fearful participants occurred as early as 300 ms after onset of fear-relevant pictures (De Jong et al., 1996; Globisch et al., 1999; Wendt et al., 2008). This early facilitation might be due to the prevalence of defensive activation over attentional deployment. In contrast, blood phobics were found to respond with startle potentiation while viewing mutilation relative to neutral pictures, but the magnitude of the startle blink elicited during the viewing of mutilation pictures was not significantly larger relative to controls (Hamm et al., 1997). These findings suggest that in blood phobics the activation of aversive motivation by phobia-related stimuli is less robust than in other specific phobias. However, in the study by Hamm et al. (1997) startle probes were administered only at late time intervals (4000, 4500 and 5000 ms) after picture onset. It remains to be clarified whether startle potentiation in blood phobics starts earlier, as in other specific phobics, or whether startle inhibition, possibly due to engagement of visual attention, initially prevails over the activation of aversive disposition, as in non-fearful individuals. In the present study, the amplitude of the startle blink elicited during picture viewing at different time intervals after stimulus onset (300, 1500, 3500 and 4000 ms) was assessed in blood phobics and non-fearful controls in order to examine both the attentional and the motivational modulation and their temporal relationship as a function of fear levels.

2. Methods and materials

2.1. Participants

The Italian version of the mutilation questionnaire (MQ; Klorman et al., 1974) was administered to 205 female undergraduates, and subjects scoring above the 90th percentile of the obtained scoring distribution (≥19) were preliminarily included in the phobic group ($n = 37$). They were then invited by telephone to the laboratory and screened with a semi-structured interview (anxiety disorders interview schedule, ADIS IV; Brown et al., 1994) by a clinical psychologist, in order to assess whether they fulfilled DSM-IV-TR criteria for specific phobia–blood/injection/injury type (American Psychiatric Association, 2000). In case the DSM criteria were met, the subject was asked for participation in the study, and an appointment was arranged for those who gave preliminary informal consent. The final sample, matching as closely as possible analogue samples to clinical populations, included 22[1] females (age range 19–27; mean = 22.77, S.D. = 2.06). Mean MQ scores for the phobic group was 21.31 (range 19–25; S.D. = 2.23).

Control participants ($n = 25$; age range 21–30; mean = 23.9, S.D. = 2.44) were randomly selected from the initial pool of subjects. They were included in the sample if they scored below 19 on the MQ and had no specific fears (including blood/injection/injury fear), as assessed before the experimental session by a 17-item reduced form of the fear survey schedule (FSS-III; Wolpe and Lang, 1964). Given that none of the control participants had specific fears, the ADIS IV interview was not administered. Their mean score on the MQ was 8.08 (range 1–17; S.D. = 4.12). The absence of clinically relevant physical and psychopathological disorders (other than blood phobia in blood phobic participants) was ascertained for each subject by means of a general health questionnaire.

2.2. Stimulus material

Forty-eight pictures, varying in emotional pleasantness and arousal, were selected from the international affective picture system (IAPS; Lang et al., 2008). They were divided into four categories according to their content[2]: mutilations (severely injured or mutilated bodies; unpleasant phobia-related), human attack (attacking humans and aimed guns; unpleasant phobia-unrelated), erotica (erotic couples; pleasant), and neutral (neutral people). Only highly arousing contents were selected for the pleasant and unpleasant picture categories, since these have been observed to induce the most remarkable psychophysiological changes (e.g., Bradley et al., 2001). Pleasant and unpleasant pictures were matched for normative arousal ratings. Pictures were presented on a digitized format via a 17 in. monitor on an IBM-

[1] The startle blink records of one participant in the phobic group were discarded from statistical analysis due to an excessive amount of missing data during intertrial intervals (ITIs).

[2] The IAPS picture numbers were as follows: erotica: 4611, 4650, 4651, 4652, 4658, 4659, 4664, 4669, 4672, 4680, 4800, 4810; neutral: 2190, 2200, 2210, 2230, 2270, 2381, 2440, 2480, 2570, 2749, 2830, 9070; human attack: 6190, 6230, 6242, 6243, 6244, 6250, 6260, 6350, 6510, 6540, 6560, 3530; mutilations: 3000, 3010, 3053, 3060, 3071, 3080, 3102, 3110, 3130, 3150, 3400, 9405.