Lack of startle blink potentiation to mutilation pictures irrespective of fearfulness
Michela Sarlo*, Giulia Buodo, Daniela Palomba
Department of General Psychology, University of Padova, Via Venezia 8–35131 Padova, Italy

A R T I C L E   I N F O
Article history:
Received 17 January 2010
Accepted 12 August 2010
Available online 19 August 2010

Keywords:
Mutilation pictures
Startle eyelblink
Blood phobia
Emotion
Attention

A B S T R A C T
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 eyelblink reflex elicited during the viewing of mutilation, human attack, erotica and neutral pictures was recorded in 22 blood phobics and 25 healthy controls. Startle eyelblink 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.

© 2010 Elsevier B.V. All rights reserved.

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 phobias 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-
Ongoing potentiation and inhibition occurring during unpleasant and emotional/attentional interplay in emotional responding has increased motivational set. Fear of feared stimuli with the activation of a clear-cut defensive cognitive and motivational set. 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 (pre-pulse) closely before a startle-eliciting stimulus (probe) transiently reduces the amplitude of the startle reflex (see Graham, 1992, for a thorough account of pre-pulse inhibition). The function of this phenomenon would be to “protect” sensory processing of the pre-pulse, acting as a gating mechanism (Anthonv, 1985; Filion et al., 1998). Assuming a limited capacity model of attention, the greater the amount of attentional resources commanded by the pre-pulse, the stronger the inhibition of startle amplitude.

When emotional pictures are presented as pre-pulses, 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 phobias, 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 (≥18) 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 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. = 2.22). 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. Also, potentiation of the startle response in fearful 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: mutilations (severely injured or mutilated bodies; unpleasant phobia-related), human attack (attacking humans and animals gun; 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, 4660, 4667, 4680, 4800, 4810; neutral: 2190, 2290, 2210, 2230, 2270, 2381, 2440, 2480, 2570, 2749, 2830, 3070; 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.
compatible computer, positioned at a distance of about 1 m from the subject. Picture resolution was 1024 × 768 pixels. Two orders of picture presentation were arranged (across subjects) to control order effects. The orders were pseudo-randomized, so that no two pictures of the same category were presented in succession. The acoustic startle stimulus consisted of a burst of white noise (96-dB, 50-ms duration, instantaneous rise time), delivered binaurally through Sony stereo headphones (MDR-V250 model).

2.3. Procedure

Upon arrival at the laboratory, participants read and signed an informed consent form. They were seated on a comfortable chair in a dimly lit, sound-attenuated room. After electrode attachment, they were instructed that a series of pictures would be shown, and that each picture should be viewed the entire duration it was on the screen. They were also told to ignore occasional noises heard on the headphones.

Each picture was presented for 6 s, after a 3 s baseline. A variable interval (12–20 s) occurred between trials. Startle probes were presented at one of four intervals (i.e., 300, 1500, 3500 or 4500 ms after picture onset) on each trial, thus providing 3 data points for each time condition within each emotional category. In addition, startle probes were delivered during 12 ITIs. The 4 probe intervals were selected in order to assess the attentional/motivational modulation of startle amplitude during the initial and later stages of picture processing. Two neutral pictures, during which a startle probe was presented, served as practice stimuli. After picture offset, participants performed picture ratings using a computerized version of the 1–9 point scales of valence and arousal (SAM, self-assessment manikin; Lang et al., 2008). The study had been approved by the local ethics committee and was performed in accordance with the ethical standards of declaration of Helsinki.

2.4. Apparatus and physiological recording

The eyeblink component of the startle response was measured by recording the electromyographic activity from the orbicularis oculi muscle beneath the left eye using Ag/AgCl miniature electrodes. The raw signal was amplified and filtered 30–300 Hz and then rectified and integrated with a time constant of 100 ms, using a Coulbourn S76-01 contour following integrator. Sampling rate was 20 Hz, then it was increased at 1000 Hz beginning 50 ms before startle stimulus and continuing until 250 ms after startle onset. Stimulus timing and data collection were implemented by VPM software program (Cook, 1997) on an IBM-compatible computer.

2.5. Data reduction and analysis

The startle responses were analyzed off line using a peak scoring algorithm (Cook, 1997), which scores each trial for magnitude in A/D units and onset latency in milliseconds. Peak response was detected in a 20–150 ms time window after stimulus onset. Blink magnitudes were standardized within each participant, using the mean and standard deviation of reflexes elicited on no-picture probe trials (i.e., during the ITIs) for a z-score transformation; a T-score transformation was applied to the resultant scores (i.e., (z × 10) + 50). This standardization procedure is known to reduce the influence of arbitrary, between-subjects variability in blink magnitude while preserving within-subjects probe response differences during affective processing (Requin and Bonnet, 1993; Bonnet et al., 1995; Bradley et al., 2006).

The analysis on the raw magnitude data during the ITIs yielded no significant differences between phobics and controls (F[1,144] = 85, p < .0001). Startle blink data were analyzed with a mixed-model analysis of variance (ANOVA), with one between-subjects factor (Group: blood phobics, controls) and two within-subjects variables as repeated measures, category (erotic, neutral, human attack, mutilations), and time (300, 1500, 3500 and 4500 ms). The corrected p-values for effects within variables with more than two levels are reported together with the Geisser–Greenhouse epsilon (e) and the uncorrected degrees of freedom. Significant main effects and interactions (p < .05) were followed by Tukey HSD post hoc tests, which correct for multiple comparisons.

3. Results

3.1. Startle eyeblink

No significant effects involving the group factor were observed (all ps > .62). The significant category main effect (F[3,132] = 26.25, p < .0001, e = .69, ηp² = .37) showed a lack of eyeblink magnitude potentiation (i.e., no significantly greater magnitude as compared with neutral stimuli, p = .99) during the viewing of mutilations, in both blood phobics and controls. Startle response magnitudes elicited during the viewing of mutilations differed from those to erotic pictures (p < .00001), which prompted maximal inhibition (i.e., significantly smaller magnitude as compared with neutral pictures, p < .00001), and human attack (p < .00001), which prompted significant magnitude potentiation (significantly greater magnitude as compared with neutral stimuli, p < .001). Blink magnitudes during the viewing of erotica and human attack also differed from each other (p < .0001). Time main effect (F[3,132] = 17.02, p < .00001, e = .78, ηp² = .28) revealed that blink magnitude increased as a function of probe onset. As shown by the category × time interaction (F[9,396] = 2.78, p < .03, e = .39, ηp² = .06), startle blink potentiation during mutilations was not observed in any of the time intervals, in that blink magnitude did not differ during the viewing of mutilations and neutral pictures (all ps > .66). Startle blink inhibition during erotic pictures (i.e., smaller magnitude as compared with neutral pictures) was reliably observed from 1500 to 4500 ms (ps < .03), and startle blink potentiation (i.e., greater magnitude as compared with neutral pictures) during the viewing of human attack was observed from 3500 to 4500 ms (ps < .05). Blink magnitude was smaller during mutilations than during human attack in the 3500-ms time interval (p < .05).

Mean blink response magnitudes across time for blood phobics and controls as a function of picture content are displayed in Fig. 1. In order to further investigate the possible emergence of startle blink potentiation in blood phobics, an additional analysis was performed comparing two extreme groups: a subgroup of blood phobics (n = 12) scoring higher on the mutilation questionnaire (MQ ≥ 21) and a subgroup of controls (n = 13) scoring lower on the mutilation questionnaire (MQ ≤ 8). Results showed no significant effects involving the Group factor (all Fs < .56, all ps > .51) and the same statistical effects highlighted by the above analysis.

![Fig. 1. Mean blink response magnitude (T-scores) to startle probes presented 300, 1500, 3500 and 4500 ms after the onset of erotica, neutral, human attack and mutilations in blood phobics (upper panel) and controls (lower panel). Error bars represent standard error of the mean.](image-url)
3.2. Affective judgments

Means and standard deviations for valence and arousal ratings in blood phobics and controls are presented in Table 1.

Overall, pleasantness ratings were lower in blood phobics than in controls (group main effect, \( F_{1,45} = 13.16; p < .001, \eta^2_p = .23 \)). As shown by the category main effect (\( F_{1,135} = 286.65; p < .0001, \epsilon = .68, \eta^2_p = .86 \)), erotic pictures were evaluated as the most pleasant contents, followed by neutral, human attack, and mutilations. The group \( \times \) category interaction was close to significance (\( F_{1,135} = 2.59; p < .07, \epsilon = .68, \eta^2_p = .05 \)) and showed that blood phobics rated mutilations as more unpleasant than controls (\( p < .02 \)).

On average, arousal ratings were significantly higher in blood phobics than in controls (group main effect, \( F_{1,45} = 18.36; p < .0001, \eta^2_p = .29 \)). However, the group \( \times \) category interaction (\( F_{1,135} = 6.70; p < .001, \epsilon = .82, \eta^2_p = .13 \)) specified that blood phobics assigned significantly higher arousal ratings as compared with controls only to mutilations (\( p < .01 \)). Furthermore, blood phobics rated mutilations as the most arousing content (\( ps < .01 \) from all other contents), whereas controls attributed comparably high arousal ratings to mutilations and erotic pictures (\( p = .87 \)). Arousal reports also varied as a function of picture contents (Category main effect, \( F_{1,135} = 58.81; p < .0001, \epsilon = .82, \eta^2_p = .57 \)), with mutilations judged to be the most arousing, followed by erotica, human attack and, lastly, neutral.

4. Discussion

The results of the present study demonstrate a lack of startle blink potentiation throughout the viewing of mutilation pictures in both healthy and fearful individuals, indicating that blood-related stimuli do not prompt the typical defense reaction, despite their high aversiveness. Crucially, such effect appears to be entirely independent of fear levels. While both groups rated mutilations as extremely unpleasant and arousing, no blink facilitation relative to neutral contents was found in any of the considered probe times. On the other hand, both phobics and controls showed the expected startle potentiation to unpleasant pictures depicting human attack, as greater magnitude as compared with neutral pictures was reliably observed from 3500 to 4500 ms. Furthermore, blink magnitude was significantly smaller to mutilation than to human attack pictures at 3500 ms, when reflex magnitude is known to asymptote and the affective modulation is maximal (e.g., Bradley et al., 1999). A lack of startle potentiation during mutilation relative to neutral contents was reported by Stanley and Knight (2004) both at 300 ms and at late probe times (2–5 s), although in their study mutilation pictures were included in a broader “disgust” category together with a small number of other contents. Lastly, Kaviani et al. (1999) reported the startle response to be inhibited during the viewing of a surgery film-clip to about the same degree as a pleasant clip, whereas startle potentiation was reliably obtained during an equally unpleasant threat clip. Our findings are further in line with previous reporting that pictures of mutilations elicit significantly smaller blink responses than during the viewing of human attack pictures, with startle probes presented between 3 and 5 s after picture onset (Bradley et al., 2001). Similar results were reported by Schupp et al. (2004) showing that startle magnitude to probes presented at 2.5 and 4.5 s was significantly less potentiated when viewing pictures of mutilations than human and animal attacks. The results of the present study extend existing research by demonstrating that: (a) mutilation contents do not elicit startle potentiation at either early or late probe times, as no difference in blink magnitude was found from neutral pictures in any of the time intervals; (b) this effect occurs regardless of whether participants are blood phobics or non-fearful controls.

The obtained temporal pattern of blink modulation suggests that blood pictures not only act as prepulse stimuli in the early stages of stimulus encoding, but also seem to command sustained attentional engagement throughout picture presentation. This may be related to the peculiarity of blood stimuli in the context of generally unpleasant, high arousing stimuli. In non-fearful participants, pictures of mutilated bodies have been shown to engage larger amount of processing resources than equally unpleasant and arousing material (i.e., human attack scenes), as indicated by greater ERP positivity and heart rate deceleration, larger skin conductance changes, and reduced spontaneous blinking rate; also, mutilations pictures result in longer viewing time and better recall (Bradley et al., 1992, 2001; Palomba et al., 2000; Buodo et al., 2006). Lastly, reaction times to tone probes are slower during the viewing of mutilations than threat scenes (Buodo et al., 2002; Lang, 1995), again indicating that blood-related stimuli require greater attentional resources than other unpleasant contents. In contrast with threatening stimuli, that clearly signal an impending danger in the environment and require fast processing in view of rapid escape, blood-related cues call for greater attentional resources and prolonged processing. Blood stimuli possibly signal the aftermath of a dangerous situation, rather than its imminence, and thus might promote the gathering of information and sustained stimulus analysis rather than attentional disengagement for immediate action.

A further possible interpretation of the absence of startle potentiation to mutilations might be related to the prevalence of an emotional response of disgust over fear. Fear and disgust might exert different reflex, reactivating influences over reflex reactivity in defense (cf. Sawchuk et al., 1999). Although both emotions motivate withdrawal, fear prompts mobilization for active defense, whereas disgust is associated with a more “static” avoidance of physical contact and reduced priming for action (Sawchuk et al., 2002; Stanley and Knight, 2004). Therefore, it is possible that a distinctive defense response is activated by blood and injury cues.

Such peculiarity of mutilation stimuli might make any difference between blood phobics and controls difficult to emerge. Indeed, no difference between healthy controls and phobics was found in the size of the startle blinks elicited throughout the viewing of blood pictures, indicating no reflex facilitation in relation to controls. Furthermore, as stated above, even in blood phobics the magnitude of the startle eyeblink elicited during the viewing of mutilations was not greater relative to neutral pictures in any of the considered intervals. The clear potentiation observed in response to disorder-unrelated unpleasant stimuli demonstrates that such effect is specific to phobic stimuli. It is worth noting that this pattern of results holds true even when selecting subgroups of participants at the extremes of the fearfulness dimension, indicating that it is not modulated by fear levels.

Previous research on other specific phobics consistently showed reliable startle blink potentiation during the viewing of
fear-relevant material. This effect clearly emerged as a “between-groups” difference, i.e., larger blink amplitudes to fear-related pictures in phobics than in controls (Hamm et al., 1997; Globisch et al., 1999; Wendt et al., 2008), as well as “within-differences” conditions, i.e., larger amplitudes to fear-related than neutral (Hamm et al., 1997; Globisch et al., 1999; Wendt et al., 2008) and even generally unpleasant pictures (Hamm et al., 1997; Wendt et al., 2008). In the present study, neither “between-groups” nor “within-differences” differences were found in blink magnitude to mutilations. In their study, Hamm et al. (1997) also reported blink magnitude to mutilations not to differ between high mutilation-fearful participants and controls. However, they did find startle potentiation to mutilation relative to neutral pictures in fearful but not in control participants. Such inconsistency between ours and Hamm et al.’s findings may be ascribed to differences in the probe times employed, i.e., manipulating early and later time intervals vs. averaging across very late time intervals only (4000, 4500, and 5000 ms), when the affective modulation is maximal. Our data indeed provide novel information on the time course of startle blink modulation in blood phobics by demonstrating that no potentiation occurs immediately after picture presentation and throughout exposure to phobic material. Startle blink potentiation has been found in other specific phobics as early as 300 ms after the onset of fear-related cues (Globisch et al., 1999), suggesting that the activation of the fear state occurs very rapidly, thus precluding the involvement of inhibition. Moreover, a significant potentiation of the startle response was found in each of the later time probe conditions until 3800 ms after picture onset (Globisch et al., 1999). In contrast, the present study demonstrated that blood phobics, as well as controls, exhibited a lack of blink facilitation from 300 up to 4500 ms after the onset of the fear-related pictures (i.e., well beyond the prepulse region), as no difference in blink amplitude was found relative to neutral contents.

Blood stimuli did induce extreme activation of the aversive motivational system in phobic participants, as indicated by subjective ratings of greater unpleasantness and arousal than controls. Being that the activation of the aversive motivational system primes responses to aversive cues, the unexpected absence of startle potentiation in blood phobics might indicate that readiness for active defense is reduced in these individuals, possibly due to the inhibitory effect of attentional engagement. However, it has to be acknowledged that at long probe intervals (3500 and 4500 ms) acoustic startle facilitation has been also reported during attended visual stimuli (see Lipp et al., 1997). This latter effect is in line with the finding that other specific phobics show both startle potentiation (e.g., Globisch et al., 1999) and increased attention to phobic pictures, as indicated by larger ERP slow wave positivity as compared to neutral contents (e.g., Miltner et al., 2005). Therefore, the relative contribution of attentional and emotional processes to startle blink modulation is yet to be fully understood within the context of responding to blood stimuli. Still, a lack of clear-cut defensive response in blood phobics is consistent with their pattern of cardiovascular responding and their clinical symptoms. Indeed, an impaired vasomotor response is thought to make phobic individuals susceptible to an evolving circulatory crisis that leads to vasovagal faint (e.g., Sarlo et al., 2008). Obviously, such response does not support preparation for defensive action, and is rather associated with motor inhibition.

In conclusion, in the present study no evidence of startle eyeblink potentiation during the viewing of mutilation relative to neutral pictures was found at any of the probe times in both healthy and phobic participants. Moreover, blood phobics did not show the typical startle potentiation to fear-related stimuli relative to controls.

We acknowledge some limitations of the present study. The concurrent recording of other psychophysiological indices of defensive activation, such as heart rate and skin conductance, would help to clarify the motivational significance of both phobic and normal responses to blood stimuli. Moreover, the inclusion of a control group of participants with other specific phobias (e.g., spider phobia) along with the presentation of non-phobia-related disgusting materials (e.g., pictures of body products, rotting food, cockroaches) would better clarify the role of disgust in the affective modulation of the startle response. Finally, the selection of blood phobic individuals with more severe symptoms (e.g., those who experience recurrent fainting episodes) and/or with greater homogeneity in relation to the phobic object (e.g., blood vs. injection) might reveal whether startle potentiation emerges in specific subgroups of blood phobics.

References


