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The role of neuroticism in startle reactions to fearful and disgusting stimuli

Glenn D. Wilson[a,*], Veena Kumari[a], Jeffrey A. Gray[a], Philip J. Corr[b]

[a]*Department of Psychology, Institute of Psychiatry, University of London, De Crespigny Park, London SE5 8AF, UK*
[b]*Department of Psychology, Goldsmiths College, University of London, New Cross, London SE14 6NW, UK*

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Abstract

It has frequently been observed that negative moods potentiate the startle reflex to unexpected, threatening stimuli. However, recent work from our laboratory suggests that this effect relates primarily to the emotion of fear or anxiety, while stimuli which evoke powerful feelings of disgust can in some circumstances inhibit the startle reflex. In this study we reanalyse data from 42 subjects in whom eye-blink amplitudes to an auditory probe were measured whilst viewing emotionally arousing film clips. Classifying the negative film clips into separate categories of "frightening" vs "disgusting" revealed a previously undetected interaction with EPQ Neuroticism. High N subjects showed greater startle reactions than low N subjects under fearful conditions but low N subjects showed greater startle when disgust was evoked. This suggests that Neuroticism may increase vigilance where evasive action is possible but promote emotional blunting when escape is not an option.

1. Introduction

The startle reflex consists of a standard pattern of behaviours and physiological changes that occurs in both humans and animals in reaction to a sudden, aversive stimulus such as a pistol shot. For experimental purposes, the most easily measured component of the startle reflex is eye-blink amplitude, and this is known to be potentiated when subjects are probed during a

* Corresponding author. Tel.: +44-171-9193254; fax: +44-171-7083497.
E-mail address: g.wilson@iop.kcl.ac.uk (G.D. Wilson).

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state of anticipatory anxiety (Grillon, Ameli, Foot & Davis, 1993). Trait fearfulness has also been shown to potentiate eye-blink responses during viewing of aversive (as compared to neutral) slides (Cook, Davis, Hawk, Spence & Gautier, 1992). Therefore it might have been expected that subjects high on Neuroticism would also show greater startle increments to aversive stimuli than low N subjects. Corr, Kumari, Wilson, Checkley and Gray (1997) and Corr et al. (1995) report findings that are partly consistent with this hypothesis, using slides depicting unpleasant scenes such as mutilated bodies, angry faces and threatening weapons, and Cloninger's (1988) "Harm Avoidance" scale, which is a measure of trait anxiety. However, a study of the relationship between personality and startle modulation using emotionally toned film clips (Kumari et al., 1996) failed to find any relationship between Eysenck's personality factors and affective modulation of eye-blink amplitudes.

A possible explanation of this negative finding invokes the distinction between fear and disgust. Balaban and Taussig (1994) found that, although startle reflexes were enhanced by exposure to negatively affective slides, the effect was limited to slides that were frightening. Blinks during disgusting pictures did not differ from the neutral condition. A similar distinction between the effects of fearful vs disgusting stimuli was found in our own laboratory using film clip material (Kaviani, Gray, Checkley, Kumari & Wilson, 1999). Of the two unpleasant film clips tested, a scene from the film Miller's Crossing, in which gangsters drag a terrified victim into a forest in order to shoot him, produced reliable startle potentiation, whereas a gruesome, though clinical, demonstration of toe surgery taken from a medical education film showed a capacity sometimes to reduce startle responses. Affective ratings of the two clips revealed that the gangster clip was primarily rated as "anxiety/threat-evoking", while the toe surgery sequence was rated by most subjects as "disgusting". Kaviani et al. discussed the differing reaction to these two films in survival terms. They suggested that when the environment presents a threat that might be avoided by rapid evasive action (e.g. a predator or gunman stalking us in a forest) it is adaptive for vigilance to be sharpened (hence startle potentiation). However, when there is no choice but to endure an unpleasant circumstance, and indeed when sudden movement might make matters worse (as in undergoing a surgical procedure), then some form of emotional "blunting" is appropriate (hence startle inhibition).

In the light of this distinction in film stimuli we looked back on our previous data (Kumari et al., 1996) to see if relationships with Neuroticism may have been obscured. We had used four negative film sequences, two of which intuitively seemed to evoke fear, and two disgust. This study examines the possible interaction between N and startle responses under these different emotional conditions. The hypothesis was that N would relate to potentiated startle under conditions of fear but not under conditions of disgust.

2. Method

Subjects were derived from the sample of 42 normal volunteers (equal males and females) tested by Kumari et al. (1996). They were divided into low and high N according to scores on the Eysenck Personality Questionnaire (EPQ) (Eysenck & Eysenck, 1975). Splitting the original group at the median N score (and excluding those who scored exactly at the median of 11)

yielded groups of 18 (low N) and 17 (high N) respectively. Each subject was paid £5 for participation.

The equipment and procedure was also as described by Kumari et al. (1996). A computerised startle response monitoring system (SR-LAB, San Diego Instruments) was used to deliver startle probes (50-ms bursts of 100 dB white noise with fairly instantaneous rise time, presented binaurally through headphones) and to record and score eye-blinks. EMG activity of the orbicularis oculi of the right eye was recorded with two disk electrodes (Ag/AgCl, 6 mm cups) filled with Dracard electrode gel. The ground electrode was placed behind the right ear over the mastoid. The amplifier gain was kept at point 3 and there was no masking noise, this being replaced by the soundtrack of the film, consisting of narration, dialogue and frequently music (39–70 dB). EMG activity was recorded in arbitrary analogue to digital (A/D) units, with eye-blink amplitude being the measure of interest for present purposes. This was the mean of recorded responses, after eliminating trials on which no blink occurred and blinks deemed spurious on the basis of their time relationship to the stimulus probe.

Recordings were taken with subjects sitting in a dimly lit, sound-attenuated room approximately 6 feet from the video screen. Subjects were told they were going to be shown a series of film-clips, some depicting pleasant, and some unpleasant, events. They were instructed to view each clip for the entire time it was on the screen and to ignore the intermittent noises they would hear in the headphones. Each film clip was approximately 3 min in duration and all subjects viewed the entire selection of 12 film clips (4 unpleasant, 4 pleasant and 4 neutral) in the same balanced order. The EPQ was completed before the experiment.

The current analysis concerns only the four negative film clips. The two classified as fear-inducing were: (1) a sequence from Bram Stoker's Dracula in which Jonathan Harker approaches Dracula's Castle by coach and experiences various chilling hallucinations, and (2) a scene from Friday the Thirteenth in which a teenage couple petting in a loft are attacked by an unseen assailant who slashes them with a knife. The two film clips categorised as more disgusting than frightening were: (1) a scene from The Fly in which a scientist's face is seen to decay and disintegrate, and (2) a medical education film demonstrating shoulder surgery. Separate fear and disgust ratings were not available for these film-clips (they had all simply been rated as very ''unpleasant''). However, their content was judged to be comparable to those distinguished as fearful vs disgusting in the Kaviani et al. (1999) study and in order to check on our a priori grouping we were able to go back to 10 subjects from the original study (6 male and 4 female) and obtain ratings of ''frightening'' vs ''disgusting'' for the four video sequences.

3. Results

Affective ratings confirmed that the film-clips had been correctly classified. Mean ratings (on a 0–8 scale) were: *Dracula* fear 3.7, disgust 0; *Friday the Thirteenth* fear 4.0, disgust 0.9; *Shoulder surgery* fear 1.8, disgust 5.3; *The Fly* fear 2.5, disgust 5.8. These differences were so striking that no significance tests were thought necessary.

The results for startle responses are shown in Fig. 1. A two-way split-plot ANOVA (low/high Neuroticism and fear/disgust film types) revealed no main effects of Neuroticism,

$F(1,33) = 0.06$, ns, or film type, $F(1,33) = 1.34$, ns; but there was a significant interaction of Neuroticism × film type, $F(1,33) = 5.41$, $P < 0.05$. The locus of this interactive effect resided in the fact that the low Neuroticism group had stronger responses to disgust (M = 96.94) than fear (M = 64.94) (mean difference = 31.99, SEM = 14.64), $t(17) = 2.18$, $P < 0.05$. In contrast, the high Neuroticism group had stronger responses to fear (M = 79.76) than disgust (M = 69.04), (mean difference = 10.72, SEM = 10.78); this latter effect was not statistically significant. Although it might appear from Fig. 1 that the two "disgusting" film clips were not equivalent as regards the N effect, no such interaction achieved significance. Nor was there any significant difference between low and high N subjects for either fear or disgust stimuli taken separately.

4. Discussion

This study re-examined some earlier data from our laboratory that had failed to show any effect of Neuroticism on startle reflexes evoked during exposure to unpleasant film clips (compared with pleasant or neutral sequences). Dividing the unpleasant film sequences into those that were fearful vs those that were disgusting revealed a previously undiscovered relationship. Whereas the low Neuroticism subjects inhibited responses to fearful, relative to

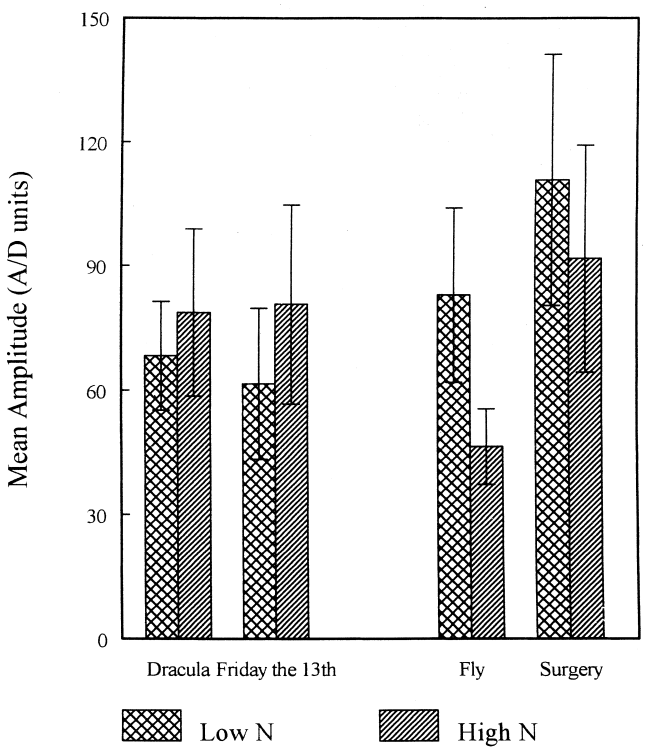

Fig. 1. Mean eye-blink amplitudes for subjects low and high on Neuroticism during exposure to four film sequences. The first two were categorised as fearful and the second two as disgusting. (Vertical bars represent SEMs.)

disgusting filmclips, this effect was absent in high Neuroticism subjects, who did not differentiate between the two types of negative films. Neuroticism thus appeared to potentiate startle under conditions of fear but reduce it under conditions of disgust. This adds support to a growing body of literature which points to an anatomical and functional distinction between these two emotions (Phillips et al., 1997; 1998; Sawchuk, Lohr, Lee & Tolin, 1999). This distinction presumably did not come to light in studies of the startle using slide stimuli (Lang, Bradley & Cuthbert, 1990) because results have traditionally been collapsed across large numbers of negatively toned slides most of which are fear relevant (e.g. snakes and spiders).

It is easy to see why N should promote extra vigilance in situations that are seen to be threatening. This is in accord with a great deal of previous research indicating a heightened sensitivity of high N individuals to anxiety-evoking stimuli, and may even define the trait of Neuroticism (Eysenck, 1992). What is more difficult to explain is why high N, compared with low N, individuals should "bury their heads" when confronted with disgusting images. Perhaps the answer is that high N people find negative stimuli generally more aversive than low N people, but that sensitisation is appropriate when effective action may still be possible, whereas defensive "blunting" will be adopted when it is not. This is one of the most striking distinctions between the two groups of stimuli described. If someone (or something) is in pursuit, then turning away and denying it is not a realistic option. However, something that is ugly can be minimised and something inevitable can be better endured by excluding it from consciousness as far as possible. Remaining hypersensitive to (disgusting) aversive stimuli might have deleterious long-term consequences such as impaired immune functioning and hence failing health. Blunting of emotions might be an evolved strategy to avoid this outcome, rather in the manner that endorphins function to counteract chronic, useless pain (Nesse & Lloyd, 1992). What Neuroticism seems to affect is the motivational power with which both these adaptive mechanisms operate in the face of aversive stimuli.

Comparing low and high Neuroticism groups in terms of overall amplitude levels should be treated with caution. Many factors complicate the interpretation of between-subject difference in EMG responses. Within-subject comparisons are much more meaningful. The fact that there were no statistically significant differences between low and high Neuroticism groups in response to either fear or disgust should not be interpreted as reflecting no fundamental differences. For example, arousal and anxiety can affect overall amplitude level, and it is possible that a process of transmarginal inhibition of response was operating in the high Neuroticism group, leading to a reduction in their general level of responding. Also anxious subjects may sweat more, further reducing startle amplitude by methodological artefact (e.g., reducing the effectiveness of the conducting electrode gel).

Note that in our data the disgusting clips actually evoked greater startle responses overall than the frightening clips (though not significantly so). The interaction between N and film-clip type is significant mainly because the low N group responded more to the disgusting than fearful clips. In the Kaviani et al. (1999) data, there appeared to be more of a suppression of response to the disgusting (toe surgery) clip across subjects generally. A clue as to the origin of this disparity may be found in the affective ratings (the frightening clip being more negative in the Kaviani study and the disgusting clips more aversive in the Kumari study, as evidenced by totalling the affective ratings for fear and disgust). In any case, the present study is based on a post hoc analysis and should be taken only as an indication that the distinction between

reactions to fearful vs disgusting stimuli is one that should be considered in future studies of individual differences in emotional reactivity.

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