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Disgust stimuli reduce heart rate but do not contribute to vasovagal symptoms

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ABSTRACT

Background and objectives: The vasovagal response demonstrates a unique form of stress response, common in medical settings yet provoked by a variety of blood-injury-injection stimuli. This study aimed to better understand the psychophysiological mechanisms of the vasovagal response..
Methods: 16 undergraduates with and 42 without a self-reported history of fainting watched five 3–5 min videos with different emotional content. One documentary clip (Neutral condition) described a campus environmental project while another (Blood/Injury) depicted portions of an open heart surgery. Three additional clips were also used, including Medical, Threat, and Contamination stimuli. Vasovagal symptoms and physiological variables were assessed during each video.
Results: As predicted, while the disgust-related stimuli (Blood/Injury, Medical, Contamination) were associated with generally lower heart rate, the Blood/Injury video produced the highest symptoms and the only significant difference between previous fainters and non-fainters. The physiological measures also revealed that participants with a fainting history experienced higher stroke volume and lower systolic blood pressure throughout, as well as several main effects of video.
Limitations: An additional decrease in systolic blood pressure and respiration produced by watching the Blood/Injury video may have been sufficient to trigger symptoms in some, though results also suggest that systemic variables do not entirely explain susceptibility to symptoms. More careful evaluation of regional blood flow may be required.
Conclusions: Participants who had previously experienced strong vasovagal responses displayed what appeared to be an anticipatory response to the Blood/Injury video. Finally, disgust stimuli may reduce heart rate but do not appear to contribute to vasovagal symptoms.

1. Introduction

Vasovagal responses produce a range of symptoms including weakness, dizziness, light-headedness, and sometimes fainting (France, Ditto, France, & Himawan, 2008; Lewis, 1932; Manolis, Linzer, Salem, & Estes, 1990; Zervou et al., 2005). These distressing responses have a significant impact on society with medical, psychological, social, and economic implications (Zurak & Bilic, 2004). The most common triggers are emotional events and stimuli (Brignole et al., 2004). At the same time, the psychological and physiological mechanisms of the vasovagal response remain poorly understood (Ritz, Meuret, & Ayala, 2010).

Though typical signs of a vasovagal response include decreases in blood pressure and heart rate (HR), it is an active stress-related response. Some aspects of sympathetic nervous system activity increase, including sympathetic stimulation of arterial β-receptors, contributing to vasodilation (Halliwill, Dietz, & Joyner, 1996). Other aspects of sympathetic activity decrease during vasovagal responses, most notably sympathetic vasoconstriction (Halliwill et al., 1996). On the other hand, the contribution of vagally-

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mediated HR deceleration to a decrease in blood pressure is less clear. In addition to earlier results showing a lack of an effect of atropine-induced parasympathetic inhibition (Lewis, 1932; Weissler et al., 1957), more recent studies have found that high frequency heart rate variability (HRV), reflecting vagally-mediated respiratory sinus arrhythmia (parasympathetic activity), was largely unchanged during vasovagal responses (Gerlach et al., 2006; Gilchrist & Ditto, 2015; Sarlo, Buodo, Munafo, Stegagno, & Palomba, 2008).

The psychological mechanisms of the vasovagal response are also not clear though one particularly important finding comes from the phobia literature. That is, fainting is not a general response to fear, even strong fear. Among people with especially strong fears (i.e., phobics), only those with blood-injection-injury (BII) fears have an elevated risk for fainting (Barlow, 2004). In fact, the lifetime prevalence of fainting among BII phobics is extremely high (Öst, 1992). Relatedly, vasovagal responses in clinical contexts have been linked to various medical, blood, injury, and injection stimuli (Ditto & Holly, 2009; Marks, 1988). Common denominators appear to be the rupturing of the body envelope and associated blood stimuli. Indeed, the importance of blood-related fears has become increasingly clear in recent studies (Ditto, Balegh, Gilchrist, & Holly, 2012; Ditto, Gilchrist, & Holly, 2012; Gilchrist & Ditto, 2012; Page & Tan, 2009).

The findings related to blood fears/body envelope violation are consistent with the idea that vasovagal responses can be triggered by feelings of disgust and associated decreases in HR and blood pressure (Exeter-Kent & Page, 2006; Page, Bennett, Carter, Smith, & Woodmore, 1997; Page, 2003; Page & Tan, 2009). However, the role of disgust has been debated and some have argued that the disgust–faint relationship is either mediated by or an artifact of the BII fear–faint relationship (Gerlach et al., 2006; Kleinknecht, Kleinknecht, & Thorndike, 1997; Olatunji, Sawchuk, de Jong, & Lohr, 2006).

That said, one limitation of much of this literature is that disgust has often been operationalized as an individual difference characteristic, disgust sensitivity, as opposed to a current emotion. As a result, similar to Rohrmann and Hopp (2008), one goal of the present study was to examine disgust as a current emotion and to compare patterns of cardiovascular response and emotional ratings of a commonly used disgusting video involving an encounter with a dirty toilet (Schaefer, Nils, Sanchez, & Philippot, 2010) and those produced by a "prototypical" vasovagal-response producing video involving open heart surgery (Ritz, Wilhelm, Gerlach, Kullowatz, & Roth, 2005). Similarly, another limitation of previous research has been the lack of non-stressful and stressful but not disgusting comparison stimuli which might help reveal disgust specific activity. Therefore, another goal was to compare responses to the disgust-inducing videos with those elicited by a typical chase-scene fear-inducing video, a medically-related fear-inducing video, as well as an initial non-emotional control video. In a recent quasi-naturalistic study of vasovagal reactions in blood donors (Gilchrist & Ditto, 2015), we found that individuals who experienced vasovagal symptoms during or just after the procedure displayed significantly greater reductions in total peripheral resistance as they approached the chair. That is, knowledge of upcoming exposure to a BII stimulus seems to have induced a prodromal response in some who developed symptoms. As a result, we thought it important to include a non-emotional baseline video. Finally, since it was thought that the physiological and emotional correlates of vasovagal responses might be more clearly observed among individuals with a history of vasovagal reactions, another focus of this study was differences between participants with and without a history of fainting. There is limited research on this topic (Ritz et al., 2010), though Vögele, Coles, Wardle, and Steptoe (2003) found that people with a fainting history, compared to those without, experienced higher anxiety and lower blood pressure following a film of a surgery.

In sum, the current study aimed to examine the psychological and physiological mechanisms of emotion-related vasovagal responses. Hemodynamic indices such as impedance cardiography have rarely been used in the exploration of BII-related vasovagal symptoms (Sarlo et al., 2008). Therefore another aim of this study was to examine autonomic and cardiovascular measures derived from impedance cardiography. It was expected that participants with a history of fainting would have end-organ functioning associated with vasodilation when exposed to stimuli related to blood. It was also expected that a video depicting blood stimuli would result in more vasovagal symptoms than a video depicting other related stimuli: a medical intervention, contamination-related disgust, or threat of injury. Also, blood fears were expected to be the strongest fear-related predictor of vasovagal responses.

2. Method

2.1. Participants and experimental conditions

Sixty young adult community and undergraduate volunteers participated in a study examining 'the psychophysiology of emotion'. Individuals who reported any neurological or cardiovascular illness, hearing or vision problems, or English not as a first or second language were not eligible for the study. In order to obtain clear physiological measures, participants were asked to refrain from vigorous physical activity on the day of the study and to avoid caffeine for 4 h and smoking for 2 h prior to the experiment. Data from one participant had to be excluded due to technical reasons. Necessary precautions were taken to avoid participants from fainting. As such, another participant withdrew during the surgery video and no participant fainted. The remaining 58 participants were 74% female and aged 18–30 years ($M = 22$, $SD = 3.2$ years), 16 with (75% female; $M = 22$, $SD = 3.2$ years) and 42 without (74% female; $M = 22$, $SD = 3.3$ years) a self-reported history of fainting. Participants watched five videos with different emotional content.

2.2. Materials

2.2.1. Stimulus videos

Five 3–5 min videos were presented on a 17-inch computer screen placed 1 m in front of the participant. A video describing a campus sustainability projected served as the Neutral (control) stimulus. A heart surgery video (Ritz et al., 2005) served as the Blood/Injury stimulus. A scene from the movie *The Exorcist* (Blatty & Friedkin, 1973) was used as the Medical stimulus. In this video, a doctor first gives an injection to a young girl and inserts a catheter in her neck in a stressful medical scene. The Contamination stimulus was a scene from the movie *Trainspotting* depicting images of a dirty toilet, known to elicit contamination-related disgust, commonly used in disgust-related research (e.g., Schaefer et al., 2010). A scene from the movie *The Shining*, in which a man chases his wife and his child wielding an axe, served as the Threat stimulus (Schaefer et al., 2010). As a manipulation check, after each video the participant were asked to indicate on 7-point scales the degree to which they experienced disgust, fear, and emotional intensity, from 1, 'not at all', to 7, 'extremely'.

2.2.2. Blood donation reactions inventory (BDRI)

Vasovagal symptoms were assessed with the BDRI. This survey includes ratings of faintness, dizziness, lightheadedness, and weakness (France et al., 2008; Meade, France, & Peterson, 1996). Consistent with recommendations from previous research and to