J Behav Med (2012) 35:393–399
DOI 10.1007/s10865-011-9366-0

Fear-related predictors of vasovagal symptoms during blood donation: it's in the blood

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Received: October 18, 2010 / Accepted: June 20, 2011 / Published online: July 13, 2011

Abstract A recent theory proposes that emotional fainting developed from an earlier adaptive characteristic, fainting in response to hemorrhage. Despite potential loss of consciousness, a dramatic decrease in blood pressure improves chances of survival in animals with severe wounds by reducing blood loss and facilitating clotting. Humans may have developed the characteristic of emotional fainting as a response to anticipated blood loss. This idea suggests that people with stronger fears of blood should be especially susceptible to fainting and milder vasovagal symptoms such as dizziness and lightheadedness. Two samples of young adult blood donors (N = 276 and 663) who completed the Medical Fears Survey (MFS) were studied. Items from the MFS related to fears of blood, needles, and mutilation were used to predict self-reported dizziness and nurse-initiated treatment for vasovagal reactions. In both samples, fears of experiencing or seeing blood loss were more closely associated with both subjective and objective measures of vasovagal reactions, despite the fact that other fears (e.g., fears related to needles) were more common overall. Better understanding of the mechanisms of vasovagal reactions has both theoretical and clinical implications, such as improving means of coping with invasive medical procedures.

Keywords Vasovagal reaction · Emotional fainting · Dizziness · Blood loss · Hemorrhage

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Introduction

"*Then the horror overcame me, and I sank down unconscious*" (Bram Stoker, *Dracula*, 1897). Even a casual examination of literature and popular culture, from Edgar Allan Poe to the Twilight series, reveals a fascination and fear of blood loss. This may provide an important clue in understanding one of the most longstanding and difficult puzzles in behavioral medicine, that is, the origins and mechanisms of emotional fainting (syncope). Emotion-related syncope is difficult to explain from a number of perspectives, including sociobiological (Ditto & Holly, 2009). For example, the adaptive value of weakness and loss of consciousness for an animal faced with a potentially life threatening situation is questionable. While some have linked emotional fainting to the idea of "playing dead" in animals, the comparison is inexact as these responses do not include actual loss of consciousness (van Dijk, 2003). Bracha (2004) presents a more convincing variation of the idea arguing that this distinctly human response allowed survival of vulnerable people (e.g., women and children) in early warfare. An actual loss of consciousness was necessary to sufficiently feign death given the more observant nature of human predators who might detect subtle glances or trembling in people trying to freeze.

This theory also does a good job bridging the link between fainting and modern-day blood, injection, and injury (BII) phobias. As noted by many (Connolly et al., 1976; Ost, 1992; Page, 1994; Thyer et al., 1985) syncope is common among BII phobics but rare among those with social phobias, etc. On the other hand, there some difficulties with Bracha's view such as the fact it assumes genetically-based change of very fundamental hemodynamic processes late in human evolution and a focus on major trauma as opposed to blood loss. That is, the prototypical stimulus for emotional fainting is

presumably the approach of a large warrior with a large weapon likely to inflict large damage. Yet fainting is just, if not more, likely to be elicited by the prospect of a small puncture or clean cut as major trauma. Returning briefly to the genre of literary horror, authors have known for years that needles and knives are especially evocative. An epidemiological example comes from Ganzeboom et al. (2003) who found that 39% of a group of medical students reported at least one lifetime incident of syncope. While many noted multiple triggers such as standing and being in a warm room, 39% who fainted said some combination of venipuncture and seeing blood was involved. The most common causes of fainting in medical settings are procedures such as immunization (Braun et al., 1997; Sutherland et al., 2008) and, in particular, blood draws and blood donation (Callahan et al., 1963; Graham, 1961; Kleinknecht et al., 1996).

Diehl (2005) recently suggested an idea that is similar to Bracha's in some respects yet simpler in that it builds on the well-documented process of hemorrhagic fainting. In general, blood loss greater than 30% of total volume elicits fainting across species. It has been known for many years that this is not due to blood loss in and of itself but an active volume-related reflex that triggers abrupt heart rate deceleration and vasodilation that, in addition to blood loss, create a large decrease in blood pressure and cerebral perfusion (Evans et al., 2001; Schadt & Ludbrook, 1991). Diehl's contribution is the suggestion that the reflex is an adaptive attempt to lower blood pressure to prevent further blood loss, increase the speed of clotting and the chances of surviving the injury.

Although hemorrhagic fainting and vasovagal syncope are often classified as different types of fainting (Hainsworth, 2004) the physiology is similar and Diehl suggests that the latter may have developed from the former as a response to *anticipated* blood loss. This matches the types of stimuli likely to elicit fainting noted above. Further, some results suggest that fainting and other less severe vasovagal symptoms are more closely associated with the idea of blood loss as opposed to physical injury, though the two notions are difficult to disentangle. Kleinknecht et al. (1996) developed a particularly useful instrument called the Medical Fear Survey (MFS) that includes items related to a variety of medical procedures (e.g., receiving an injection in the arm, receiving stitches) and stimuli (e.g., seeing a large bottle of your blood, seeing a bleeding wound to a person's eye). Reflecting the general association between BII phobias and fainting, total score on the MFS was associated with self-reported lifetime history of fainting (Kleinknecht et al., 1996). More interesting, both Kleinknecht et al. (1996) and Labus et al. (2000) examined fainting in relation to specific factor scores. In the first case, score on a factor reflecting specific blood-related items such as "seeing a large bottle of human blood" significantly distinguished fainters and non-fainters whereas factor scores related to cutting objects (e.g., knives) and deformity (e.g., seeing someone with a missing leg) did not. However, a factor score composed of various needle-related fears was even more strongly related to history of fainting, suggesting that fear of blood may not be the key issue. On the other hand, the "needle" factor in this study as well as the one by Labus et al. (2000) included items associated with fear of blood loss such as "having blood drawn from your arm" and "seeing blood being drawn from someone's arm". Rather than trying to interpret the meaning of factor scores, the present study examined the relative importance of individual MFS items in predicting vasovagal symptoms. Another contribution of the present study is that vasovagal symptoms were not assessed in terms of reported lifetime prevalence but immediately after exposure to a specific activity that often produces symptoms, that is, blood donation. It was predicted that vasovagal symptoms would be more closely associated with fears related to the sight or experience of blood loss than other medical fears.

Method

Participants

Results from two samples of young adult blood donors are presented. Sample 1 (N = 276) comes from a recent study conducted primarily to compare the effects of the muscle tensing technique, Applied Tension (AT), on blood donation-related symptoms depending on whether AT is performed before or during blood donation. Archival data from another study of AT (Ditto et al., 2003) in which the MFS was administered were also examined (Sample 2, N = 726). In both cases, donors were recruited in mobile blood clinics held in colleges and universities. Potential participants for Sample 1 were excluded if they had given blood on more than 10 prior occasions. To make the two samples comparable in this respect, these more experienced donors were also dropped from Sample 2 yielding 663 participants. As would be expected in this environment, participants were young ($X = 20.5 \pm 2.8$ and 21.0 ± 4.2 years, respectively), fairly inexperienced ($X = 1.7 \pm 2.1$ and 2.1 ± 2.4 previous donations, respectively) donors with a slight predominance of women (54 and 61%, respectively). Common medical fears in these groups are noted in Table 1.

Procedure

Participants were recruited just before they registered at a mobile blood clinic organized by the provincial blood supplier, Héma-Québec, and completed a brief pre-donation

Table 1 Highest rated fears within category (M ± SD)

Sample 1	
Needle-related fears	
1.1 (1.1)	Receiving an anesthetic injection in the mouth
0.8 (1.1)	Observing someone getting their finger stitched
0.7 (0.9)	Receiving a hypodermic injection in the arm
0.6 (0.9)	Having blood drawn from your arm
Blood-related fears	
0.4 (0.8)	Seeing a large bottle of your own blood
0.4 (0.8)	Seeing a large bottle of human blood
0.3 (0.7)	Seeing a large beaker of animal blood
0.2 (0.7)	Seeing a large bottle of human blood on tv
Mutilation-related fears	
1.9 (1.3)	Seeing the remains of bodies following an airline crash
1.7 (1.2)	Seeing a bleeding wound to a person's eye
1.7 (1.3)	Observing a surgical amputation
1.6 (1.2)	Seeing the mutilated body of a dog that has been run over by a car
Sample 2	
Needle-related fears	
1.3 (1.0)	Receiving an anesthetic injection in the mouth
0.8 (1.0)	Seeing someone receiving an injection in the mouth
0.8 (1.1)	Observing someone getting their finger stitched
0.8 (0.8)	Receiving a hypodermic injection in the arm
Blood-related fears	
0.5 (0.8)	Seeing a large bottle of your own blood
0.4 (0.8)	Seeing a large beaker of animal blood
0.3 (0.7)	Seeing a large bottle of human blood
0.3 (0.6)	Observing blood pulse through a vein
Mutilation-related fears	
1.9 (1.2)	Seeing a bleeding wound to a person's eye
1.9 (1.3)	Seeing the remains of bodies following an airline crash
1.7 (1.3)	Seeing the mutilated body of a dog that has been run over by a car
1.7 (1.2)	Observing a surgical amputation

questionnaire focusing on demographic variables. The study was presented as an investigation of a technique, Applied Tension, that may or may not ease the blood donation experience. The effects of the interventions are discussed elsewhere (Ditto et al., 2003; Holly et al., 2011). Consistent with the random assignment of participants to groups, preliminary analyses revealed no associations between experimental conditions and medical fears, supporting the use of these data to examine possible links between different medical fears and vasovagal symptoms.

After recruitment, participants who did not learn AT passed immediately through the typical blood donation procedure involving medical screening, venipuncture with a 16 gauge needle, and withdrawal of 450 ml of blood while in a semi-reclined position. Those asked to learn AT watched a brief, 2-min video and were told to practice this technique involving repeated five-second cycles of isometric muscle tension at different points in the blood donation procedure. More details can be found in Ditto et al. (2003) and Holly et al. (2011). After the procedure, all donors are required to remain in the clinic for about 20 min and encouraged to eat and drink. At the beginning of this period vasovagal symptoms were assessed with the Blood Donation Reactions Inventory (BDRI), a well-validated 11-item survey requesting ratings of symptoms such as dizziness, lightheadedness, and weakness (Meade et al., 1996). It was decided to focus on presyncopal symptoms since, consistent with previous research, full faints were fairly rare, occurring in 3% of participants in both Samples 1 and 2. That said, in addition to BDRI scores, it was also possible to obtain an objective measure of vasovagal symptoms in the form of chair reclining. The primary treatment for a donor who displays evidence of a vasovagal reaction is elevation of the legs by reclining the chair further. This is usually done by a nurse with extensive experience in blood collection and donor reactions. Except for their direct observations, the nurses who interacted with participants were unaware of any personal characteristics such as their fear ratings.

As part of the post-donation packet, participants completed a slightly abbreviated 30-item version of the MFS was administered consisting of the 10 needle-related items, the 10 blood-related items, and the 10 mutilation-related items. One potential limitation of the study is that participants completed this questionnaire after blood donation as opposed to before. However, these were "trait" as opposed to "state" ratings of fear and the key question was not the magnitude of the predictive relationship between items and vasovagal symptoms *per se*, but the relative associations between vasovagal symptoms and different types of fears. Each situation was rated on a 0–4 scale of the degree to which it elicits "no fear or tension at all" to "terror".

Data analyses

A recent factor analysis of the BDRI revealed four items that reflect the primary vasovagal experience: dizziness, weakness, faintness, and lighheadedness (France et al., 2008). Ratings of these items were summed and log-transformed. Regression equations predicting BDRI symptom scores were conducted. To stay as close as possible to the raw data and avoid confusion due to interpretation of factor scores, all 30 individual log-transformed MFS items were viewed as potential predictors along with the possible confounding variables of age, sex, previous blood donation experience, and Applied Tension condition. To identify the variables most strongly associated with

symptoms stepwise regression analyses were conducted. Age, sex, previous blood donation experience, and Applied Tension condition were forced into the model first followed by the fear-related variables in order of importance. Both samples were large, allowing the use of a number of predictor variables in regression equations. Nevertheless, to reduce the number of variables in the equations, only predictors demonstrating a significant association ($P < 0.01$) with the dependent measure in preliminary univariate analyses were entered. This means that in each case there were at least 15 participants per predictor variable, generally viewed as a good ratio of predictor variables to sample size. To examine relations between dichotomous outcome variables such as the presence or absence of chair reclining logistic regression equations were calculated using the same predictors. Finally, to determine whether the pattern of fear-related predictors was associated with sex, separate analyses were also conducted using data from men and women.

Results

Sample 1

BDRI results

All bivariate correlations between BDRI ratings of dizziness and individual fear items were positive, ranging from r = 0.30 for BDRI and "seeing blood being drawn from someone's arm" to r = 0.05 for BDRI and "seeing photos of wounded soldiers from war".

In the regression equation, both sex (standardized $B = 0.25$, $P < 0.001$) and previous blood donation experience (standardized $B = -0.19$, $P = 0.002$) were associated with BDRI score (results concerning the effects of Applied Tension in these samples can be found in Ditto et al., 2003; Holly et al., 2011). Women and less experienced donors reported more vasovagal symptoms than men and more experienced donors. However, rating of fear of "seeing blood being drawn from someone's arm" (standardized $B = 0.25$, $P < 0.001$) predicted BDRI over and above these variables, condition, and age. The only other predictor that approached significance was the person's rating of how disturbed they would be by "seeing a bleeding wound to a person's eye" (standardized $B = 0.11$, $P = 0.052$).

While the results of separate regression equations conducted using the data from men and women were not identical, they reinforce the importance of fear of blood loss. In men, the significant predictors of BDRI score after entry of demographic variables were fear of "having blood drawn from your arm" (standardized $B = 0.32$, $P = 0.001$) and "seeing a bleeding wound on a person's arm" (standardized $B = 0.22$, $P = .019$). In women, the only significant predictor of BDRI after the demographic variables was fear of "seeing a large bottle of your own blood" (standardized $B = 0.26$, $P = 0.002$).

Chair reclining results

In the logistic regression equation predicting chair reclining in all participants, the only significant fear-related predictor was "seeing blood being drawn from someone's arm" (OR = 4.55, 95% CI = 1.97–10.51, $P < 0.001$). The frequency of chair reclining in relation to sensitivity to seeing blood draws is displayed in Fig. 1.

In logistic regression equation predicting chair reclining in men, the only significant fear-related predictor was "having blood drawn from your arm" (OR = 27.43, 95% CI = 1.76–42.37, $P = .018$). In women, the only significant fear-related variable was "seeing blood being drawn from someone's arm" (OR = 3.84, 95% CI = 1.56–9.44, $P = 0.003$).

Sample 2

BDRI results

All bivariate correlations between BDRI ratings of dizziness and individual fear items were positive, ranging from r = 0.37 for BDRI and fear of "having blood drawn from your arm" to r = 0.06 for BDRI and "seeing photos of wounded soldiers from war".

In the regression equation, both experience (standardized $B = -0.20$, $P < 0.001$) and sex (standardized $B = 0.08$, $P = 0.039$) were associated with BDRI score. However, rating of fear of "having blood drawn from your

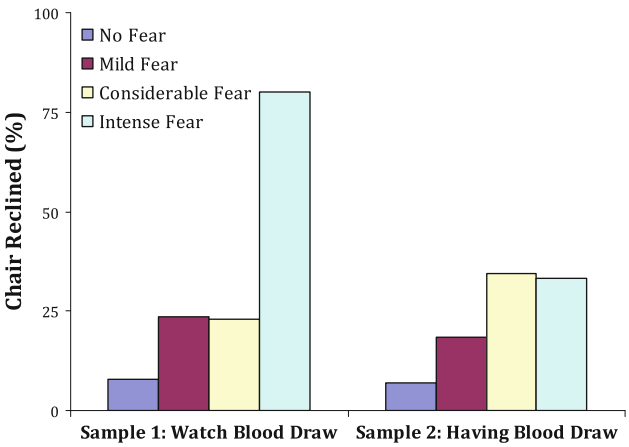

Fig. 1 Nurse-initiated treatment for vasovagal symptoms (chair reclining) in relation to donor fears

arm" predicted BDRI over and above the demographic variables (standardized $B = 0.34$, $P < .001$). Continuing this focus on blood, the other significant predictors of vasovagal symptoms were fear of "seeing a small vial of your own blood" (standardized $B = 0.17$, $P < .001$) and fear of "seeing a large bottle of your own blood" (standardized $B = 0.11$, $P = 0.010$), respectively.

The results of separate regression equations conducted using the data from men and women were similar. In men, the significant fear-related predictors of BDRI score were "having blood drawn from your arm" (standardized $B = 0.34$, $P < .001$) and "seeing a large bottle of your own blood" (standardized $B = 0.20$, $P = .001$). In women, the significant variables were "having blood drawn from your arm" (standardized $B = 0.34$, $P < .001$), "seeing a small vial of your own blood" (standardized $B = 0.21$, $P < .001$), and "observing someone getting their finger stitched" (standardized $B = 0.12$, $P = 0.015$).

Chair reclining results

The only fear-related predictor was fear of having blood being drawn from one's arm (OR = 3.70, 95% CI = 2.15–6.38, $P < 0.001$; Fig. 1). Identical results were obtained in the separate analyses of data from men and women (OR = 5.21, 95% CI = 2.00–13.58, $P = .001$ and OR = 2.54, 95% CI = 1.25–5.18, $P = 0.010$, respectively).

Discussion

Consistent with previous research in volunteer blood donors, who might be expected to be less susceptible to vasovagal reactions than the general population, outright faints were rare. However, the majority in both samples reported at least some symptoms on the BDRI. And the results support the hypothesis that to the extent fears were related to vasovagal symptoms, they are fears related to blood. Of course, other factors are involved in vasovagal symptoms in the blood clinic, such as actual blood loss.

On one hand, the conclusion about fears seems obvious—people who are afraid of blood are more susceptible to vasovagal symptoms in a blood donation environment. On the other hand, it is important to note that symptoms were *not* strongly associated with a number of other fears, even those that were much more common (Table 1). It is especially interesting that vasovagal symptoms were not strongly related to fears of needles. Even though they were probably less fearful of needles than the general population, participants' needle-related fears were significantly stronger than fears related to blood. Indeed, the fairly large needle used in blood donation is probably the most salient aspect of the procedure. Surveys of prospective blood donors often indicate that the needle is a disincentive to give blood (Bartel et al., 1975; Sojka & Sojka, 2008). Fear of blood is rarely mentioned. Yet within the clinic, variations in sensitivity to blood-related stimuli were more predictive of vasovagal symptoms than sensitivity to being pierced by a needle.

The associations between fear of blood and chair reclining provide additional support for the idea. As noted above, clinic nurses are experienced in recognition of vasovagal symptoms and the primary intervention is elevation of the legs vis-à-vis the torso. The chair reclining results provide some objective evidence of an association with fear of blood. Further, while the standardized regression coefficients related to BDRI scores are modest, the odds ratios related to chair reclining indicate sizable effects.

Obviously, the present data provide no insight into the origins of the fears reported in this research. It may be interesting to note that the Medical Fears Survey is a descendant of the traditional Fear Survey Schedule and using data from a large twin sample, we previously observed evidence of significant heritability in most fears on the questionnaire but especially those related to injury and death (Rose & Ditto, 1983). This idea is not original—this paper included a reference to Hall, (1897) conclusion that "there is a peculiar prepotent quality about some of these fears that suggests some such ancient origin" (p. 245).

In addition to the origins of such fears, it will also be interesting to examine the possible links between these findings and the emotion of disgust in future research. Several authors have argued that the unique susceptibility of blood and injury phobics to fainting is related to the involvement of disgust in BII phobias (Page, 1994; Sawchuk et al., 2002; Tolin et al., 1997). There is psychometric and psychophysiological support for this idea, in particular the association of disgust with parasympathetic activity (Levenson, 1992). On the other hand, the idea is complex and there is a detailed literature about issues such as the different types and manifestations of disgust, comorbity with BII fears, etc. (e.g., Cisler et al., 2009; Woody & Treachman, 2000). Obviously, exposure to many disgusting stimuli, such as food-related disgust, is not associated with fainting. In a structural equation modeling study, Kleinknecht et al. (1997) found that after controlling for levels of BII fears, the association between disgust and fainting disappeared. Olatunji et al. (2006) obtained a similar result though following Page's (Page, 2003) suggestion that susceptibility to disgust may amplify the effects of exposure to BII stimuli, they also found support for a model that disgust sensitivity may predict BII fear

which then in turn predicts fainting. Thus, a more general susceptibility to disgust may increase susceptibility to fainting by increasing reactions to blood-related stimuli. Alternatively, the association of disgust with fainting may spring from the link between sensitivity to blood and fainting. Better understanding of these issues awaits further research.

A different but not incompatible perspective is Engel's (1978) classic suggestion that emotional fainting is the result of simultaneous activation of physiological processes promoting "fight or flight" and those of "conservation-withdrawal". While some aspects of this creative theory, in particular, the proposed link with sudden cardiac death have not been supported, the idea of conserving blood may be a useful way to operationalize the theory. Is a weaker version of the hemorrhage reflex elicited by stimuli that suggest upcoming blood loss, such as the approach of a phlebotomist with syringe? Are similar processes elicited by stimuli more removed from the idea of immediate personal blood loss such as seeing a pool of blood? Diehl's (Diehl, 2005) proposal provides an interesting framework for future research on vasovagal syncope that is biologically plausible and consistent with a number of experimental and epidemiological results.

Acknowledgments This research was supported by grants from the Canadian Institutes of Health Research and the Canadian Blood Services. The assistance of Hema-Quebec is gratefully acknowledged.

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