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Selection of Key Stressors to Develop Virtual Environments for Practicing Stress Management Skills with Military Personnel Prior to Deployment

Stéphane Bouchard, Ph.D.,^{1,2,3} Oliver Baus, Ph.D. (C),^{2,3} François Bernier, Ph.D.,⁴
and Donald R. McCreary, Ph.D.⁵

Abstract

Virtual environments (VEs) are presently being used to treat military personnel suffering from posttraumatic stress disorder (PTSD). In an attempt to reduce the risk of PTSD, VEs may also be useful for stress management training (SMT) to practice skills under stress, but such use necessitates the development of relevant stress-inducing scenarios and storyboards. This article describes the procedures followed to select which VEs could be built for the Canadian Forces. A review and analysis of the available literature and of data collected post-deployment from 1,319 respondents on the frequency of stressors and their association with psychological injuries were pulled together to propose eight potential virtual stressors that can be used to practice SMT: seeing dead bodies or uncovering human remains; knowing someone being seriously injured or killed; receiving artillery fire; being unable to help ill or wounded civilians because of the rules of engagement; seeing destroyed homes and villages; clearing and searching homes, caves, or bunkers; receiving small-arms fire; and participating in demining operations. Information reported in this article could also be useful to document traumatic stressors experienced in theater of operations and their potential impact on psychological injuries.

Introduction

EXPOSURE TO AN INCIDENT in which an individual encounters severe physical harm or a life-threatening occurrence can lead to significant psychological distress. Posttraumatic stress disorder (PTSD) is the most frequent mental disorder that may develop following a traumatic event. It includes symptoms of anxiety, arousal, dissociation, or flashbacks and affects between 1% and 14% of the general population. At-risk individuals, such as combat veterans and victims of natural disasters or criminal violence, have an exceedingly high prevalence rate of PTSD symptoms, ranging from 3% to 58% within 3 months of a trauma.¹ According to Hoge et al.'s data, the number of soldiers at risk for mental disorders increased from 9% to 16.6% for those who have returned 3 to 4 months postdeployment, often experiencing symptoms of "shell shock" or other traumatic experiences from their active duties.² In a further study through a U.S. Department of Defense screening, 20.3% of soldiers and 42.2% of reserve soldiers returning from Iraq require mental

health treatment.³ The fifth report of the Mental Health Advisory Team,⁴ based on 2,195 U.S. soldiers deployed in Iraq and 699 in Afghanistan in 2007, using self-report measures, reports that 6.9% of the Iraq-deployed sample scored positive for depression (8.8% for those deployed in Afghanistan), 7.3% for anxiety (8.3% for those deployed in Afghanistan), 15.2% for PTSD (13.3% for those deployed in Afghanistan) and 17.9% for any behavioral problem (17.0% for those deployed in Afghanistan). Other U.S. studies report similar estimates, with slightly different cohorts of deployed or recently deployed personnel, ranging from 14% to 16.6%.^{2,4}

Information has been published on variables associated with mental health of military personnel, while they were in garrison, based on information collected in 2002 on 5,155 regular Canadian Forces members and 3,286 reserve force members.⁵ A significant strength of this study is that PTSD was assessed with a reliable structured interview as opposed to estimates based on cutoff scores from self-report measures. However, Sareen et al.'s data⁵ was not gathered specifically with deployed or recently deployed personnel but rather

¹Université du Québec en Outaouais, Gatineau, Québec, Canada.

²Laboratoire de Cyberpsychologie de l'UQO, Gatineau, Québec, Canada.

³University of Ottawa, Ottawa, Ontario, Canada.

⁴Defence Research and Development Canada—ValCartier, ValCartier, Québec, Canada.

⁵Defence Research and Development Canada—Toronto, Toronto, Ontario, Canada.

reflect the mental health of military personnel in the last 12 months as measured while they were on their base in Canada. Only 34% of them had been in combat or peacekeeping missions. The 1-year prevalence of the four most common mental disorders was 6.9% for major depression, 4.8% for alcohol dependence, 3.2% for social phobia, and 2.3% for PTSD. PTSD prevalence increases by exposure to combat, to peacekeeping operations, or to seeing atrocities or massacres, with increases in the magnitude of 2.1-, 1.15-, and 4.33-fold respectively. Rates of PTSD among military personnel may differ in other countries (e.g., 4% for the United Kingdom's 2003 deployment in Iraq⁶), depending on the nature of the work performed and the context of the mission.

Since Killgore et al. found that soldiers who have prior combat experience report more somatic than affective complaints,⁷ it is possible that levels of significant distress are even higher than estimates of PTSD. Sareen et al. added that the diagnosis of PTSD in their Canadian sample was essentially the only mental disorder significantly associated with combat and/or peacekeeping missions and that most other mental health problems found in this sample were attributable to a wide range of putative risk factors.⁸ Participating in both combat and peacekeeping missions appears to have a greater negative impact on mental health than does exposure to combat or peacekeeping only.⁸

Military personnel in peacekeeping missions are subject to several stressors as well, including potentially traumatic events. Out of 2,947 U.S. peacekeepers deployed to Bosnia-Herzegovina, 74% reported being exposed to at least one such event.⁹ In that sample, the mean number of potentially traumatic events peacekeepers were exposed to was 2.38. About 5.9% of these peacekeepers appeared to meet the DSM-IV's PTSD criteria.

Ehlers and Clark, as well as Halligan et al., proposed a very interesting model of PTSD. In a nutshell, several factors lead to a poor integration of the traumatic event in autobiographical memory and to a negative appraisal of the trauma and its consequences.^{10,11} Behavioral and cognitive avoidance further contribute to prevent memory and emotional integration of the event as well as more adaptive appraisal.^{10,12} The posttraumatic symptomatology is reported to vary as a function of several interacting variables,^{10,13,14} including the characteristics of the stressor, variables specific to the victim, subjective response to the stressor, and the response of others to the victim.

One potential way to mitigate the effects of operational deployment on the psychological well-being of military personnel who deploy on combat or peacekeeping is to teach them validated stress management techniques. Training in stress management is important because, among other reasons, it has a strong impact on performance in situations requiring emotional, cognitive, and behavioral control such as military operations.¹⁵ It is hoped that stress management training (SMT) can contribute to building resilience and preventing psychological injuries, including PTSD. However, traditional SMT strategies may need to be modified to fit with what is called in the military context "mental readiness training," where the classical cognitive-behavior strategies are adapted to the military culture and delivered by people with operational experience and credibility.^{15,16} Enhancing mental readiness involves training military personnel to be more efficient in psychological coping skills to control their emotions, cognitions, and behaviors.^{15,17}

Simply teaching general coping skills during lectures may not be sufficient to lead to effective stress management. Like any behavioral skill, learning in theory how to use coping strategies may transfer poorly to actual behavior change in stressful situations. Practice is needed, and virtual reality (VR) appears to offer interesting possibilities to facilitate practice in stressful situations.¹⁸⁻²⁰ The basic principle for effective learning of coping skills is to first teach and explain the strategies. That can be done in a group format and can be formulated in different ways that target various audiences, from policymakers to soldiers. However, the next step is to practice coping skills in simple situations and then progress to increasingly stressful and potentially traumatic events, using VR. The user can, at his or her own pace, move through the stressful scenarios and learn to master the required stress management strategies. VR-based training would offer the opportunity for the infusion of mental readiness training principles as the scenario unfolds and reinforce the lessons learned in courses, videos, and classroom simulations. Trainers could also better tailor the training situations to the specific needs of each trainee. It is then expected that trained military personnel will transfer these skills and apply more efficiently the stress management strategies while facing stressful and potentially traumatic situations during deployment.

However, prior to testing the efficacy of such a program, careful consideration must be given to the types of VR scenarios to be designed for such a purpose. Developing a virtual environment (VE) is a lengthy and costly process. It involves several technical steps:²¹ analyzing tasks/users in the early preparation stage, specifying concept design and storyboarding, building the VE, implementing and then evaluating the VE and its effectiveness, and training the user. Thus, before creating a storyboard of what will happen to the user and what tasks must be performed, the choice of the VE must be carefully planned. For the treatment of PTSD with in vitro exposure, researchers and clinicians may interview people suffering from PTSD and veterans to find frequent and relevant traumatic stressors. The approach is slightly different with primary prevention. One option is to develop VE adapted to specific populations such as medical personnel²² or coastguards.²³ In this case, the VE has the advantage of being tailored to the specific tasks to be performed. But as VEs become more situation-specific, the number of potential users decreases. If, in order to practice SMT skills, the aim is to develop a VE that is both stressful and applicable to a wide range of military personnel, researchers and clinicians may need to look for more generic stressors. Any type of virtual stressors might be developed to practice SMT, such as aiming at a threatening and moving target, but it would be more appealing clinically if strategies to control emotions, cognitions, and behaviors could be repeatedly practiced to cope with stressors that might be traumatic. People could practice their SMT skills during the situations in which they would most need them. At the same time, it is important to develop stressors that are not so strong that they could psychologically injure the trainees.

This work reports on the procedures followed to identify several stressful situations that could be used in VEs designed to train military personnel in stress management techniques. The aim was to list VEs that are significantly stressful, specific enough to allow reducing the likelihood of developing PTSD,

and generic enough to apply to a large number of military personnel involved in the current theater of operation (i.e., Afghanistan). This challenge was addressed by integrating knowledge from three sources: (a) published information on subjective characteristics of stressors associated with PTSD; (b) the objective characteristics of stressors associated with PTSD, including the frequency of occurrence of specific military stressors; and (c) analysis of new data on combat experience among Canadians and potential association between some stressors and mental health problems.

Step 1. Subjective Characteristics Associated with Traumatic Stressors

There is no clear boundary between ordinary and traumatic stressors;²⁴ instead, it is the individual perception and appraisal of the event that determines its potential toxicity.^{10,25,26} In addition, the occurrence of a traumatic event does not necessarily lead to the development of a mental disorder such as PTSD. For example, a study²⁷ on the natural course of the psychological reaction following a traumatic event such as rape revealed that a majority of victims could meet the diagnostic criteria of PTSD in the days following the event, and that number decreased to 40% at 6 months after the event. The natural and progressive decay in PTSD symptoms occurred despite the lack of intervention. Studies like this one have helped researchers understand that it is not only stressors but also how people react to them that lead to PTSD or significant psychological injuries.^{10,25,28,29}

A traumatic event evokes the response of catastrophe, and the common denominators of psychological trauma are intense fear, helplessness, horror,¹ loss of control, and the threat of annihilation.³⁰ The likelihood, and perhaps the intensity, of posttraumatic stress is positively associated with the perceived intensity of the threat or danger³¹ as well as with the level of suffering.³² The characteristics of an individual's perception that affect the traumatic potential include the perceived intensity of the threat to life of own or others, the perception that harm is inflicted voluntarily, the importance of the resulting losses, the unpredictability of the event,^{33,34} and the feeling of powerlessness.³⁵ Most of the time, the severity of a trauma is evaluated via the perceived level of threat to life.³⁶ While the perceived level of threat has been found to predict PTSD in 12 distinct studies,³⁷ the severity of a trauma has also been reported as a predictor of PTSD symptoms.^{28,38–40} Adverse childhood experiences,^{41,42} coping styles,^{12,43} and gender⁴⁴ have also been reported as individual variables that modulate impact of stressors on the development of PTSD.

Another human factor associated with how traumatic an event can potentially be is the challenge it poses to the individual's belief system, or the defiance of the individual's ability to give it a sense, thereby denying coming to terms with it.^{45,46} Witnessing the horror of human carnage, "seeing other people maimed, dismembered or turned into a pink mist by a direct hit can be a highly traumatic experience, particularly when such carnage involves someone close"; "the greater the identification with the damaged person, the greater the threat posed to one's own sense of security and invulnerability."^{46(p27)} Furthermore, due to the continued exposure to threats while still in theater, soldiers are unable to grieve the loss or injury of a close comrade; thus, instead of

being able to live and process the normal but intense emotions that attend the loss, individuals partially numb-up to experience and store the grief.¹⁴

It seems that those who subsequently develop PTSD report greater emotional responses during the event than those who do not develop PTSD.⁴⁷ Individuals who react with strong negative emotions such as fear, guilt, shame, anger, disgust, or sadness, or with strong physical reactions of anxiety, such as palpitations, shaking, dizziness, sweating, hot flashes, or chills, during and immediately after the event, are more vulnerable to developing PTSD.^{38,48–50} According to Herman, the salient characteristic of a traumatic event is its power to inspire helplessness and terror,³⁰ and of the three emotions characterizing the diagnostic criteria of PTSD—fear, horror and helplessness—it is the latter one that best predicts PTSD.⁵¹ This information is particularly pertinent in today's theaters of military operations, where asymmetrical warfare often condemns soldiers to wait until fired upon before being able to identify enemy combatants.⁴⁶ In the same vein, Wallenius et al. observed that an unpredictable and diffused threat could evoke a feeling of powerlessness, resignation, and a perception of a lack of control.⁵²

At the same time, it seems that the complete absence of emotion during the event is also linked with PTSD. The term *fright* refers to the absence of emotion, thought, and words and the sensation of being frozen during part of the event, when one suddenly faces the reality of his own death or that of another person.³⁶ Experiencing fright during an event significantly increases the risk of meeting PTSD criteria in the future.⁵³ Along the same line, several studies suggest that dissociation during and right after the event is strongly related to developing PTSD symptoms.^{54–57} According to a meta-analysis,³⁷ dissociation is the best predictor of PTSD; however, several authors suggest that when considering dissociation, factors such as the intensity of the event⁵⁸ and the duration of the dissociation⁵⁰ also need to be taken into account.

To sum up, the following subjective variables appear to be related to stress and lead to PTSD in military personnel: perceived personal threat, horror, helplessness, loss of control, unpredictability, challenge to personal beliefs system, identification with victims, guilt, shame, and dissociation. In developing a VE to practice stress management skills, researchers and clinicians may want to include some of these psychological ingredients in the storyboard. These subjective factors deserve the trainer's attention during SMT. Users immersed in VE should be able to practice their coping skills when facing stressors that trigger some of these psychological reactions. On the other hand, these subjective variables should also be closely monitored to serve as guides to decide when it is time to stop the immersion because the VE has become too stressful. Despite the importance of subjective factors modulating the impact of stressful life events, the development of a VE should also take into account objective factors that are likely to be stressful or traumatic.

Step 2. Objective Characteristics Associated with Traumatic Stressors

The second review of the literature targeted characteristics that influence the trajectory and severity of psychological injuries and peritraumatic risk factors strongly related to the

development and chronicity of PTSD.^{25,36} Since Hans Selye's pioneering work on stress,⁵⁹ decades of experimental controlled research has shown that not every stimulus is equally stressful.^{60–67} In general, stressful stimuli possess one of the following characteristics: personally challenging to physical, social, or ego integrity; unavailability of control or coping response; and novelty and/or unpredictability.

Specific to PTSD, the characteristics of potentially traumatic stimuli include the severity of the exposure,^{28,68} the predictability,²⁵ and the duration of the event.^{69,70} It seems that exposure to longer potentially traumatic events is associated with a greater severity of PTSD symptoms.⁷¹ Other characteristics that seem to increase the likelihood of psychological harm include an effect of surprise as well as being trapped or exposed to the point of exhaustion.³⁰

One overview of the literature on PTSD,³⁶ among others, supported the idea of dividing traumatic events into two categories. Type I traumatic events tend to be sudden, unexpected, and of rather short duration. Type II traumatic events tend to be cumulative, to span over a much longer period of time, to involve repetition, to be caused voluntarily by humans, and to sometimes be foreseeable. Some authors suggest that PTSD is more commonly associated with Type II events.^{72–74} More specifically, it has been reported that events associated with prolonged victimization, such as torture, are associated with the highest estimates for chronic PTSD.⁷⁵

Commonly reported traumatic events include learning about traumatic events that happened to others; the sudden, unexpected death of a colleague; witnessing a killing or serious injury; having a car accident or other serious accident; being mugged or threatened with a weapon; witnessing a natural disaster; being badly beaten up; discovering a dead body; being sexually assaulted (other than rape); being raped; being shot or stabbed; suffering from a life-threatening illness; having a child suffer from a life-threatening illness; being held captive; and being tortured or kidnapped.⁷⁴ Combat-specific stressors have also been documented,^{2,77–79} and they include experiencing actual combat;⁷⁶ participating in the killing of enemy soldiers; living under the constant threat of identifiable and unidentifiable combatants, such as booby-trapped children or infants; witnessing horrifying maiming and slaughter of fellow soldiers or civilians such as grotesque death, dismemberment, or disfigurement; and participating in or failing to act against the commission of atrocities. In Afghanistan and Iraq, the most potentially traumatic events included "witnessing the violent death of a friend or valued leader, being responsible for the death of unarmed children, failing to save a buddy from death or serious injury, friendly fire, witnessing atrocities, or surviving an unexpected assault in which many friendly casualties were suffered."^{14(p15)} The experience of being captured and living in prisoner-of-war conditions, including confinement, torture, and extreme deprivation, can also represent a traumatic event.¹³ In the case of females, the traumatic event could also imply being the target of sexual harassment or sexual assault by their male colleagues.⁸⁰ Rape, regardless of gender, has been consistently found to be one of the most pathogenic traumas.⁸¹ For example, Kilpatrick et al. found that crimes involving a rape, physical injuries, and threat to the victim's life increase the likelihood of the victim developing PTSD by 8.5 times compared to crimes in which these three factors are not present.⁸² In addition, events implicating the discovery of

human bodies,⁸³ unexpected or intentional events threatening life, and physically or psychologically degrading experiences are highly susceptible to favor the development of PTSD.^{28,36} Events causing physical injury are more often associated with the development of PTSD than events that do not cause injury.^{74,82}

Organizational factors can also have an impact on the mental health of deployed soldiers, peacekeepers, and combat veterans, including the pace of military operations,⁸⁴ deployment length,⁴⁴ first deployment,⁴⁴ exposure to combat,⁴ similarity of an event with a previously traumatic event,¹³ and past potentially traumatic deployments.^{4,85,86}

One last category of objective factors having an impact on mental health is of particular interest to the development of VE scenarios: environmental factors. Environmental factors surrounding a potentially traumatic event seem to play a large part in its toxicity. Acoustically, the deafening and continuous noise during firefighting, the sounds of a rocket motor buzzing close overhead, the sound of a mortar shell screaming down on one's position, and the sounds of animals or humans agonizing in death are powerful stressors.⁴⁶ Olfactory stimuli, such as the smells of human waste, human waste burned in diesel oil, burning trash, blood, viscera, and burned flesh, can be psychologically toxic and act as markers of traumatic events.⁴⁶ Finally, darkness tends to heighten the level of anxiety.⁴⁶

Overall, several objective stressors can be recreated in VR to stress military personnel to a sufficient degree to allow practicing stress management skills. To be stressful, stimuli should minimally present a challenge or a threat to the individual and involve lack of control or limited coping possibilities and novelty or unpredictability. Potentially traumatic stressors applicable to military personnel must include experiencing combat, death of enemy or fellow soldiers, witnessing horrifying atrocities, being responsible for the death or serious injury to civilians or fellow soldiers, being captured or tortured, and being the victim of sexual assault or degrading experience. Some environmental factors associated with the traumatic event can also increase its negative impact, including loud noise, sounds of agony from human or animals, odors of burned flesh or viscera, and darkness. There is no doubt that all these stimuli can be stressful. Yet there is no indication of the frequency of occurrence of these stressors. In the case of U.S. operations in Iraq and Afghanistan, useful data regarding stressors has been systematically collected by the Mental Health Advisory Team.⁴ Stressors that have been experienced in theater of operations among at least 50% of the sample, either in Iraq or Afghanistan, are presented in Table 1. From this data, it appears that seeing and knowing people getting hurt or injured, as well as seeing dead bodies, are highly frequent stressors.

Step 3. Stressors Reported by Canadian Military Personnel in Afghanistan

The third step in our search for guiding information to select key stressors to develop VE for practicing SMT prior to deployment in active war zones is to examine the frequency of specific stressors experienced by Canadian military personnel and those potentially suffering from PTSD. Unfortunately, only direct interviews with people suffering from PTSD would allow pinpointing which stressor caused PTSD,

TABLE 1. RATE^a OF STRESSORS/COMBAT EXPERIENCED BY MORE THAN 50% OF U.S. SOLDIERS IN THE MHAT-V

<i>Combat experience</i>	<i>Iraq (%)</i>	<i>Afghanistan (%)</i>
Receiving incoming artillery, rocket, or mortar fire	81	92
Knowing someone seriously injured or killed	72	87
Having a member of your unit become a casualty	55	77
Being attacked or ambushed	52	75
Seeing dead bodies or human remains	61	74
Receiving small-arms fire	60	70
Seeing dead or seriously injured Americans	46	64
Shooting or directing fire at the enemy	39	63
Having hostile reactions from civilians	46	59
Being in threatening situations where you were unable to respond because of the rules of engagement	42	54
Clearing/searching caves or bunkers	16	51
Seeing destroyed homes and villages	65 ^b	51 ^b
Working in areas that were mined	60 ^b	50 ^b

^aPercentages are adjusted for duration of the missions and are reported only for brigade combat team (i.e., supporting task force members are excluded from the Afghanistan sample) except for the last two items.

^bData collected from Appendix C of the MHAT-V report (p. 121) unadjusted for time spent in theater of operations. Data for the Afghanistan sample includes supporting Task Force members.

Source: Mental Health Advisory Team (MHAT) V, February 2008, Table 8, p. 167. Reproduced with permission.

and such data is not currently available. Nevertheless, knowing both the frequency of the stressor in the troops and among people suffering from psychological injuries would allow increasing the clinical relevance of the VE that will be developed. Also, it should shed some light on which stressors may be too strong and risky to reproduce due to the risks of psychologically injuring the trainees.

Methods and Sample

Raw data was obtained from the Canadian Forces Land Personnel Concept and Policies Office on the frequency of stressors and combat experiences among Canadian military personnel during deployment in Afghanistan. The data comes from the postdeployment Human Dimensions of Operation (HDO) survey, an endeavor in the Canadian Forces to provide information on human dimensions that can affect individual and group performance during and after missions.⁸⁷ The postdeployment version of the HDO includes the short version of the Stress on Operations Scale developed by Director General Military Personnel Research and Analysis using items from the U.S. Army Mental Health Advisory Team survey (MHAT; see also Killgore et al.⁸⁸). It contains a list of 31 situations (but we analyzed only 30 stressors because one stressor is classified) that may cause soldiers to experience stress, usually when they go outside the base. Note that it does not capture well stressors experienced by those who do not perform all or part of their work outside the base. For each of the situations presented in the survey, two answers are required. First, using a 5-point rating scale, respondents are directed to indicate how often they have experienced each of these situations. Second, they are asked to indicate how much trouble or concern each of these situations has caused them, on a scale from 1, *no trouble or concern*, to 5, *very much trouble or concern*. For the purpose of listing potential situations worth developing in VR, we must first document as many stressors as possible. We therefore decided to focus on whether or not the stressful situation occurred, even if it happened only once and if only minimal concern was evoked.

Since the summer of 2007, the survey also includes the Kessler Psychological Distress Scale,⁸⁹ a 10-item self-report assessing psychological distress based on the level of anxiety and depressive symptoms experienced in the last 4 weeks. A cutoff score of 30 or more indicates that the respondent has three out of four chances to meet the diagnostic criteria for an anxiety or depressive disorder, which is 10 times the risk found in the general population. (Note that raw data obtained from Military Personnel Operational Research and Analysis include between 2 and 8 cases with missing data on the Kessler Psychological Distress Scale. Thus, the exact percentage of strongly probable cases of suffering from anxiety or depressive disorder reported in our analyses may be underestimated by a few decimal points.) The information available was not precise enough to provide specific and reliable diagnoses, and therefore it is better to refer to "psychological injuries" or to "strong probability of anxiety and depressive disorders." Based on that cutoff score, estimates of 108 military personnel, or 8.2% of the respondents, were very likely to suffer from an anxiety or depressive disorder at the time of the survey approximately 4 to 6 months after redeployment.

This data should be interpreted with caution because it does not represent a detailed analysis of stressors involved in the development of reliably diagnosed cases of PTSD. However, they are the closest estimation available to address which frequent stressful combat situations are associated with psychological injuries.

The sample consisted of 1,319 military personnel, with 53% ranked between private and master-corporal, 24% ranked between sergeant and chief warrant officer, 15% between lieutenant and captain, and 8% ranked as senior officers and higher. Note that HDO was administered to all military personnel deployed, and therefore not all respondents participated in active combat outside the base.

Results

An examination of the rate of stressful situations in Afghanistan reported during this iteration of the postdeployment HDO shows that some stressors are more frequently

experienced than others (see Table 2). For example, knowing someone seriously injured or killed and receiving incoming artillery, rocket, or mortar fire were experienced by more than 70% of the respondents. Seeing destroyed homes or villages, working in areas that were mined or had improvised explosive devices, and being attacked or ambushed were also experienced by 50% or more of the Canadian military personnel deployed in Afghanistan. As described in Table 1, most of these stressors were also reported by U.S. soldiers deployed in Iraq or Afghanistan. The average trouble or concern experienced in the entire sample is generally low, except for a few stressors: receiving incoming artillery, rocket, or mortar fire; knowing someone seriously injured or killed; seeing destroyed homes or villages; working in areas that were

mined or had improvised explosive device; and being attacked or ambushed.

When looking only at the 108 people who were the strongly probable cases of suffering from psychological injuries, the frequency of stressful experiences closely mirrored what was found in the entire sample. The least frequent stressful experience was engaging in hand-to-hand combat (22%, or 24 out of 108 cases), and the most frequent was to know someone seriously injured or killed (77%, or 83 out of 108 cases). However, to assess the clinical relevance and safety, it is more interesting to see *among those to whom each stressor happened*, what is the percentage of people who are strongly susceptible to suffering from an anxiety or depressive disorder (second column in Table 2). For example, being respon-

TABLE 2. RATE OF MILITARY PERSONNEL AT HIGH RISK FOR SUFFERING FROM ANXIETY OR DEPRESSIVE DISORDER (PSYCHOLOGICAL INJURIES) AMONG THOSE WHO EXPERIENCED STRESSFUL SITUATIONS

<i>Stressful situations in the Human Dimensions of Operations survey (number of respondents without missing data)</i>	<i>% of stressor in entire sample</i>	<i>Rate of occurrence</i>	
		<i>% strongly probable anxiety and/or depression cases among those who experienced the stressor (n = 108)</i>	<i>Average trouble or concern felt among those who experienced the stressor (SD)</i>
Had a close call; was shot or hit but saved by protective equipment (N = 1,306)	4.9	53.1	2.06 (1.15)
Being responsible for the death of Canadian or ally personnel (N = 1,305)	3.1	48.8	1.74 (1.09)
Engaging in hand-to-hand combat (N = 1,307)	3.3	48.8	1.67 (0.85)
Witnessing brutality/mistreatment toward noncombatants (N = 1,311)	7.9	31.1	1.84 (0.95)
Disarming civilians (N = 1,307)	9.0	26.5	1.53 (0.86)
Being wounded/injured (N = 1,302)	6.4	25.3	1.88 (0.16)
Had a close call; a bullet or shrapnel hit a piece of personal equipment (N = 1,306)	11.3	23.1	2.07 (1.06)
Clearing/searching caves or bunkers (N = 1,308)	12.2	19.4	1.62 (0.90)
Calling in fire on the enemy (N = 1,306)	15.2	19.2	1.49 (0.80)
Witnessing violence with the local population or between ethnic groups (N = 1,304)	20.7	18.9	1.59 (0.82)
Being directly responsible for the death of an enemy (N = 1,303)	16.4	18.2	1.58 (0.92)
Being in threatening situations and being unable to respond because of rules of engagement (N = 1,310)	20.9	15.7	2.52 (1.29)
Handling or uncovering human remains (N = 1,305)	15.7	15.7	2.09 (1.07)
Participating in demining operations (N = 1,305)	19.9	15.4	2.06 (1.11)
Witnessing an accident that resulted in serious injury or death (N = 1,305)	30.4	13.9	2.13 (1.02)
Clearing/searching homes or buildings (N = 1,310)	22.8	13.7	1.64 (0.90)
IED/booby trap exploded near you (N = 1,308)	38.3	13.2	2.23 (1.11)
Shooting or directing fire at the enemy (N = 1,308)	27.6	12.5	1.54 (0.87)
Receiving small-arms fire (N = 1,309)	39.3	12.4	1.87 (0.93)
Seeing ill/injured people and being unable to help (N = 1,305)	30.0	12.3	2.07 (0.97)
Seeing dead or seriously injured Canadians (N = 1,307)	40.0	11.9	2.50 (1.09)
Having a close call: dud landing near (N = 1,304)	31.7	11.9	2.26 (1.07)
Having hostile reactions from local civilians (N = 1,307)	42.0	11.1	1.60 (0.77)
Being attacked or ambushed (N = 1,306)	49.9	10.6	2.09 (0.96)
Seeing dead bodies or human remains (N = 1,302)	43.8	10.4	1.94 (0.97)
Working in areas that were mined or had IEDs (N = 1,306)	51.8	10.0	2.17 (1.07)
Having members of your own unit become a casualty (N = 1,302)	41.2	9.9	2.61 (1.16)
Seeing destroyed homes or villages (N = 1,308)	57.7	9.7	1.48 (0.72)
Knowing someone seriously injured or killed (N = 1,307)	72.2	8.2	2.56 (1.07)
Receiving incoming artillery, rocket, or mortar fire (N = 1,304)	77.5	7.3	2.09 (0.99)

IED, improvised explosive device.

sible for the death of Canadian or ally personnel is the least frequent stressor in the entire sample. It occurred to 3.1% of the respondents, or 41 times. Among these 41 cases, 20 respondents (48.8%) scored above the cutoff score on the Kessler Psychological Distress Scale and are thus strongly probable cases of anxiety or depression. Thus, even though this stressor is infrequently experienced among those deployed to Afghanistan, when it does occur, it appears to be associated with an increased likelihood of suffering from an anxiety or depressive disorder. On the other hand, participating in demining operations is a more frequent stressor, reported as being experienced by 19.9% of the entire sample, but is associated with a strong probability of suffering from an anxiety or depressive disorder in only 15.4% of those who were involved in demining operations. It is impressive to note that rare and not especially troubling events, when looking at the global sample, are those that, when they occurred, were the most frequently associated with anxiety and depression. And the opposite is true for stressors that were more frequent or caused more trouble or concern: they are less likely to be associated with anxiety or depressive disorders. The difficult choice when selecting key stressors to develop a VE is to find the balance between frequency and consequence of stressors. Respondents are also likely to have been exposed to more than one stressful situation during their rotation in Afghanistan, so it is impossible to infer from this data that these stressors are the cause of the anxiety or depressive problems.

Integration of Results from the Three Sources of Information

The exact and defining objective features of a traumatic event remain a point of contention. Our approach was to find converging information from various sources in order to find the most appropriate stressors. Table 2 shows that the seven stressors most (i.e., more than 20%) associated with psychological injuries are (a) being hit and saved by protective equipment, (b) being responsible for the death of Canadian or ally personnel, (c) engaging in hand-to-hand combat, (d) witnessing brutality or mistreatment toward noncombatants, (e) disarming civilians, (f) being wounded, and (g) having a piece of equipment being hit. Since the current objective focuses on developing coping strategies as opposed to treatment using in virtual exposure, developing VE storyboards may be questionable for all of these stressors except hand-to-hand combat. It is doubtful that one wants to desensitize people to inhumane situations and stressors, and the long-term consequences would probably be disastrous. Thus, less traumatic and more frequent stressful situations have been retained in our analysis because it would probably be more productive to develop them into virtual scenarios.

Every other stressor may be appropriate, but a shorter list must be drawn. Stressor selection was based on a few criteria, such as (a) frequency of occurrence of at least 50% among those military personnel who were involved in active combat; (b) frequency of occurrence of at least 10% among Canadian military personnel deployed in Afghanistan; (c) rate of strongly probable cases of suffering from anxiety or depression among those who experienced the stressor not higher than 20%; (d) feasibility of recreating the stressor in VR; (e) sharing objective characteristics associated with traumatic

stressors; and (f) sharing subjective characteristics associated with traumatic stressors. After submitting stressors in combat experience to these criteria, eight stressful situations stand out (see Table 3). These stressors are frequent, present, strong psychological challenges that last long enough to be used in storyboards unfolding in VR and involve either unpredictability or lack of control. They are also among the most troubling reported by the respondents. Finally, they possess important subjective characteristics that were identified as significant in traumatic stressors.

Despite our efforts to operationalize the selection process of key stressors, the final selection was still based on subjective criteria. Judging which stressors were unpredictable and involved lack of control or loss of control, a feeling of helplessness or horror, and novelty was not based on empirical grounds. For example, clearing houses, caves, or bunkers was considered to involve more control over one's own behavior than was being under fire. Knowing someone, including a unit member, being injured or killed was considered as more novel than being unable to help because of rules of engagement. Nevertheless, our process remains a tentative attempt to follow a formal and explicit approach that is rarely documented in the development of VE.

Consistent with what was observed in Table 2, the prevalence of these eight stressors is inversely proportional to the rate of occurrence of strongly probable cases of suffering from an anxiety or depressive disorder among those who experience them. The final choice of which VE to develop should be based on a decision to create either situations that are experienced by most military personnel and are not strongly associated with psychological injuries (i.e., receiving incoming fire) or situations that are experienced by fewer military personnel yet are more strongly associated with psychological injuries (i.e., clearing/searching houses, caves, or bunkers).

Conclusion

PTSD represents a very likely and severe psychological injury that can develop following exposure to traumatic events. Psychological resilience is a known moderator of the impact of deployment stressors on depression postdeployment.⁹⁰ Psychological resilience involves three factors related to the military environment: (a) commitment (vs. alienation), control (vs. powerlessness), and challenge (vs. threat).⁹⁰ Strong stressors led to less depression among soldiers who scored high on the military hardiness scale. Along those lines, the transactional model of stress⁹¹ insists on the difference between perceived challenge and perceived threat. According to this model, psychological stress comes from the mismatch between environmental demands and psychological resources. When facing a stressor, the individual makes a primary appraisal of whether the stressor represents a challenge or a threat and a secondary appraisal of the availability of coping resources. Such two-stage cognitive models are supported by a wide variety of empirical evidence^{15,92} and even is echoed in neuropsychological mechanisms of emotions and emotion regulation.^{93–95}

We believe that resilience, mental readiness, and adequate stress management strategies would facilitate dealing with stressors, appraisal of the trauma and its consequences, and memory integration, thus protecting against psychological

TABLE 3. CHECKLIST OF TRAUMATIC EVENTS SELECTED FOR VIRTUAL ENVIRONMENT TO BE DEVELOPED FOR STRESS MANAGEMENT TRAINING

Stressful combat experiences and situations	Frequent (>50% in Table 1; >10% in Table 2)	Prevalent in psychologically injured personnel (<20%)	Perceived challenge or threat	Duration (long)	Unpredictable	Lack or loss of control	Helplessness threatening	Life threatening	Challenge to beliefs systems	Horrible	High in stimulations (sounds, smell, etc.)	Voluntarily caused harm	Novelty
Seeing dead bodies and/or uncovering human remains	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓
Knowing someone seriously injured or killed	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓
Receiving artillery fire	✓	✓	✓	✓	✓	✓	✓	✓			✓		
Being unable to help because of ROE	✓	✓	✓	✓		✓	✓		✓	✓			
Seeing destroyed homes and villages	✓	✓	✓	✓		✓	✓		✓	✓			
Clearing/searching (house, cave, bunker)	✓	✓	✓	✓	✓			✓			✓	✓	
Receiving small-arms fire	✓	✓	✓	✓	✓			✓			✓		
Demining operations	✓	✓	✓	✓	✓			✓					

ROE, rules of engagement.

injuries and reducing the risks of PTSD. We also believe that these skills could be taught, practiced, and sharpened during immersions in VR. Since the development of a VE is a long and costly process, a cost-effective solution is to develop a handful of carefully selected virtual scenarios or storyboards based on the stressful situations that are experienced by a majority of military personnel. The first step in developing these scenarios consists of identifying relevant stressors.

Stressors most often associated with psychological injuries, such as anxiety and depressive disorders, are rather infrequent, and it is questionable whether it is feasible, ethical, or desirable to use highly traumatic events such as witnessing brutality or rape or helping an injured civilian woman or child. For SMT in general, it may be a better investment of time and resources to develop virtual scenarios that apply to as many people as possible. But it may be more fruitful to look at stressors that are both disturbing and also relatively frequent because they would allow practicing SMT in situations that are likely to lead to traumatic reactions.

Our three-steps approach consisted in documenting subjective and objective factors that characterize traumatic stressors. We further examined the frequency of stressors experienced in theaters of operations and which stressors were most often associated with probable mental health disorders. During that process, eight stressors stand out: seeing dead bodies or uncovering human remains; knowing someone (i.e., a unit member) being seriously injured or killed; receiving artillery fire; being unable to help ill or wounded civilians because of the rules of engagement; seeing destroyed homes and villages; clearing and searching homes, caves or bunkers; receiving small-arms fire; and participating in demining operations. Additional scenarios might be worth considering, such as patrolling in dangerous situations; experiencing an attack on the base, including the ensuing base defense activities; and participating in a transport convoy. Other researchers may need to develop VEs for more specific populations, such as medics, special forces, or submarine sailors. The final choice of a VE must be dictated by a need analysis, opportunities, and feasibility.

Researchers and clinicians from other countries interested in developing VEs may want to consider other stressors as well. The stressors experienced by military personnel vary not only according to the theater of operations but also according to the nationality of the troops or the nature of the missions assigned to the units of a particular nation. For example, a study with troops in Bosnia-Herzegovina reported that 100% of the sample of 219 peacekeepers reported experiencing at least one tragic or life-threatening event.²⁹ Among peacekeepers, 73% witnessed natural disasters, 54% witnessed serious injuries or illness, 39% were seriously injured, 26% witnessed physical assaults, and 7% witnessed sexual assault.⁹ Again, the likelihood of being exposed to a potentially traumatic event did not correlate positively and linearly with actually developing PTSD. For example, in Bolton et al.'s sample of peacekeepers, stressors that occurred the least frequently were the most likely to lead to PTSD, with the prevalence of PTSD being 18% for witnessing sexual assault (the least frequent stressor) followed by 12% for witnessing physical assault, 11% for being seriously injured, and 8% for witnessing serious injuries or natural disasters (the most frequent stressor).⁹

Strategies are being developed to help military personnel to cope with stress. Guidelines and handbooks such as the

Marine Corps Reference Publication 6-11c (2000) are used to help personnel deal with combat stress, sometimes with suggestions of strategies to implement predeployment, during deployment, and when returning home. These programs often focus on reducing the stressors (e.g., dealing with logistic issues) more than on coping psychologically with acute stressors or on increasing resilience. More recent programs, such as *Battlemind*, developed by the Walter Reed Army Institute of Research, and the *Programme d'Entraînement à la Résilience Militaire*, developed by Routhier¹⁶ for the Canadian Forces Quebec Area, are making greater use of SMT techniques. Some of these strategies, such as self-talk and thought stopping, address primary appraisal of stressful stimuli; others allow building a realistic but more reassuring secondary appraisal of coping, using autogenic training and meditation, visualization, music, signing or reading, and humor; and some can be used to sustain acute stress associated with objective life-threatening stressors, such as listening to silence, focusing, breathing, de-identification, or self-observation. A significant challenge with military personnel is to have them not only listen to the content of the SMT programs but actually practice coping skills until they are fully mastered. Because of virility or potential "army strong" mentality,⁹⁶ some soldiers may be reluctant to practice emotion-regulation techniques. Using VR to practice SMT skills may be more attractive to soldiers and allow trainers to coach trainees more effectively. Practicing autogenic training or self-talk, for example, when immersed in a VE where the user is under attack and surrounded by wounded units, members, and friends, may help increase the stress level enough so training becomes more effective. It is hoped that such training may be useful not only to better cope with stress but also to help military personnel efficiently process the strong emotions involved in potentially traumatic stressors and thus prevent the development of mental disorders such as PTSD. In the meantime, the next steps are to build some of the VEs proposed in this article and pursue the development process up to empirically testing the VEs.²¹

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References

1. American Psychiatric Association (2000). *Diagnostic and statistical manual of mental disorders*. 4th ed., text rev. Washington: Author.

2. Hoge CW, Castro CA, Messer SC, et al. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *New England Journal of Medicine* 2004; 351:13–22.
3. Milliken CS, Auchterlonie JL, Hoge CW. Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *Journal of the American Medical Association* 2007; 298:2141–8.
4. Mental Health Advisory Team (MHAT) V. (2008). *Operation Iraqi Freedom 06–08: Iraq: Operation Enduring Freedom 8: Afghanistan*. Washington, DC: Office of the Surgeon Multi-National Force-Iraq; Office of the Command Surgeon; and Office of the Surgeon General United States Army Medical Command.
5. Sareen J, Cox BJ, Afifi TO, et al. Combat and peacekeeping operations in relation to prevalence of mental disorders and perceived need for mental health care. *Archives of General Psychiatry* 2007; 64:843–52.
6. Hotopf M, Hull L, Fear NT, et al. The health of UK military personnel who deployed to the 2003 Iraq war: a cohort study. *Lancet* 2006; 367:1731–41.
7. Killgore WDS, Stetz MC, Castro CA, et al. The effects of prior combat experience on the expression of somatic and affective symptoms in deploying soldiers. *Journal of Psychosomatic Research* 2006; 60:379–85.
8. Sareen J, Belik SL, Afifi TO, et al. Canadian military personnel's population attributable fractions of mental disorders and mental health service use associated with combat and peacekeeping operations. *American Journal of Public Health* 2008; 98:2191–8.
9. Bolton EE, Litz BT, Britt TW, et al. Reports of prior exposure to potentially traumatic events and PTSD in troops poised for deployment. *Journal of Traumatic Stress* 2001; 14:249–56.
10. Ehlers A, Clark DM. A cognitive model of posttraumatic stress disorder. *Behaviour Research & Therapy* 2000; 38: 319–45.
11. Halligan SL, Michael T, Clark DM, et al. Posttraumatic stress disorder following assault: the role of cognitive processing, trauma memory, and appraisals. *Journal of Consulting & Clinical Psychology* 2003; 71:419–31.
12. Gil S, Caspi Y. Personality traits, coping style, and perceived threat as predictors of posttraumatic stress disorder after exposure to a terrorist attack: a prospective study. *Psychosomatic Medicine* 2006; 68:904–9.
13. Briere J. (1997) *Psychological assessment of adult post-traumatic states*. Washington, DC: American Psychological Association.
14. Nash WP. (2007) Combat/operational stress adaptations and injuries. In Figley CR, Nash WP, eds. *Combat stress injury: theory, research, and management*. New York: Routledge, pp. 33–63.
15. Thompson MM, McCreary DR. (2006). Enhancing mental readiness in military personnel. In Britt TW, Adler AB, Castro CA, eds. *Military life: the psychology of serving in peace and combat*. Westport, CT: Praeger Security International, pp. 54–79.
16. Routhier C. (2007) *Programme d'entraînement à la résilience militaire (PERM)*. Unpublished document: SQFT.
17. Armfield F. Preventing posttraumatic stress disorders resulting from military operations. *Military Medicine* 1994; 159:739–46.
18. Stetz MC, Long CP, Schober WV, et al. (2007). Stress assessment and management while medics take care of the VR wounded. In Wiederhold BK, Bouchard S, Riva G, eds. *Annual Review of CyberTherapy and Telemedicine*, Vol. 5. San Diego: Interactive Media Institute, pp. 165–72.
19. Thompson MM, McCreary DR. (2006) Enhancing mental readiness in military personnel. In *Human dimensions in military operations: military leaders' strategies for addressing stress and psychological support*. Meeting Proceedings RTO-MP-HFM-134, Paper 4. Neuilly-sur-Seine, France: RTO, pp. 401–12.
20. Wiederhold BK, Wiederhold M. Virtual reality for post-traumatic stress disorder and stress inoculation training. *Journal of CyberTherapy & Rehabilitation* 2008; 1:23–35.
21. Wilson JR, Eastgate RM, D'Cruz M. (2002). Structured development of virtual environments. In Stanney KM, ed. *Handbook of virtual environments: Design, implementation, and applications*. Mahwah, NJ: Erlbaum, pp. 353–78.
22. Stetz MC, Long CP, Wiederhold BK, et al. Combat scenarios and relaxations training to harden medics against stress. *Journal of CyberTherapy & Rehabilitation* 2008; 1:239–46.
23. Wiederhold MD (2005). Psychological monitoring during simulation training and testing (final report). Issued by U.S. Army Aviation and Missile Command Under.
24. Weathers FW, Keane TM. The criterion: a problem revisited: controversies and challenges in defining and measuring psychological trauma. *Journal of Traumatic Stress* 2007; 20:107–21.
25. Barlow DH. (2002) *Anxiety and its disorders: the nature and treatment of anxiety and panic*. 2nd ed. New York: Guilford.
26. Van Hooft M, McFarlane AC, Baur J, et al. The stressor Criterion-A1 and PTSD: a matter of opinion? *Journal of Anxiety Disorders* 2009; 23:77–86.
27. Rothbaum BO, Foa EB, Murdock T, et al. A prospective examination of post-traumatic stress disorder in rape victims. *Journal of Traumatic Stress* 1992; 5:455–75.
28. Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for post-traumatic stress disorder in trauma-exposed adults. *Journal of Consulting & Clinical Psychology* 2000; 68:748–66.
29. Thompson MM, Pastò L, McCreary, DR. Deployment stressors: coping and psychological well-being among peacekeepers. Presented at the 7th International Command and Control Research and Technology Symposium. Quebec City, Canada, 2002.
30. Herman J. (1997) *Trauma and recovery: the aftermath of violence—from domestic abuse to political terror*. New York: Basic Books.
31. Green B, Grace MC, Gleser CG. Identifying survivors at risk: long-term impairment following the Beverly Hills Supper Club fire. *Journal of Consulting & Clinical Psychology* 1985; 53:672–8.
32. Speed N, Engdahl BE, Schwartz J, et al. (1989). Posttraumatic stress disorder as a consequence of the POW experience. *Journal of Nervous & Mental Disease* 1989; 177:147–53.
33. Green B. Psychological research in traumatic stress: an update. *Journal of Traumatic Stress* 1994; 7:341–62.
34. Green BL, Grace MC, Lindy JD, et al. Risk factors for PTSD and other diagnoses in a general sample of Vietnam veterans. *American Journal of Psychiatry* 1990; 147:729–33.
35. Bartone PT, Adler AB. (1994). A model for soldier psychological adaptation in peacekeeping operations. *Proceedings of the 36th Annual Conference of the International Military Testing Association* (pp. 33–40). Rotterdam: European Nations of the IMTA.
36. Martin M, Germain V, Marchand A. (2006). Facteurs de risque et de protection dans la modulation de l'état de stress post-traumatique. In Guay S, Marchand A, eds. *Les troubles liés aux événements traumatiques: dépistage, évaluation et trai-*

- tements. Montréal: Les Presses de l'Université de Montréal, pp. 58–86.
37. Ozer EJ, Best SR, Lipsey TL, et al. Predictors of post-traumatic stress disorder and symptoms in adults: a meta-analysis. *Psychological Bulletin* 2003; 129:52–73.
 38. Bernat JA, Rondfeldt HM, Calhoun KS, et al. Prevalence of traumatic events and peritraumatic predictors of posttraumatic stress symptoms in a non clinical sample of college students. *Journal of Traumatic Stress* 1998; 11:645–64.
 39. Green MA, Berlin MA. Five psychosocial variables related to the existence of post-traumatic stress disorder symptoms. *Journal of Clinical Psychology* 1987; 43:643–9.
 40. Hodgins GA, Creamer M, Bell R. Risk factors for posttrauma reactions in police officers: a longitudinal study. *Journal of Nervous & Mental Disease* 2001; 189:541–7.
 41. Cabrera OA, Hoge CW, Bliese PD, et al. Childhood adversity and combat as predictors of depression and post-traumatic stress in deployed troops. *American Journal of Preventive Medicine* 2007; 33:77–82.
 42. Belik SL, Stein MB, Asmundson GJG, et al. Relation between traumatic events and suicide attempts in Canadian military personnel. *Canadian Journal of Psychiatry* 2009; 54:93–104.
 43. Bliese PD, Castro CA. (2003) The soldier adaptation model (SAM): Applications to peacekeeping missions. In Britt TW, Adler AB, eds. *The psychology of the peacekeeper: lessons learned from the field*. Westport, CT: Praeger Security International, pp. 185–204.
 44. Adler AB, Huffman AH. The impact of deployment length and experience on the well-being of male and female soldiers. *Journal of Occupational Health Psychology* 2005; 10: 121–37.
 45. Janoff-Bulman R. (1992). *Shattered assumptions: towards a new psychology of trauma*. New York: Free Press.
 46. Nash WP (2007) The stressors of war. In Figley CR, Nash, WP, eds. *Combat stress injury: theory, research, and management*. New York, NY: Routledge, pp. 11–31.
 47. Kilpatrick DG, Resnick HS, Freedy JR, et al. (1998) Post-traumatic stress disorder field trial: evaluation of the PTSD construct-criteria A through E. In Widiger TA, Frances AJ, Pincus HA, et al, eds. *DSM-IV sourcebook*, Vol. 4. Washington, DC: American Psychiatric Press, pp. 803–41.
 48. Andrews B, Brewin CR, Rose S, et al. Predicting PTSD symptoms in victims of violent crime: the role of shame, anger, and childhood abuse. *Journal of Abnormal Psychology* 2000; 109:69–73.
 49. Maercker A, Beauducel A, Schutzwohl M. Trauma severity and initial reactions as precipitating factors for posttraumatic stress symptoms and chronic dissociation in former political prisoners. *Journal of Traumatic Stress* 2000; 13: 651–60.
 50. Martin M, Marchand A. Prediction of posttraumatic stress disorder: peritraumatic dissociation, negative emotions and physical anxiety among French-speaking university students. *Journal of Trauma & Dissociation* 2003; 4:49–63.
 51. Roemer L, Orsillo SM, Borkovec TD, et al. Emotional response at the time of a potentially traumatizing event and PTSD symptomatology: a preliminary retrospective analysis of the DSM-IV criterion A-2. *Journal of Behavior Therapy & Experimental Psychiatry* 1998; 29:123–30.
 52. Wallenius C, Larsson G, Johansson CR. Military observers' reactions and performance when facing danger. *Military Psychology* 2004; 16:211–29.
 53. Vaiva G, Brunei A, Lebigot F, et al. Fright and other peritraumatic responses after serious motor vehicle accident: prospective influence on acute PTSD development. *Canadian Journal of Psychiatry* 2003; 48:395–401.
 54. Marmar CR, Weiss DS, Schlenger WE, et al. Peritraumatic dissociation and post-traumatic stress in male Vietnam theater veterans. *American Journal of Psychiatry* 1994; 151: 902–7.
 55. O'Toole BL, Marshall RP, Schureck RJ, et al. Risk factors for post-traumatic stress disorder in Australian Vietnam veterans. *Australian & New Zealand Journal of Psychiatry* 1998; 32:21–31.
 56. O'Toole BL, Marshall RP, Schureck RJ, et al. Combat, dissociation, and posttraumatic stress disorder in Australian Vietnam veterans. *Journal of Traumatic Stress* 1999;12:625–40.
 57. Tichenor V, Marmar CR, Weiss DS, et al. The relationship of peritraumatic dissociation and posttraumatic stress: findings in female Vietnam theater veterans. *Journal of Consulting & Clinical Psychology* 1996; 64:1054–9.
 58. Spiegel D, Cardena F. Comments on hypnotizability and dissociation. *American Journal of Psychiatry* 1991; 148:813–5.
 59. Selye H. (1974) *Stress without distress*. Philadelphia: JB Lippincott.
 60. Abelson JL, Khan S, Liberzon I, et al. Effects of perceived control and cognitive coping on endocrine stress responses to pharmacological activation. *Biological Psychiatry* 2008; 64:701–7.
 61. Dienstbier RA. Arousal and physiological toughness: implications for mental and physical health. *Psychological Review* 1989; 96:84–100.
 62. Henry JP, Grim CE. Psychosocial mechanism of primary hypertension. *Journal of Hypertension* 1990; 8:783–93.
 63. Marks IM. (1987) *Fears, phobias and rituals: panic, anxiety and their disorders*. New York: Oxford University Press.
 64. Mason JW. A review of psychoendocrine research on the pituitary-adrenal cortical system. *Psychosomatic Medicine* 1968; 30:576–607.
 65. Rose SM. Endocrine responses to stressful psychological events. *Psychiatric Clinics of North America* 1980; 3: 251–76.
 66. Sapolsky RM. Endocrinology alfresco: psychoendocrine studies of wild baboons. *Recent Progress in Hormone Research* 1993; 48:437–68.
 67. Dickerson SS, Kemeny ME. Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychological Bulletin* 2004; 130:355–91.
 68. Brunet A, Sergerie K, Corbo V. (2006) Une théorie neuro-cognitive des processus impliqués dans le développement et la remission des psychotraumatismes. In Guay S, Marchand A, eds. *Les troubles liés aux événements traumatiques: dépistage, évaluation et traitements*. Montréal: Les Presses de l'Université de Montréal, pp. 119–36.
 69. Lane PS. Critical incident stress debriefing for health care workers. *Omega: Journal of Death & Dying* 1993–1994; 28: 301–15.
 70. Paton D. Disasters and helpers: psychological dynamics and implications for counseling. *Counseling Psychology Quarterly* 1989; 2:303–22.
 71. Zeiss R, Dickman H. Incidence and person-situation correlates of former POWs. *Journal of Clinical Psychology* 1989; 45:80–7.
 72. Breslau N, Davis GC, Andreski P, et al. Traumatic events and post-traumatic stress disorder in an urban population of young adults. *Archives of General Psychiatry* 1991; 48: 216–22.

73. Kessler RC, Sonnega A, Bromet E, et al. Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry* 1995; 52:1048–60.
74. Resnick HS, Kilpatrick DG, Dansky BS, et al. Prevalence of civilian trauma and posttraumatic stress disorder in a representative national sample of women. *Journal of Consulting & Clinical Psychology* 1993; 61:984–91.
75. Yehuda R, McFarlane AC, Shalev AY. Predicting the development of posttraumatic stress disorder from the acute response to a traumatic event. *Biological Psychiatry* 1998; 44: 1305–13.
76. Lee D, Young K. Post-traumatic stress disorder: diagnostic issues and epidemiology in adult survivors of traumatic events. *International Review of Psychiatry* 2001; 13: 150–8.
77. Callers J, Foy DW, Donahue CP, et al. Post-traumatic stress disorder in Vietnam combat veterans: effects of traumatic violence exposure and military adjustment. *Journal of Traumatic Stress* 1988; 1:181–92.
78. Flack Jr WF, Litz BT, Keane TM. (1998) Cognitive-behavioral treatment of war-zone-related posttraumatic stress disorder: a flexible, hierarchical approach. In Follette VM, Ruzek JJ, Abues FR, eds. *Behavioral therapies for trauma*. New York: Guilford, pp. 77–99.
79. Karnow S. (1983) *Vietnam: a history*. New York: Viking Press.
80. Baker RR, Menard SW, Johns LA. The military nurse experience in Vietnam: stress and impact. *Journal of Clinical Psychology* 1989; 45:736–44.
81. Kaminer D, Grimsrud A, Myer L, et al. Risk for post-traumatic stress disorder associated with different forms of interpersonal violence in South Africa. *Social Science & Medicine* 2008; 67:1589–95.
82. Kilpatrick DG, Saunders BE, Amick-McMullan A, et al. Victim and crime factors associated with the development of crime-related post-traumatic stress disorder. *Behavior Therapy* 1989; 20:199–214.
83. McCammon S, Durham TW, Allison EJ, et al. Emergency worker's cognitive appraisal and coping with traumatic events. *Journal of Traumatic Stress* 1988; 1:353–72.
84. Castro CA, Adler AB. Preface to the special issue. *Military Psychology* 2005; 17:131–6.
85. McCarroll JE, Fagan JG, Hermesen JM, et al. Posttraumatic stress disorder in U.S. Army Vietnam veterans who served in the Persian Gulf War. *Journal of Nervous & Mental Disease* 1997; 185:682–5.
86. Wolfe J, Erickson DJ, Sharkansky EJ, et al. Course and predictors of posttraumatic stress disorder among Gulf War veterans: A prospective analysis. *Journal of Consulting & Clinical Psychology* 1999; 67:520–8.
87. Brown KJ, Villeneuve M, Lamerson CD. (2005). Human Dimensions of Operation Survey: revision and two-year validation. Technical note 2004-10. Ottawa: National Defence Headquarters.
88. Kilgore WDS, Cotting DI, Thomas JL, et al. Post-combat invincibility: violent combat experiences are associated with increased risk-taking propensity following deployment. *Journal of Psychiatric Research* 2008; 42:1112–21.
89. Kessler RC, Andrews G, Colpe et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine* 2002; 32: 959–6.
90. Dolan CA, Adler AB. Military hardiness as a buffer of psychological health on return from deployment. *Military Medicine* 2006; 171:93–8.
91. Lazarus RS, Folkman S. (1984). *Stress, appraisal, and coping*. New York: Springer.
92. Ursin H, Eriksen HR. The cognitive activation theory of stress. *Psychoneuroendocrinology* 2003; 29:567–92.
93. Phillips ML, Drevets WC, Rauch SL, et al. Neurobiology of emotion perception I: the neural basis of normal emotion perception. *Biological Psychiatry* 2003; 54:504–14.
94. Phillips ML, Drevets WC, Rauch SL, et al. Neurobiology of emotion perception II: implications for major psychiatric disorders. *Biological Psychiatry* 2003; 54:515–28.
95. Pruesner JC, Dedovic K, Khalili-Mahani N, et al. Deactivation of the limbic system during acute psychosocial stress: evidence from positron emission tomography and functional magnetic resonance imaging studies. *Biological Psychiatry* 2007; 63:234–40.
96. Stetz MC, Bouchard S, Wiederhold B, et al. (2009) The receptiveness of stress management techniques by military personnel. In Wiederhold BK, Riva, G, eds. *Annual Review of CyberTherapy and Telemedicine 2009*. Amsterdam: IOS, pp. 125–7.

Address correspondence to:

Dr. Stéphane Bouchard

Dept de Psychoéducation et de psychologie

Université du Québec en Outaouais

C.P. 1250 Succ Hull

Gatineau

Canada J8X 3X7

E-mail: stephane.bouchard@uqo.ca