Resilience and Cognitive Flexibility Training:
A Literature Review and Discussion of Instructional Support for Integrating into Programs of Instruction

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Abstract

In this review of the literature on resilience and associated training techniques, we focus on enhancement of individuals' psychological flexibility. Having resilience means individuals are able to manage against or recover from any acute functional impairments that result from stress, and do not develop chronic impairment as a result of stress. We limit ourselves to evidence-based methods that foster focused, self-sustaining strategies. Having identified best practices for promoting resilient performance, we describe a framework for resilience training. Our curriculum encompasses resilience training content, learning environments, and assessment using psychophysiological and behavioral tools. For content, our literature review suggests three broad recommended approaches each having an evidence base, not requiring expert administration, and easily integrated into instruction. These techniques are focused breathing and relaxation (themselves components of other, more specialized techniques), simple biofeedback (its evidence shows rapid and sustained control over physiological processes), and physical activity (its evidence shows increased stress tolerance related to physical fitness). For learning environments, we characterize five representative types: Role plays, simulation-based systems, online (web or mobile) self-directed platforms, and operational contexts. For tools that measure the psychological flexibility resulting from training, we discuss the need to link behavior with physiological determinants within the learning environment.

Keywords

Psychological stress; resilience; education and training

1 Introduction

The psychological flexibility, or *resilience*, to quickly adapt to ever-changing and complex environments is key for military service members in every aspect of their lives, both on the battlefield and off. Resilience in all facets of life (Yamada et al., 2013) promises increased fitness for duty, preparedness, mission readiness, performance, and reintegration. The same holds true for individuals from numerous other areas, including athletics (Crocker et al., 2015), firefighting (Voshell et al., 2008), policing (Miller, 2008), even education (Gu & Day, 2007).

In this paper we describe a resilience training and education curriculum that integrates physiological sensor and performance metrics into any existing program of instruction to support individuals' understanding and awareness of the impact of psychological stressors on their health, and to help teach them to cope with stressors. *Our objective is to develop a curriculum to support individual resilience training through mind-body awareness, breathing and relaxation, physical fitness, and similar techniques, built on best practices revealed by the myriad of recent studies.* We aim to take an adaptive, modular approach. Our approach features didactic instruction combined with practical exercises; it looks to assess how well individuals develop stress-reduction skills, by taking advantage of existing learning environments and by using behavioral and physiological metrics; and it advocates real-time assessment data feedback and instructional guidance to instructors to facilitate their tailoring of content to the classroom and eventually the individual.

In this document we identify evidence-based best practices for promoting resilient performance in the face of the types of stressors particularly relevant to individuals such as physical exertion, lack of sleep, and danger of death or physical harm (Bartone, 2006). We are concerned with how schoolhouse instructors would effectively and efficiently integrate best practices into training, how or where the practices align with existing curricula, and whether or not they can be made modular. We are focused on those practices that can be delivered in relatively short amounts of time—hours rather than weeks—replacing or enhancing existing resilience training since individuals' training time is already extremely constrained. We are also interested only those practices for which an expert is *not* needed to deliver the training; instead each curriculum module must be presentable and integrable into the course or unit by any motivated instructor, at most following a non-complicated, non-intensive train-the-trainer program.

We conducted a literature review of existing resilience-building approaches with an open-ended

perspective, meaning we have tried to include samples of the wide range of best practice techniques. For our training purposes, we narrow down to those best practices that fit our specific requirements—ease of integration, timeframe, and non-expert delivery. We are well aware that *no one resilience-promotion methodology is necessarily superior to any other, nor does one approach fit all situations*. Instead, we advocate training a mixture of methods so that instructors are able to tailor the training to their classes, and individuals can select whichever practices fit their context, their lifestyle, and their beliefs.

The next sections present the literature review and our initial recommendations for resilience training techniques to be integrated into our resilience and cognitive flexibility training curriculum. Following the review, we present ideas for how the curriculum can take advantage of existing learning environments and measurement tools to fit neatly into an instructor's existing program of instruction and still promote resilience.

1.1 Purpose of Literature Review

In this review of literature—associated partly with military-focused resilience training techniques, but with a broader perspective—we are concerned mainly with enhancement of psychological (rather than physical) flexibility at the individual (rather than programmatic) level. The meaning of 'enhancement' is that early interventions are of somewhat more interest than later ones. Preventive resilience training can occur prior to exposure to stressors, to support the early identification of risk and to decrease the likelihood of development of any functional impairment (or related concerns such as persistent distress or other psychological health manifestations). Enhancing resilience can occur as well after symptoms appear, for example during treatment to prevent continued impairment and promote rapid recovery. We limit our interest to those methods that are evidence based and that foster focused, self-sustaining strategies (Luthar & Cicchetti, 2000; Meredith et al., 2011).

The implication of our concern with psychological flexibility at the non-programmatic level is the need to define and bound resilience training that is delivered to the individual. One definition of psychological resilience is the ability to cope with or overcome exposure to adversity or stress. By extension, having resilience suggests that the individual first is able to manage or recover from any acute functional impairments that result from the adversity or stress, and second does not develop any type of chronic impairment as a result of the adversity or stress.

1.2 Background

A recent report by the RAND Corporation (Meredith et al., 2011) identifies 77 programs designed to support psychological resilience. Of these programs, the vast majority have received funding or sponsorship from the military. These programs have taken various approaches to developing psychological resilience, focusing on mental, social, physical, and/or spiritual aspects. The target audiences for these initiatives include service members, military families, health care providers, children, and recruits. Programs are delivered by psychologists, chaplains, and other mental health professionals in small groups and classes, face-to-face, and through online audio and video presentations among other formats.

Despite the prevalence of these programs, little data exist to support their effectiveness in preventing negative outcomes involved with battlefield stress (Meredith et al., 2011; Denning et al., 2014). Many of these programs have been implemented relatively recently, and are in the process of being evaluated. Completed evaluations of these programs tend to suffer from methodological shortcomings, including lack of participants to obtain sufficient statistical power, lack of participants from military populations, and other factors. The most widely implemented resilience training program, the Army's Comprehensive Soldier Fitness (CSF), has been evaluated by researchers both internal and external to the military, and findings do not support its effectiveness (Eidelson et al., 2011; Steenkamp et al., 2013). The dearth of empirical support for these programs may be related to a lack of a strong theoretical foundation (Denning et al., 2014), that is, there is no research-based rationale for these programs to be successful in the first place.

Additional impediments to the success of these programs are difficulties in their implementation. In a detailed analysis of 23 resilience programs (Meredith et al., 2011), common issues were found with leadership support, logistical problems with scheduling, funding shortcomings, and a lack of "fit" within military culture as the most common barriers to their implementation. Furthermore, there still exists a stigma with reporting mental health issues in the services (Sharp et al., 2015), and many service members feel that seeking out these programs is a sign of weakness.

Though these studies seem to paint a bleak picture, in truth they describe many resilience enhancement techniques that do, according to other literature, have substantial benefit. For a resilience training curriculum to be successful, then, the challenges identified in these studies must be adequately addressed. A useful, representative set of techniques have to be taught and learned effectively and efficiently. In the remainder of this document we present our approach to overcoming these challenges.

1.3 Defining and Measuring Resilience

According to Denning et al. (2014), more effective preventive interventions can be promoted by determining risk factors for future impairment and moderators and mediators to be manipulated to reduce that risk. Nash et al. (2011) are concerned that there remains a lack of well-defined categories and instruments to identify such risk, but increasingly validated measures are being developed. For instance, Smith et al. (2013) propose a six-item brief resilience scale based on a definition of resilience that most closely matches the original meaning of the word—the ability to recover from stress—and discuss personal and social resources such as mindfulness, optimism, purpose, and active engagement in coping skills. ('Coping' and 'resilience' are used synonymously here, although there is some evidence to suggest they are slightly different constructs; Fletcher & Sarkar, 2013.) The Connor & Davidson (2003) resilience scale has received some support for its use in assessing intervention impact, but neither it nor other measures reach the level of a "gold standard" (Windle et al., 2011). We and others have advocated situated tasks for measuring resilient behaviors (Hubal, 2012; Pangallo et al., 2015).

Castro & Adler (2011) cite a technical panel that defined resilience as comprising "the sum total of the psychological processes that permit individuals to maintain or return to previous levels of well-being and functioning in response to adversity". Burns & Antsey (2010) suggest resilience is a "network of…attitudes and behaviours that enable adaptive coping strategies" to stressors. The key is that these definitions rest on psychological and behavioral mechanisms, rather than attributes or risk or protective factors that confer susceptibility or resistance to the harmful effects of adversity. Those instead are covariates (or mediators or moderators), along with environmental and social factors, but by this definition *the concept is one can enhance one's own resilience through intervention*. Resilience is thus a latent construct inferred through an individual's behavior in response to adversity. *We subscribe to this approach, and the training practices we aim to deliver take the perspective that change in behavior—through actions as well as intentions—is key to resilience-building.*

One type of foundational support for resilience promotion is found in Carroll et al. (2012), who present a framework under which resilient behavior both is adaptive and fosters recovery ("bounce-back"). A satisfactory training program, under this framework, would incorporate skills that support these two components. Another standard of evidence for effective prevention programs—as well, in this case, intervention—is based on their efficacy, effectiveness, and dissemination (Flay et al., 2005). Effective

programs take into account sociocultural factors and are life-stage appropriate. They use varied methods of delivering knowledge and seeking behavior change, particularly active over passive methods. Meanwhile, Denning et al. (2014) refer to proximal and distal outcomes, and cite relevant SAMHSA guidelines for having six programmatic goals, including promoting cost-effective and safe prevention, treatment, and recovery practices and ensuring behavioral health care is person-centered.

2 Interventions

Meredith et al. (2011) found several individual-level resilience-promotion factors within the military programs they studied, including positive thinking, positive coping, positive affect, behavioral control, and realism training. Social integration and group involvement are the community factors most widely used by programs. Many technology-based resilience training programs rely on common techniques, broadly categorized as mind-body practices, stress inoculation training (SIT), forms of cognitive-behavioral therapy (CBT), and arousal control and self-regulation (Taylor & Schatz, 2011; Vakili et al., 2014). Lake (2015), meanwhile, provides some guidance for use of various complementary and alternative medicine (CAM) interventions including those that address desensitization to stress experiences, biofeedback, and physical and even nutritional therapies. We touch on all of these approaches here.

As is suggested by the number, range, and overlap of existing programs, there are many approaches to training resilience, and most are complementary. Mindfulness-based stress reduction (MBSR), for instance, typically involves mindfulness meditation and some form of workout, such as yoga (Li & Goldsmith, 2012; Menezes et al., 2015). Meditation itself has a number of techniques, including concentration (e.g., on breathing, on a mantra, or on a single point, to cultivate attentional control), mindfulness (which focuses on thought patterns, to enable the individual to better engage in the present), and relaxation (for letting go of stressors when, for example, they interfere with sleep). Mindfulness-based mind fitness training (MMFT) is an elaboration of MBSR intended as much for inducing stress resilience as stress reduction. In parallel, practitioners of these skills often practice yoga, tai chi, or even just stretching; these exercises (of which there are also many variants) both relax the body and focus energy productively. Castro & Adler (2011) claim that principles of mental health training include relevant and purposeful content, based on experience, and an action-based approach.

2.1 Mindfulness, Meditation, and Mind-Body Practices

2.1.1 Overview and Evidence

2.1.1.1 Types of Mindfulness Practices

Mindfulness is described as bringing one's attention to the present experience on a moment-by-moment basis (Stanley et al., 2011). Practitioners see mindfulness as a means to become increasingly aware of one's own "internal experience" and, through different techniques, to learn to focus or redirect attention (Baer, 2014). To get participants to accept mindfulness as a tool to promote resilience, they typically introduce a range of practices, including controlled breathing, progressive muscle relaxation (PMR), and guided imagery. Rees (2011), for instance, offers three candidate mind-body techniques having three very different mechanisms of action and thus different cognitive, physiological, and physical effects. These are transcendental meditation (sometimes referred to as 'restful alertness', although the technique is formally proprietary and standardized), mindfulness (broadly construed, to include concentration, insight, and Zen mediation) or stress management, and PMR.

Jha and colleagues (2010) showed that mindfulness training can have a positive impact on working memory capacity—as a measure of cognitive control—and on emotion. These findings are important in that managing cognitive demands and regulating emotion allows individuals to focus attention on goals and thus better handle stressful situations. Salmon et al. (2011) discuss how mindfulness is usable for effecting change in the context of a transactional model of stress and coping (Glanz et al., 2002), which states that in response to a stressor or threat, the individual engages in primary appraisal of the event itself, secondary appraisal of one's own coping resources and strategies, and appraisal of outcomes. Mindfulness training emphasizes awareness by promoting attentional control and "tolerance for challenging experience, both external (i.e., harsh environmental conditions) and internal (e.g., physical pain, intense emotions, distressing thoughts)" (Johnson et al., 2014). It can work in concert with other techniques, such as self-regulation of stress responses, to enhance stress resilience.

Wadlinger and Isaacowitz (2011) elaborate on how training attention (e.g., through MBSR or even gaze fixation) can be used to regulate emotion, in turn boosting resilience. Wadlinger and Isaacowitz describe three forms of attention. First, concentration, comprising alerting (readiness), orienting (selective focus), and executive control (inhibitory) mechanisms, requires individuals to "engage their cognitive resources" to

focus on stimuli and/or maintain awareness. Second, distraction training recruits the orienting and executive control mechanisms to purposefully shift focus towards or away from information, particularly valenced content, and possibly make sense of conflicting content. Third, rumination involves directing focus 'inward' towards feelings. There is "savoring" of positive emotional content that makes good use of the attentional mechanisms (i.e., controls focus on negative thoughts or adverse reactivity), but also maladaptive rumination (e.g., an inability to "disengage from repetitive negative thoughts" or otherwise perseverate on content) that may indicate that non-optimal attentional functioning. Present moment awareness is typically associated with attention and reflection, whereas emotional acceptance is typically negatively correlated with rumination and thought suppression (Teper & Inzlicht, 2013).

2.1.1.2 Physiology and Mental Health

Mindfulness has physiological correlates that suggest stress reduction. Johnson et al. (2014) showed during early immersive training, mindfulness training altered heart rate and breathing rate recovery following stressful training, and correlated with a set of biomarkers before, during, and after exposure to stressful training. Quaglia et al. (2015) showed that mindfulness practice has measurable event-related potential (ERP) effects, specifically a speeded response to discernment among happy, neutral, and fearful facial expressions. As Quaglia et al. suggest, mindfulness may enhance the quality of social behavior in socioemotional contexts by promoting efficient top-down attention to and discrimination of others' emotions, alongside greater monitoring and inhibition of automatic response tendencies. Teper and Inzlicht (2013) showed that mindfulness practice influenced error-related negativity (ERN), the neural response that occurs after commission of an error. Mindfulness meditation led to fewer errors, higher ERN (indicating greater attention), and greater emotional acceptance of errors. Lewis et al. (2015) found that, through their predeployment SIT (PRESIT) approach, participants exhibited greater heart rate variability (HRV; indicating *reduced* arousal) during a post-training live environment simulation designed to *heighten* arousal.

Fjorback et al. (2011) conducted a meta-analysis of MBSR and MBCT (Mindfulness-Based Cognitive Therapy) studies, and found that MBSR generally improved mental health compared to treatment as usual (TAU), and that MBCT could reduce the risk of depressive relapse compared to TAU. Overall, studies showed medium effect sizes. Lake (2015) suggests enhanced coping is achieved through the practice of meditation, particularly with others so as to reduce stigma and establish "social connections". MacCoon et

al. (2014) showed that MBSR, in comparison to a control, did not lead to improved ability in sustained attention but might affect visual discrimination.

2.1.2 Summary and Implications—Mindfulness Practices

Thomas and Taylor (2015) propose to build on a culture, represented by the military, of mission orientation and stoicism to develop a mindfulness-based pre-incident training regimen to reduce stigma and lessen adverse consequences of exposure to stressful situations. *While we support the intent behind such proposals, a drawback for our purposes is the intensity and extensiveness required of mindfulness training.* For instance, the participants in Jha et al. (2010) were taught by an expert in mindfulness practice, in a course involving 24 hours of class instruction over eight weeks, with on average weekly two-hour meetings and a full-day silent retreat. Similarly, Johnson et al. used a 20-week course with requests of participants to practice daily mindfulness and self-regulation exercises of at least 30 minutes. MacCoon et al. (2014) required eight weeks of training, and the participants in Teper and Inzlicht (2013) needed to have at least one year of meditation experience.

However, components of mind-body practices have merit in and of themselves, some of which can be taught and learned in shorter periods of time through self-directed or non-expert instruction, and which appear to have meaningful influences on neural networks and brain state (Tang & Posner, 2014; Xue et al., 2014). Some individuals, we believe, can acquire skills such as controlled breathing, gaze focus, and stretching that might not attain the sophistication of attentional control or accomplished yoga but still support adaptation and coping under stressor situations and recovery from those situations.

2.2 Stress Inoculation Training

2.2.1 Overview and Evidence

SIT is a three-phase process involving psychoeducation, coping skills acquisition, and the application of these skills in the presence of gradually intensified stressors. Serino et al. (2014) conducted a literature review of SIT approaches, focusing on the delivery of the training and psychophysiological measures of effect. Because we are mainly interested in resilience promotion, we discuss two SIT studies addressed by Serino et al., PRESIT (Hourani et al., 2011) and STRIVE (Rizzo et al., 2012).

STRIVE is stress resilience training aimed at enhancing emotional coping strategies prior to active deployment to a live environment. In it, an immersive simulation presents live environment situations and a

virtual coach guides the participant, encouraging relaxation and emotion self-regulation. In PRESIT, the concept is to train resilience promotion techniques such as breathing and relaxation and then capture participants' behaviors (joystick controller responses to reaction time stimuli and identification of weapons, suspicious items or activities, and aircraft) during training within a stimulus-laden video- and game-based environment (Hubal et al., 2010).

There are important differences in scope between PRESIT and STRIVE. At their core PRESIT and STRIVE differ in what they train and what they require of the individual. STRIVE considers the appraisal of stressful events that cause emotional reactions, and how such appraisal can be redirected toward more resilient reactions. To do so STRIVE seeks to create an environment in which individuals can learn and practice situation-specific strategies to cope with live environment-related stressors. STRIVE scenarios, based on virtual reality (VR) exposure work (Reger et al., 2011), are intended to be wide-ranging and narrative-based so as to emotionally engage individuals and to generalize to true live environment experiences. Further, STRIVE aims to investigate if it is possible to predict the impact of appraisal of stressors on allostasis across numerous physiologic measures in response to stressful VR scenarios, and any benefits of stress resilience training.

PRESIT, in contrast, is not focused on appraisal of stressful events rather stress mitigation techniques themselves. The use of a virtual environment in PRESIT is for practice of SIT skills in a somewhat realistic environment, not *per se* to have individuals confront realistic live environment situations, although the intent is also that the situation-agnostic techniques practiced in this environment generalize to true live environment experiences. The purpose of a physiologic measure (HRV) in PRESIT is to consider the influences of the kind of stress resilience training employed (breathing and relaxation exercises) in response to an overall stressful scenario.

For STRIVE, VR is inherent to creating an immersive environment in which individuals can learn and practice context-dependent skills. Training is focused on the individual, hence presents a variety of virtual experiences. What the individual does in the VR environment needs to relate to what would be done in an actual live environment context to capture stress reactions. For PRESIT, the technology is convenient to creating an environment in which individuals can practice more general learned skills. Training is not individualized, hence can be group based and use a small set of non-immersive virtual experiences. (Training could be individualized, though at some cost to the minimizing of stigma associated with learning

stress-reducing techniques with others and then practicing them when needed.) What the individual does in the environment is marginally related to what would be done in an actual live environment context, instead it is a means of gathering general stress reactions.

2.2.2 Summary and Implications—Stress Inoculation Training

The implication for purposes here is that either technique, and SIT in general, appears to be stress-reducing. When administered in advance of a stressor environment (as with early intervention) SIT engenders coping skills. When administered subsequent to a stressful situation it is intended for recovery (Wiederhold & Wiederhold, 2008). The studies show that, in support of our goals of ease of integration, timeframe, and non-expert delivery, a combination of individually convenient components (breathing exercises, learning emotional appraisal) tested in a relatively expedient format (a simulated environment) has benefit for participants.

2.3 Cognitive-Behavioral Therapy

2.3.1 Overview and Evidence

CBT is based on the theory that psychological problems result from and are maintained by "cognitively distorted" perceptions of and perseveration over experiences and events (Vakili et al., 2014). Accordingly, changing faulty patterns of thinking and behavior or reframing distorted thoughts can improve psychological functioning, and intrusive thoughts can be dealt with through distress management skills. CBT uses various techniques to develop coping strategies (Rothbaum et al., 2000), but generally tries to address maladaptive thoughts and behaviors through goal-directed action and self-awareness. A CBT program might incorporate, for example, sessions on understanding the nature of stress and stress reactions, breathing and/or relaxation exercises, and cognitive restructuring techniques (Crawford et al., 2013). To illustrate the latter, one technique often employed is expressive writing, commonly through journaling. The individual might be encouraged to record situations or events, initial beliefs, identification of negative thinking, possible consequences, and alternative explanations. Adler & Castro (2013) found that expressive writing is supported in the civilian literature, although with service members who report high levels of combat exposure it is contraindicated.

Mansdorf et al. (2007) present a representative coping intervention that derives not from live environment experience but from civilian exposure to war-related stressors. The Mansdorf et al. approach

involves three components. First is to reinforce a sense of safety, in the authors' case the physical environment in which civilians survived but in general the perception (e.g., on the part of the service members) that they are in a place where they can practice additional coping skills. Second is social support, similar to organizational factors described by Denning et al. (2014). Third is what Mansdorf et al. refer to as BASIC Ph, six coping resources originally promulgated by Lahad (1997). These are beliefs and values, affect, social support, imagination, cognition, and physiology. Any one of these six factors can be called upon to counter any distress that may be present. For example, physiology can be a factor in distress, and express itself in shaking, sweating, or quickened breathing, but physiology can also be used as a mechanism to control and manage distress, by employing relaxation techniques such as controlled breathing and muscular relaxation. Similarly, one's imagination can cause considerable distress by focusing on worst case scenarios, similar to the maladaptive rumination described by Wadlinger and Isaacowitz (2011). However, imagination, and attentional control more broadly, can also be called upon to look at the future in a more hopeful and optimistic manner, such as in focusing on a future event or even employing fantasy material to divert attention from the objective-but-transient reality being experienced. Cognitive factors, meanwhile, are logical and rational approaches to dealing with the trauma. This takes the form of dialogue, discussion, and the use of specific strategies to cope with threat or trauma. A different but related form of CBT, meanwhile, is Acceptance and Commitment Therapy (ACT; Ruiz, 2010). ACT enhances resilience through its own six focus areas, including acceptance of uncomfortable thoughts and feelings, self-awareness, and commitment to achieving growth in personal values. ACT is delivered in individual sessions, in small groups, or through print or interactive media, with a varying duration dependent on the individual's needs.

2.3.2 Summary and Implications—Cognitive-Behavioral Therapy

For the purposes of this review, CBT is valuable but not readily deployable, as it is a therapy rather than a kind of training. However, some techniques associated with CBT and utilization of coping resources may be more easily teachable and can form part of our training package.

2.4 Arousal Control and Self-Regulation

2.4.1 Overview and Evidence

2.4.1.1 Biofeedback Methods

In biofeedback, individuals learn conscious control over body functions that are often thought to be autonomous, such as brain activity, blood pressure, and heart rate. This self-regulation is accomplished by observing the real-time display of physiological indicators during, and changes in bodily signals as a result of, training.

There are many techniques to support biofeedback. Hourani et al. (2011) used a simple oscillating panel and enticed participants to maintain their heart rate, using controlled breathing, within set bounds. Andersen et al. (2015) used controlled breathing and imagery and simple audio recordings to control heart rate and respiration. Other researchers employ a virtual environment to produce high physiological arousal and thus be used as a technique for anxiety induction (Brouwer et al., 2011; Carroll et al., 2012, 2014; Chittaro, 2013; Johnston et al., 2015) and through that arousal control. Russoniello et al. (2013) show how biofeedback helps individuals with anxiety and depression to learn to relax. Russoniello et al. used a non-invasive monitoring device (e.g., ear clip or finger cuff) to record biological signals during a recreational activity (in that case, video game play). McCraty and colleagues (Cohn et al., 2013; McCraty & Atkinson, 2012; Weltman et al., 2013) discuss their training system, a mobile approach using biofeedback and cardiac coherence training to help individuals manage stressors, limiting adverse effects and boosting their value in mission performance. McCraty & Shaffer (2015) describe how the self-regulation demonstrated by HRV coherence suggests resilient behaviors in response to changing and stressful contextual demands.

Biofeedback is rarely used in isolation from other resilience-promotion methods. For instance, CBT and biofeedback are often used in combination (Squire et al., 2014) for resilience training, especially in response to exposure to trauma. Hourani et al. (2011) integrated biofeedback into their PRESIT. Oded (2011) describes a mix of techniques, including biofeedback, mindfulness, and SIT, to help individuals better cope with stressors.

Eye movement desensitization and reprocessing (EMDR) is a psychotherapeutic approach similar to exposure therapy (Reger et al., 2011) in which the therapist guides the patient to engage in left-right eye movements (or other forms of bilateral stimulation) while at the same time recalling and working through

('digesting') a traumatic event. EMDR is mainly used to treat psychological problems such as anxiety disorder and addiction, though is also characterized as a self-help technique (Shapiro, 2012) so may be pertinent to resilience promotion. Russell and Figley (2012) discuss variations of EMDR that may be used to strengthen and promote resilience in high-stress situations. Jeffries and Davis (2013) suggest that EMDR could be useful as an adjunct to other techniques, such as CBT, at least in some circumstances, since rhythmic eye movement appears to lessen distress through diversion of attention from stressor stimuli and thus may facilitate the other components of the intervention.

Mental imagery, the intentional imagining of (usually positive) situations or events, has been shown to positively affect cardiac coherence (Kaplan & Epstein, 2011-12). Tarrier (2010) describes how even brief intervention involving positive imagining can lead to improved resilience. Guided imagery is a similar idea that also recruits the senses for a 'multisensory experience' used as a relaxation technique, often in concert with breathing and relaxation. Bedford (2012) provides one explanation how imagery techniques combined with mindfulness might lead to physiological benefit. There is some question, however, as to the applicability of imagery approaches as there are individual differences in auditory and visual imaging abilities (Hubbard, 2010; Kosslyn et al., 1984).

Tactical (controlled) breathing is taught to specialists including special warfare troops, police, snipers, and athletes for use during their missions (Grossman & Christensen, 2004). Hourani et al. (2011) adapted the instructions to indicate that the stress breathing would be in two parts (attentional retraining prior to a mission; restoration training subsequent), and found that the training influenced individuals' HRV (Lewis et al., 2015). Zotov et al. (2011) report similar results; increased cognitive performance was reflected in telling patterns of phase shifts in HRV. In general, arousal control techniques such as deep breathing can help with attentional focus and, with other cognitive reframing or psychotherapeutic methods, help individuals overcome triggers of negative emotion by broadening perspectives or seeing situations from different angles (Vakili et al., 2014).

2.4.1.2 Computing-Intensive Methods

We have already mentioned that many of the techniques described here are used in concert to promote resilience. The same is true of the technologies used to support those techniques. One such technology is VR or game-based simulation systems. For instance, VR-based graded exposure therapy protocols have linked general stress levels with real-time neurophysiological data, and may have some relevance for

enhancing stress resilience (Lake, 2015). Similarly, Russoniello et al. (2013) engaged participants in biofeedback during game play while Hourani et al. (2011) focused on SIT using a video- and game-based environment. Another approach is described by Sotomayor et al. (2013) who present a high-fidelity, severe-trauma simulator for medical personnel to learn to manage stressful injuries. Gaggioli et al. (2014) also use VR in a paradigm they label Interreality for the prevention of adverse response to and management of stressors. In this approach Gaggioli et al. propose that the individualized experience in the real world continuously interacts with therapist-controlled challenging tasks in a virtual world. The aim is to be able to monitor stress levels and decision making as participants cross the virtual/real boundary, provide guidance and feedback to improve self-awareness, and ultimately deliver improved appraisal, coping skills, and self-efficacy. At a lower end of technology use, Evers et al., (2006) describe a program targeting effective stress management practices, in an attempt to effect behavior change through five stages (pre-contemplation, contemplation, preparation, action, and maintenance). Activities include relaxation, exercise, and social support activities. The program employs an expert system to provide individualized feedback reports on stress management behaviors throughout the intervention. Vakili et al. (2014) consider the role of advanced technology in stress-resilience training, and have produced a set of guidelines for development and requirements for intervention.

2.4.2 Summary and Implications—Arousal Control and Self-Regulation

For our training package, the practice of biofeedback appears promising, particularly when used in conjunction with engaging experiences such as are provided by game-based environments. The physiological outcomes, such as HRV coherence or better-managed blood pressure (McCraty & Atkinson, 2012), are important in and of themselves, but there is additional benefit in the individual learning to achieve this control through self-directed activities such as breathing and imagery.

2.5 Service-Specific Initiatives

2.5.1 Overview and Evidence

According to Adler & Castro (2013), it is critical to consider how elements of the individual's job influence resilience. For instance, a sense of mission and responsibility is inherent in all that service members do. Adler & Castro note that these characteristics have positive influence when viewed from an occupation perspective (e.g., a willingness to take risks and control emotions) but negative effect in non-

occupational settings (e.g., unnecessary risks, flatness of emotion). This viewpoint is a foundation of a series of service-specific resilience training approaches, described next.

2.5.1.1 Comprehensive Soldier Fitness

The goals of the U.S. Army's CSF (now a component of Comprehensive Soldier & Family Fitness, CSF2, which in turn is encompassed by the Army's Ready and Resilient Campaign, or R2C, campaign) program fit directly with the aims of this research: To prevent adverse functional impairments consequent to exposure to stressors by increasing resilience in service members prior to deployment. Denning et al. (2014) describe several reviews of CSF that do not support its effectiveness, but its developers defend the initiative. They argue that the CSF program, among other aspects, includes tailored online training focused on service members' physical, mental, emotional, social, familial, and spiritual fitness (Cornum et al., 2011), as indicated by their responses to a hundred-odd question survey (the Global Assessment Tool; Lester et al., 2013). The training modules (which encompass the resilience training described next) involve assertiveness, negotiation, social skills, creative problem solving, cognitive restructuring, positive psychology and the use of optimism and positive explanatory approaches, and decision making. CSF also promotes psychological health by requiring as well as encouraging service members to participate in training sessions—at home stations or in the live environment, as appropriate or needed—conducted by Master Resilience Trainers (MRTs).

2.5.1.2 Army Resilience Training

What are now the U.S. Army's comprehensive resilience modules began as Battlemind (Castro et al., 2006), which in turn shares roots with the Australian Defense Forces' Self-Management and Resilience Training (BattleSMART). Battlemind is an empirically-based mental health training program for preparing service members for the psychological demands of the live environment (Castro & Adler, 2011). Different Battlemind modules are intended for predeployment, during combat, and post-deployment. All of the training is intended to be delivered in small-group, at most one-hour settings to encourage interaction and discussion. Predeployment Battlemind uses a psychoeducational approach, not dissimilar to CBT, in that individuals are taught to identify different types of traumatic events; to recognize psychological problems in themselves (and others); about the prevalence of psychological problems; to reflect on and normalize their own reactions to operational stressors; to seek help to discuss anger, withdrawal, or sleep problems; and in general to maintain a mental 'toughness' in stressful contexts, thus gaining self-confidence in their

resilience—"facing fear and adversity with courage". These attitudes and skills, and the destigmatization of help-seeking, are meant to carry over during deployment, when service members are taught to recognize stress management concerns as cumulative effects of stressors build up.

Post-deployment, Battlemind is focused on transition, including those stressors associated with everyday, mundane relationships and responsibilities (as opposed to the often arousing aspects of the live environment). In sessions led by a psychological health professional, it reinforces that the skills that served in the live environment can be adopted—and adapted—for the transition out of the live environment. Battlemind, unlike other types of post-deployment approaches, does not encourage recounting or reliving traumatic events, as it is intended more as resilience building than restorative, although Shipherd (2013) describes a study focused on post-deployment intrusive deployment-related thoughts.

2.5.1.3 Combat Operational Stress Control

The U.S. Marine Corps developed its Combat Operational Stress Control (COSC) for preventing, identifying, and treating potential adverse responses to stressor events. One part of COSC is training service members on how to perceive of stress as a continuum, using a color-coded model (green to indicate readiness; yellow for reactivity; orange for injury; red for illness; MCRP 6-11C & NTTP 1-15M, 2010). Another part is leadership training (as opposed to service member training) on mitigating stressors, identifying stress reactions, and confronting stress casualties (Nash, 2011). A third part is a first aid 'toolkit' for care of combat operational stress injuries.

Under its Operational Stress Control and Readiness (OSCAR) program, the Marine Corps trains and certifies leadership on COSC. Like MRTs, OSCAR mentors are able to serve as role models and deal with stress problems. More expert personnel—OSCAR 'extenders' who, as medical staff and religious specialists, may be early in spotting stress reaction, as well as psychological health personnel—provide additional stress control services and promote healthy social functioning.

A similar program is the U.S. Air Force's Airman Resilience Training (Gonzalez et al., 2014), also a psychoeducational program for boosting stress reactions prior to, during, and after deployment. Acosta et al. (2012) describe the Army's Real Warriors Campaign, an attempt to address issues related to mental health and psychological well-being among service members and their families, including programs designed to promote resilience and reintegration of service members returning from combat zones, and to support their families. Acosta et al. do not discuss more than core messages and health communications,

but the campaign website (www.realwarriors.net) provides information on behavioral fitness and breathing, meditation, and relaxation techniques.

2.5.2 Summary and Implications—Service-Specific Initiatives

Our training curriculum is not intended to replace or subsume existing service-specific resilience training. Instead, we aim to augment the knowledge and skills that service members learn in them, and elements of that training can be incorporated into the curriculum as an instructor sees fit.

2.6 Other Approaches

2.6.1 Overview and Evidence

2.6.1.1 Sociocultural Training

Though it does not address resilience *per se*, training on social and cultural knowledge and skills may benefit individuals and help them cope with stressors. The recently-completed DARPA Strategic Social Interaction Modules (SSIM) program sought tools, techniques, and strategies to create positive outcomes in difficult (high-risk, high-consequence) social encounters. The goal was training on skills such as perspective-taking, sense-making, and reflection and recovery (Hubal et al., 2015b) that allow an individual to adapt to and successfully manage interactions that occur on unfamiliar "social terrain". In current courses, language, regional expertise, and culture concepts are discussed in the classroom but not typically applied in field exercises, hence individuals do not gain confidence in their ability to manage the unexpected or difficult interactions requiring complex skills. Schmitt (1994) describes the idea behind tactical decision games as a process of putting the student in a role facing a tactical problem with limited time and information. Repeatedly working through courses of action helps decision-making become more effective and efficient. Halverson et al. (2015) describe a study of two SSIM training tools designed to achieve similar sets of learning objectives related to social interaction skills. Cacioppo et al. (2015) report on results of a study that investigated the separate benefits of social resilience training and cultural awareness training. Social resilience led to increases in learning objectives such as perspective taking that can serve individuals in the live environment, whereas cultural awareness led to decreased negative attitudes that can help individuals in understanding causes and effects of stressful events.

Some interventions are more about knowledge of others' tendencies that own. For instance, a 1-2 hour course on recognizing others' potential for adverse behaviors (e.g., QPR Gatekeeper Training for Suicide

Prevention; Matthieu et al., 2008) is important for colleagues, coworkers, friends, and family to identify warning signs of trouble but also to understand what to look for in themselves. Certain of the service-specific programs, such as COSC, also involve maintenance of awareness and need for stress mitigation by others.

2.6.1.2 Arts and Physical Therapies

Just as technology is used in conjunction with, or to support, resilience promotion methods, so do a number of CAM techniques. Many of these are therapies used most often to elicit communication and encourage personal development in individuals with behavioral, emotional, and/or mental health problems, through such media as art, music, poetry, creative writing, and play (Sargent et al., 2013). Some are specialized techniques that require expert administration, such as acupuncture, others more general techniques that can be learned largely by the individual. Yoga, for instance, has been found to support emotion self-regulation (Menezes et al., 2015) and to decrease depressive and anxious symptoms (Pascoe & Bauer, 2015). Salmon et al. (2011) describe mindfulness practice and its reliance on CAM techniques such as body scan (systematically and intentionally moving attention throughout the body, attending to sensation in different regions), yoga, meditation, and cognitively oriented awareness practices. Kemper and Khirallah (in press) discuss how shortened versions of self-guided techniques such as relaxation, guided imagery, and mindfulness can have beneficial effects on motivated participants. The course produced by Jha et al. (2010), in addition to MBSR, didactically covered topics in how to integrate mindfulness skills in realistic situations, and included a stress resilience skills section, drawing on concepts that provided specific guidance for using focused attention to reregulate physiological and psychological symptoms following an experience of extreme stress. Diet, similarly, may influence stress response or reaction (Montain et al., 2010). Nutrients including vitamins and minerals, amino and omega-3 fatty acids, anti-oxidants and other natural products may increase resilience and reduce the severity of response to stressor exposures. Finally, exercise, in the form of physical movement in general or specific activities such as martial arts, participation in sports, or engaging in recreations such as hunting or hiking—perhaps even play with one's children, as is encouraged by CSF2—generally leads to stress tolerance and thus resilient behavior (Salmon, 2001; Yi, 2004).

Crawford et al. (2013) reviewed CAM studies that involved multiple integrated self-managed emotional control techniques, relevant in that the techniques are not solely self-learned nor are reliant on an ongoing

basis on a trainer or therapist. The high-quality programs that Crawford et al. identified include MBSR; Cognitive Behavioral Stress Management (CBSM, another long-term, group-based program that combines relaxation, imagery, deep breathing, and CBT to reduce tension and intrusive stressful thoughts and improve interpersonal communication skills); biofeedback-based techniques including Autogenic Training (AT) that uses self-suggestion to achieve relaxation and regulated breathing and heartbeat; a form of transcendental meditation called Relaxation Response Training (RRT) intended to reverse sympathetic activation that produces a stress response; yoga; and studies that involved relaxation techniques (e.g., PMR) combined with techniques like deep breathing, guided imagery, or CBT. One of the observations is programs like MBSR and CBSM require substantially more specialized training of and sustained practitioner involvement, compared to interventions like AT and RRT which can be more quickly learned by participants.

2.6.1.3 Unhealthy Coping

To be complete, we note that there are negatively-perceived coping mechanisms on which many individuals rely as a way of dealing with or distracting themselves from stressful experiences. For example, many researchers have noted an increased use, generally post-deployment, of alcohol, smoking, drugs, overeating, unsafe driving, and many other risky behaviors in service members (Acosta, 2012; Adler & Castro, 2013; McCraty, 2012; Meredith et al., 2011). Just as clinicians may advocate a mix of healthy coping techniques to maintain engagement in the resilience promotion process (Shipherd, 2013), so some individuals tend toward multiple unhealthful practices in an attempt to accommodate their stresses. We have advocated an approach to assessing tendency toward these behaviors as a first step toward treatment (Hubal, 2012), but the same assessment could be used to guide prevention and resilience promotion.

2.6.2 Summary and Implications—Other Approaches

Of the approaches just presented, those that we see fitting initially into a training curriculum are the CAM-based methods that rely on physical movement. As training advances, we envision other methods, such as creativity-based techniques like journaling, art, and music, easily integrating as well. We can also foresee some types of 'unhealthy' practices being suggested in appropriate contexts—consider, for example, suggesting to the individual that he or she set aside time to do nothing but relax while drinking a beer—but we will not advocate for any such behaviors and these recommendations are not included in our curriculum.

3 Making Sense of the Literature

3.1 Learning Environment and Assessment Tools

The intent here is to be mindful of what practices work best for different individuals in different contexts. One venue is the classroom, in which evidence-based techniques such as MBSR (Baer, 2003), MMFT (Stanley et al., 2011), and meditative breathing for control and relaxation (Hourani et al., 2011) may be introduced in a group setting. Also in that setting it can make sense to look to create an immersive (in the sense of home theater, rather than use of head-mounted displays) experience for generating certain levels of stress (induced, e.g., through increased challenge, emotional realism, and lack of control), by which the individuals can practice their skills. Existing behavioral metrics can be adapted that are known to reflect maintained or diminished performance under stress, including reaction and response times, (in)appropriate response to stimuli, impulsiveness, and perseverance. When appropriate, based on the individuals' actions, and when these devices are available, physiology monitoring occurs through non-invasive means, such as earclip HRV, smartbands, pressure-sensing devices, or even a wireless cardio or neural activity monitors, feeding those data to instructors or a tutoring system for analysis to rapidly determine effects of stress or stress control on performance. It is also important that instructors understand how to integrate these practices seamlessly into their existing curricula, given pressures on training time and availability; it is impractical to consider developing an entire new course or training program just for resilience skills. The content should fit with any course's specific program of instruction.

Another venue for applying resilience skills is outside the classroom. Resilience skills are intended for daily life, not just the battlefield. Certainly there can be takeaway materials from the class such as notecards and links to information and guidance found on online resilience sites (e.g., www.nccosc.navy.mil; www.realwarriors.net). But it is of interest to study how, for instance, to integrate with existing technologies like mobile phones (Kizakevich et al., 2014) and smartwatches to provide continuous assessment capability as the individuals experience daily stressors—and sustainment training, perhaps through mini vignettes portrayed on small screens that encourage the individuals to practice their skills.

These settings and assessment tools are discussed further in the learning environments and metrics sections below. It is exactly our intention that we provide instructors with the background and resources needed to integrate evidence-based best practices seamlessly into their existing programs of instruction.

3.2 Comparisons Across Interventions

Table 1 summarizes the discussion of resilience techniques just presented. The table provides justification for the techniques we aim to choose for resilience and cognitive flexibility training, at least initially, in light of the criteria we have set out for our curriculum (ease of integration, timeframe, and non-expert delivery).

{insert Table 1 about here}

4 Learning Environments

We have gone into detail to identify evidence-based best practices for promoting resilient performance. In our review of literature associated with resilience training techniques, we focused on prevention or enhancement of psychological aspects of individuals' resilience. That review fits into a larger picture, for which our concept is to identify evidence-based training content for use in our resilience and cognitive flexibility training curriculum, a framework which also includes two other components, presented in more detail now. These two components are the *environments in which training takes place* and the *tools used to measure learning*.

To simplify, we characterize just five types of learning environments, that is, settings in or through which an individual might learn and practice resilience skills. These five are the classroom, role plays, simulation-based systems, online (web or mobile) platforms, and group exercises. We note, though, that these five are each representative of a host of similar or analogous conditions and thus together cover a large portion of possible learning environments.

4.1 Classroom

The classroom environment is instructor-led or at least instructor-guided. The instructor determines when and how to insert resilience content into the course and across the course's timespan, eventually to cover most or all skills. The content can be introduced using different training methods most appropriate to the place in the course and the skills being taught. Relatively static content such as that included in CSF or COSC is useful for refresher training, and can serve as foundational knowledge for more active learning. Thus, for instance, role plays (described next) are useful for blocking out a scene and experiencing surprising elements of what is being taught, but less relevant for simply learning about resilience skills themselves. Further, the elements associated with knowledge *about* resilience skills would be brought into

the course earlier, as though the service-specific programs, and the experiential parts—knowledge of *how to* or *when to*—later, after individuals have had built a skills foundation. The instructor is also responsible for addressing transfer of training by using variants of situations portrayed. The idea is to present, for example, a given situation early in the course with little conflict and relatively well-defined behavioral responses to critical junctures where conflict does exist, while later in the course present the same general situation (having the same players, setting, initial conditions as the base situation) but repurposed to bring out nuances in appropriate behavioral responses. Later still, the instructor might resort to role plays in which a small team might run through several additional variants to learn to expect (and deal with) the unexpected.

4.2 Role Plays

Role plays are a viable training method in some contexts for somewhat realistic practice and assessment of resilience skills. Aside from reasons *not* to include role playing, such as the difficulty of finding or hiring role players during field exercises, their expense, training requirements, fatigue, and their ability to go off-script, one motive to advocate for role plays is to enable 'embodied' learning to get individuals to practice and demonstrate resilience skills, in a controlled environment that authentic interactions (unscripted and naturally-occurring real-world interactions) do not afford. For role plays as a possible strategy, it is important first that those who are hired or brought on to take on specific roles are accomplished in the skills that they need to demonstrate, and second that there are good and bad outcomes that individuals can demonstrate. Additionally, role players (particularly novice ones) should take on roles they do not know, otherwise they tend to resort to prior experience, and when possible should be given roles where they need to act outside their comfort zones, rather than assigning easier roles to handle. Role plays are to be considered a proxy for more ecologically valid but logistically untenable methods, such as experiential learning in real-world—possibly unsafe or costly—conditions (Hubal et al., 2004). When possible, role plays may be conducted in instrumented rooms that permit video analysis of unscripted, uninhibited movement (Tu et al., 2015).

To improve role playing we present a couple of recommendations. First, pre-briefing participants (i.e., prior to enactment of a situation), such as having the role player and student establish their (play-acted) relationship in advance of the encounter itself, can be a powerful means of getting the individual engaged

in the situation that is subsequently portrayed. A simple augmentation would be to conduct the pre-briefing in the room where the role play is to take place, so that the individual could become familiar with the surroundings and layout and with most of the players, perhaps leaving out some of the role players so that the individual would not recognize, for instance, a lone new (and presumably important) player.

Second, it might make sense for small teams to work different variations on situations, switching roles for each. Role players would know which experience to demonstrate each round. Thus the first round could be the variation as is currently developed, the second would introduce some twist to the situation, the third could be a 'normal' situation where nothing of particular interest happens. The advantage to this approach is even though all the individuals would see the strategies and outcomes from previous run-throughs, in the role changing they would have totally different experiences.

4.3 Simulations

We use the term simulation to cover virtual, constructive, and gaming environments. They may be used in class or a dedicated computer lab, or accessed with the individual's personal desktop or mobile computing devices. Regardless of the distribution platform, and aside from the types of technology used (e.g., interactive multimedia, virtual reality), which are design considerations of training developers and not as important to instructors, simulations enable the individual to become familiarized with knowledge and acquire skills in an environment that mimics but does not reproduce the actual environment in which what is learned is applied. For instance, using a game engine to render responsive virtual characters with which the individual interacts, s/he may practice engagement and coping skills across a variety of situations. Skills and confidence in one's capabilities can be gained in this way, but they are not actual humans with whom the individual is interacting.

Instructors are often able, in simulated environments, to control the insertion of faults, establish difficult conditions, and provide situation-specific assistance (Frank et al., 2004). Practice situations can become increasingly complex. In such environments instructors, when present, act more as facilitators, wherein their role is to present authentic problems, give guidance during problem solving, and demonstrate linkages among concepts (Ross et al., 1998). In this environment the individual is learning by doing, with reach-back to supporting materials such as descriptions of best practices that the individual might need to review. When the individual performs well, more complex situations—representing conflict or real-world

complexity—are presented. When the individual makes mistakes, less complex situations along with instructional support provide just the right level of assistance. Along the way, an instructor reacts to differences between individuals' actions and pre-established performance criteria. An instructor compares the individual's performance against expected actions in a particular situation at some point along this continuum, and from there sends the individual forward or backward in the learning progression. Ultimately the individual demonstrates skills in a realistic validation setting. The individual needs to demonstrate skills competence in carefully defined situations. These situated assessments are presented in, preferably, high-fidelity simulated environments or may even use a live environment (real world places, tools, and people).

4.4 Self-Learning Environments

Online or mobile platforms are useful for some skills acquisition and practice. These of course can be used in conjunction with the other learning environments; our reason for including this category is to describe a setting in which the individuals learn on their own, rather than with other individuals and/or an instructor. These may be the platforms in which the individual learns or relearns content from such established programs as CSF. We are mainly interested, though, in resilience skills that supplement and extend the current methodology that is in place as part of CSF and like programs.

As a rule, self-paced learning occurs using tools such as browser-based techniques or mobile apps, through which learning content is familiarized and some practice can occur. For instance, the National Center for Telehealth & Technology has developed a portfolio of mobile apps to help individuals learn about and incorporate concepts regarding different mental health practices. Example apps are the ACT Coach that promotes "mindfulness and acceptance strategies" to help individuals cope with stressful situations; Breathe2Relax for practicing breathing and relaxation techniques; Tactical Breather in support of biofeedback; and T2 Mood Tracker for enabling individuals to monitor any behavioral changes of their own. Similarly, we have recently tested a browser-based tool for acquiring and practicing skills having decision-making and perceptual components (Hubal et al., 2015a). In general self-paced learning works up until situations that require strategic thinking and attitude adjustment, for which experiential environments are more applicable. Online and mobile approaches are useful for situations that over-rely, to a degree, on abstraction and divorce from context, and fewer repeated iterations with less-changing conditions.

4.5 Group Training Environments

Learning is not, of course, restricted to the classroom or dedicated facility. Instead, realistic practice and sustainment training is critical to acquiring and maintaining skills, particularly at the group level. It is the instructor's responsibility to map mission-essential tasks to operational training experiences (using live, simulated, or mock-up environments). Elsewhere we have advocated a systematic model that provides the instructor with methods and data for determining which training configurations are appropriate for different training needs (Frank et al., 2000). For example, validation of skills may be done in the live training environment, after group members have passed proficiency 'gates' using hands-on equipment or part-task trainers. The role of the instructors in defining guidelines for the use of different training environments is critical; their students will be successful in gaining skills only if the instructors are comfortable with the devices and their roles in the training process.

As the students engage in practice against operational learning objectives defined by the instructor, because the training is meant to mimic real conditions, its members may experience the stressors associated with complex, dynamic live environments. The instructor, then, should identify opportunities during and outside of training having the need for resilience skills and encourage their practice. Again, the skills we promote for classroom instructors do not require expertise to administer nor excessive time to learn. In a sense, applying resilience techniques during or surrounding operational practice is best, as it is closest to actual live environment operations and thus the techniques would be expected to readily transfer.

5 Assessment and Modeling

Earlier we introduced the concept of assessing individuals' learning of resilience skills via non-invasive tools. We discussed how, in different learning contexts, such as within the classroom versus during daily activities, some practices work better than others. Inside the classroom, for example, instructors may rely on group activities using role plays or immersive environments to create stressor experiences through which individuals can learn to apply resilience techniques like relaxation and biofeedback. Individuals' actions can be monitored not only through data (such as reaction and response times and patterns) collected while demonstrating performance of tasks but also using tools such as heart rate measurers, smartwatches and bands, interactive badges (Kim et al., 2012), and neural activity sensors. Outside the classroom, meanwhile, the types and occurrences of stressful situations are normally harder to predict or control, yet

individuals can prepare themselves to use appropriate coping behavior for when they do occur by practicing techniques like controlled breathing and maintaining fitness, and using available technology such as mobile phones and smartbands (Zubair et al., 2015). In this section we go into slightly more detail on these assessment tools and technology.

5.1 Psychophysiological Metrics

Resilience skills training response may be measured by behavioral metrics, as we discuss below, as well as by many types of physiological methods. Here we focus on just three noninvasive psychophysiological markers. First, respiratory rate (RR) is the number of breaths per minute, and should generally decrease after relaxation, relative to a baseline, and increase after physical exertion. Second, electrodermal activity (EDA) is a skin conductance measure and while it has weaknesses regarding accuracy and repeatability, it is relatively convenient to record (Poh et al., 2010) and can serve as a broad gauge of anxiety or activity level (Boettger et al., 2010; Boucsein, 2012).

Third, the normal resting rhythm of the heart—the time between successive heartbeats—is actually quite variable. This variability is of much research interest and a "coherent" level suggests a number of behavioral, self-regulatory, and ultimately health-related benefits (McCraty & Shaffer, 2015). The variability is also trainable, as through breathing exercises (Lewis et al., 2015; Tharion et al., 2012) and physical exertion (Saccomani et al., 2014). On a relatively stationary participant (movement creates noise in the heart rate data), there are many methods with which to measure heart rate variability (HRV) (Malik et al., 1996) and devices, including chest straps, smartwatches, digit-based photoplethysmographs, and earlobe clips.

5.2 Behavioral Metrics

Many types of actions can characterize an individual practicing resilience techniques. Those that can be captured that are of interest here are those relevant to the resilience training we are advocating, in the different environments we just described.

5.2.1 Responses to Focused Breathing and Relaxation

One example is gaze or eye tracking. Eye movement is indicative of sustained attention (Oken et al., 2006), and smoothly controlled scanning suggestive of relaxed performance (Mills & Hubal, 2001), as would be shown following a relaxation breathing exercise. Clark et al. (2012) describe how non-laboratory

studies can improve the understanding of attentional focus. Their lab has developed online tools to assess gamers and non-game players on basic perceptual skills such as search and inhibition. Measuring eye movement can utilize gaze tracking equipment, but does not have to. For instance, one means of tracking gaze is to present stimuli around a field of view, require the individuals to respond to those stimuli, and assess their response time (RT; Hubal et al., 2010).

Much research suggests that other resilience-relevant responses can also be induced through simulation-based exercises. As one example, Carroll et al. (2013; 2014) studied game-based situations that were designed to engage individuals in real-world situations while incorporating the stresses of the live environment. Analyses suggested that EDR increased as a result of participating in simulation-based training designed specifically to induce stress. Hourani et al. (2011) also demonstrated how to capture different types of behavioral responses such as RT to cues in the environment that can be influenced by resilience-promoting techniques. Importantly, simulation-based training in virtual and game-based platforms is an instructional technique already used in many schoolhouses, and individuals are comfortable with the use of these technologies.

5.2.2 Responses to Simple Biofeedback

The behavior to be measured may be on the part of the individual, or it may be activity within a simulation that is influenced by the individual's behavior that is concomitant with improved physiological functioning. For instance, Morie et al. (2011) had individuals control a virtual character's physical movement through their breathing, and showed a positive effect on the participants. Russoniello et al. (2009) showed that 'casual' game play could lead to reduced stress responses. Lewis et al. (2015) documented reduced arousal following a short biofeedback regimen using breathing. Dempsey et al. (2015) and Hernandez et al. (2014) describe uses of keyboard, mouse, and tactile pressure sensing. Squire et al. (2014) describe the development and validation of an application that blends cognitive training for resilience with advanced biofeedback to provide support for individuals dealing with stress-related issues. Its crux is heart rhythm coherence (Cohn et al., 2010); a "smooth, sine-wave-like pattern" in an individual's HRV trace suggesting s/he is in an optimized state compatible with the development of resilience, as well as other benefits. All of these studies used a combination of physiological and easily-assessed behavioral measures of performance.

5.2.3 Responses to Physical Activity

The measurement of physical exertion is easiest, as there are innumerable devices that could be employed. Accelerometers, gyroscopes, temperature gauges, dedicated heart rate monitors, spirometers, even GPS signal analyses—much of these buried in mobile phones, smartwatches, sociometric badges, and other wearable devices—are all usable in determining aspects of physical movement, with some measures more applicable to different physical activities than others (see below).

5.3 Linking Metrics to Training

Part of understanding current best behavioral measurement practices is to define what 'success' (regarding psychological flexibility) looks like. Thus it is extremely important to determine how to link an individual's behavior with physiological determinants within the learning environment, so that we can identify how the practice of a given resilience technique influences performance. We introduce the topic here, broadly, but understand the importance it holds—and complexity it involves.

To illustrate the point, we consider three examples. The initial example is an individual, through the practice of controlled breathing, influencing the movement of a virtual character and also steadying his own heart rate, following that individual watching a highly intense two-minute urban terrain ambush segment from an award-winning (thus, well-produced) movie. In this situation, we presume that the film clip is engaging and powerful enough that it induces a kind of anxiety, measured as an autonomic response via HRV from pre-viewing to post-viewing and immediately upon entering the virtual scene. As the scene progresses, and the character moves in accordance with the individual's breathing pattern, we need to synchronize to the HRV measure, hopefully showing a causal relationship from controlled breathing to cardiac coherence. Once that is established for this individual, we can remove the need for a heart rate monitor, and at that point and subsequently the individual could bring up the virtual scene—possibly even imagine it—and establish the physiological control through his breathing.

The next example is an individual twice playing the role of a small unit leader conducting a key leader engagement (KLE) with an unfriendly indigenous village chief (two variants on the situation, both of which involve the role player making the chief imposing and trying to rile the participant), being videotaped and wearing non-intrusive sensing devices, once prior to and once following the practice of brief mindfulness meditation as part of a yoga routine. Similar to the previous example, we wish to correlate the changes in

performance between the two conditions (i.e., variants) with any changes induced by the mind-body practice. Physiological metrics may be more difficult to capture in this situation, though, both because the individual is necessarily physically moving in the KLE, thereby introducing noise to such measures, and because there is no guarantee there was any physiological change from pre to post. However, other behaviors and activities can be useful, such as the calmness with which the individual carries himself during the interaction as it becomes stressful, where the individual looks, and the words and intonation that the individual uses.

The final example has the individual responding to various stimuli presented during an immersive situation such as participating in a convoy passing through a threatening foreign town. The requirement of the individual in this simulation is to respond using gestures to virtual team members and radio dispatches to command to suspicious activities in the scene, and to shoot with an instrumented weapon if needed. During the engagement it may be difficult to monitor the participant for his use of resilience-promoting skills, but not impossible. It may be possible, for instance, to capture controlled breathing or controlled eye movement during lulls in the fighting, compared to breathing and gaze patterns during the fight, or even changes in those measures between encounters. Gestures, vocal patterns, and targets of fire, too, may prove instructive, particularly changes in their expression between firefights, especially if the practice of coping skills is detected in the interim. We note that physiological measures may not be the most informative or usable in this type of learning/practice environment, as they are in the previous examples.

6 Development of Instructional Support

Our goal is to characterize costs/benefits of, as well as bounds on, the resilience and cognitive flexibility training curriculum. For instance, any two different resilience-promotion techniques involve slightly different practices thus demanding differing amounts of time, space, and potential costs. What is friendly to individuals in a schoolhouse may be less practical in the live environment; the techniques that we present to individuals must be adaptable to the context and flexible in, for example, length of time. The techniques may also result in different outcomes. For example, Hourani et al. (2011) trained individuals on two breathing techniques. An attentional retraining exercise was intended to allow them to become more focused or calm in the moment (e.g., during a lull in stressful activity in the live environment), whereas a recuperative training exercise was meant to provide restorative rest when in a safe environment. To address

instructors' varying training needs, we believe the resilience and cognitive flexibility training should provide guidance, utilizing a data-driven approach that takes the guesswork out of designing and administering resilience training. We advocate combining information gathered from instructors and their students to provide a practical, yet empirically grounded, recommendation regarding the most appropriate course of training. The instructors' needs might be assessed through a brief questionnaire to determine the training objectives of the course, resources available to them, and their familiarity with the training content. To support tailoring the training to individual groups, information from students could be gathered regarding factors that have been determined empirically to be relevant to the development of resilience. A recommendation procedure weighing the relative contributions of this information would then assist the instructors in specifying the most relevant resilience techniques to train, identifying additional training resources available to them, and providing suggestions for feedback strategies for use during the course based on the unique needs of their students.

6.1 Instructional Support Elements

We suggest that the resilience and cognitive flexibility training use responses to brief questionnaires from the instructor and the students to prescribe training content and methods to the instructor. These questionnaires might be provided through an interface that is available for easy access in both desktop and smartphone browsers. Data from these would feed into the training recommendation. The rationale behind these components is described below.

6.1.1 Instructor Assessment

Part of the training curriculum guidelines is to steer the instructor through a series of questions to gather information about three critical considerations: The specific training objective the instructors are trying to achieve with the implementation of resilience training, the resources available to them in its delivery, and the extent to which they are familiar with the training content. The responses the instructors provide help them to identify the most appropriate training techniques, environments, and assessment strategies for their specific needs as well as guide them in where to find additional training content, interpret assessments, and deliver feedback effectively.

6.1.1.1 Training Objectives

Key to developing any training is a clear understanding of the training objectives to be achieved. In

terms of resilience training, there are several potential desired outcomes, including general education about resilience, inoculation against stress prior to deployment to a live environment or other stressful event, or mitigating the effects of post-traumatic stress. These different training objectives require the application of the appropriate technique, environment, and assessment strategy. For example, a classroom environment lends itself to training the didactic components of resilience. In this situation, implementing a knowledge test would be more effective than a physiological measurement. Practicing resilience skills already learned, on the other hand, would be best accomplished in a simulated or self-learning environment with the option of behavioral and physiological assessments. The instructor questionnaire elicits information about the overall training goals which in turn informs the final training recommendation.

6.1.1.2 Resources

Today's fiscal reality for all the armed services is that training budgets are reduced and instructors are being asked to do more with less. As a result, there are few resources and little time in training schedules to implement new training initiatives. For this reason, the resilience and cognitive flexibility training curriculum should be designed to deliver training recommendations based on a variety of learning environments and assessment strategies. Already the instructor will have collected information regarding the extent to which resources are available in order to maximize training efficiency. These resources include access to facilities (e.g., classrooms, simulation centers, live environments), training technology (e.g., computers, mobile devices, physiological measurement devices), and training time.

6.1.1.3 Content Familiarity

The addition of instructional content to an existing course is a challenge from a doctrinal perspective, and as such instructors from all of the services will have to develop and deliver their own content if resilience is to be trained. The preparation and delivery of training of any sort is not a trivial task even when the instructor is familiar with the content, and most individuals are not familiar with the most effective means of developing resilience as a skill. To address this issue, the curriculum guidebook should help the instructors determine the extent to which they are familiar with the various resilience techniques available through a series of knowledge-based questions. This information guides the training recommendation delivered to the instructors in two ways. If an instructor is particularly knowledgeable about a specific technique, preference should be given to that technique in the resulting recommendation. However, if the instructor is not familiar with the most relevant resilience training techniques, environment,

or assessment given the objectives and needs of the students, curriculum materials must direct the instructor to resources where more information is available.

6.1.2 Student Assessment

While one purpose of the resilience and cognitive flexibility training curriculum is to help instructors determine the appropriate resilience training content given their needs and constraints, another component involves gathering information based on the students' characteristics to enable tailoring of training. The rationale behind this assessment is to leverage the existing research in predicting resilience outcomes in order to maximize training effectiveness. In the process of developing a resilience training strategy, the instructor prompts each student to complete a brief questionnaire providing the most relevant information to their training success. The responses to these questionnaires are used to estimate the overall propensity for resilience of the group. This information assists the instructor in determining the depth, breadth, and number of techniques required to maximize the resilience of the students.

Predictors of resilience have been well-researched in the clinical and applied psychology fields. A recent meta-analysis of predictors of resilience (Lee et al., 2012) determined that demographic, protective, and risk factors each play a role in the extent to which resilience is developed. In addition, several well-validated and easy to administer measures of resilience exist. While these measures have shown to be consistent across age and cultural demographics, many of these findings have not been replicated. As a result, we believe there exists a unique opportunity to extend the research into resilience prediction as well as provide targeted training to individuals. The potential predictors for inclusion in the student assessment are described below.

6.1.2.1 Demographic Information

Two demographics, age and gender, are most frequently cited as related to resilience (Lee et al., 2012). However, the research has been mixed with regard to the direction of the effects of these variables. Most studies suggest people are more likely to develop resilience as they age (e.g., Campbell-Sills, et al., 2009), but others show the opposite effect (e.g., Beutel et al., 2009). The effects of gender are similarly unclear (Lee et al., 2012). In wartime scenarios, gender tends to moderate resilience, but this relationship is complicated by the gender-related differences in the self-report of stressful experiences and symptoms, and the social stigma involved in their report (Masten & Narayan, 2012). Methodological inconsistencies probably account for some of these discrepant findings. The likelihood of a sample varying sufficiently

along these factors to drive differences in training strategy recommendations is low. However, as they are easy to assess, we propose to include them in the initial predictor battery as potential moderators.

Other demographic information is likely to be more useful in terms of predicting individuals' resilience. Occupational specialty may influence the probability an individual has experienced a traumatic event in the past or the extent to which he or she may be likely to experience stress as a routine part of their service. Physical fitness, as measured through self-reported physical fitness test scores, can indicate an overall physiological wellbeing that may predict resilience. Additionally, religious affiliation and faith are positively related to resilience (Crawford et al., 2006).

Some hobbies and interests may predict resilience as well. Playing video games has been shown to reduce stress through the induction of "dissociative" states (Snodgrass et al., 2011), and individuals who tend to play video games may be more able to mitigate the effects of stressors through this activity. Furthermore, resilience has been linked to the ability to form and maintain stable interpersonal relationships (Wright et al., 2013). While this characteristic in itself may be difficult to assess through a questionnaire, the extent to which individuals participate in team sports or consider themselves to have long term, close friendships may serve as an indicator of this factor.

Much research into the development of resilience has focused on this process in children. In these populations, aspects of the child's family life are predictive, including a stable home environment, close and positive relationships with primary caregivers and siblings, high socioeconomic status, and education level of parents (Wright et al., 2013). While this research deals with the development of resilience in the wake of a recent stressful event or life situation for a child, these factors may still play a role later in life.

6.1.2.2 Risk Factors

Several psychological conditions have been identified as reliable risk factors in terms of negative outcomes to stress. A recent meta-analysis by Lee et al. (2013) showed that measures of depression, anxiety, negative affect, perceived stress and post-traumatic stress disorder each had moderate effect sizes when related to resilience. One strength of this analysis was its inclusion of only studies that used reliable and validated measures of these risk factors. While the purpose of this effort is not to diagnose a clinical psychological condition, each of these risk factors is easily and quickly assessed using a variety of questionnaires, which make them ideal for inclusion in the research predictor battery.

Individuals in high risk, high consequence positions, such as military personnel, have unique risk factors

due to the stresses of the live environment. Bartone (2006) described the primary stressors resulting from modern military operations (see **Table 2**). The extent to which an individual has been subjected to each of these stressors can be considered a risk factor for the development of a stress-related disorder. To assess these factors, questions regarding the individual's most recent experiences are important to be incorporated into the predictor battery. Groups with many of these risk factors would benefit from longer, more thorough training sessions. More importantly, dealing with the cognitive and emotional aftermath of a deployment to a live environment would need to be a focus of resilience training for such individuals.

{insert Table 2 about here}

6.1.2.3 Protective Factors

While risk factors are negatively related to the development of resilience, protective factors seem to promote adaptation. Resilience is the result of a complex developmental process (Masten, 2007), and to suggest that the presence or absence of these factors is a direct cause of resilience is an oversimplification. However, these factors do seem to predict the extent to which resilience is developed.

In their meta-analysis, Lee et al. (2012) found life satisfaction, optimism, positive affect, self-efficacy, self-esteem, and social support to be strongly related to resilience. Each of these protective factors can be assessed through a short, validated questionnaire. When compared to the risk factors evaluated in this research, the protective factors showed higher effect sizes, supporting the theory that resilience can in fact be defined as the presence of these protective factors (Masten et al., 1990). Further, the implication is that in order to maximize resilience development, focus should be placed on the development of these protective factors rather than mitigating the risks.

Cognitive skills, such as general intelligence and cognitive flexibility, are protective factors in children (Masten, 2007). These factors are likely related to the extent to which complex problem solving skills are present, which enable the individual to actively manage stressful situations. D'Zurilla and Sheedy (1991) investigated the relationship between college students' problem solving ability and perceived stress, and found that problem orientation and problem solving skills were related to perceived stress (although their findings were self-described as somewhat tenuous). Their interpretation of these findings was that problem solving reduces stress through increasing perceived control of the situation.

A recently defined construct of interest is 'grit', or "trait-level perseverance and passion for long-term goals" (Duckworth et al., 2007). In a sample of cadets at the U.S. Military Academy, those who scored

more highly on a grit scale were less likely to drop out than their peers. Interestingly, grit appears to be either orthogonal or slightly negatively correlated with intelligence (Duckworth & Quinn, 2009). While grit has not shown to be predictive of resilience per se, it is conceptually similar and is quickly assessed using a 12-item scale.

Taken together, measures of the demographic, risk, and protective factors related to resilience can be used to develop a predictive model and inform tailoring training. Demographic factors can be addressed using a single question on a questionnaire. Risk and protective factors would be assessed using existing validated measures.

6.1.2.4 Direct Measures of Resilience

The goal of resilience and cognitive flexibility training is to engender resilience in individuals in an easy-to-implement format. The research reviewed here suggests that many factors play a significant role in the development of resilience, and to assess each one using a reliable and valid measure would take a prohibitively long time. A battery of predictors of resilience has not been administered to individuals for the purposes of tailoring training. Research is required to develop a final, validated model of resilience predictors based on a manageable battery for inclusion in the student assessment, pitting the predictor battery against existing measures of resilience to serve as a criterion.

Two examples of well-researched resilience measures include scales developed by Connor and Davidson (2003) and Wagnild and Young (1993). Both have demonstrated high reliability and validity. The RS in particular has shown high correlations with several measures of constructs related to resilience (Ahern et al., 2006). Both measures are composed of 25 Likert scale items, and are easily administered. We propose to investigate the use of either one or both of these measures as a criterion for the proposed validation study and model development.

It may seem reasonable to avoid assessing the predictors of resilience entirely, and simply providing a pre-test of resilience to individuals based on one of these two tests. While this approach would be shorter and more straightforward, the outcome would be much less actionable from a training perspective. Such a pre-test would answer the question “Are your students currently resilient?” but not provide information on the underlying factors that influence that answer. In order to tailor resilience training effectively, it is critical not to simply have a baseline of resilience, but to appreciate the reason why this baseline may be high or low. For example, if a group tends to score in the low range on a self-efficacy questionnaire,

providing them with a highly novel resilience technique in a complex learning environment would likely fail. Similarly, if an intact group returns from deployment to a live environment where many of the stressors described by Bartone (2006) were present, identifying and addressing residual effects of these stressors should be a priority.

6.2 Training Recommendations

When the students have completed their assessment questionnaires, the resilience and cognitive flexibility training curriculum guidelines should help the instructors analyze the data and produce training recommendations that address the training techniques, environments, and assessment strategies most likely to maximize training effectiveness. This enables the instructors to review their responses to the questionnaires and, importantly, to view a profile of the relevant characteristics of their students. If an instructor is not familiar with the recommended training content or platforms, the guidelines could provide links to existing online resources (websites, videos, books, etc.) where additional information is available. Based on the information provided, even novice instructors should feel confident that the resilience training they are developing has been specifically designed with their and their students' needs in mind.

7 Summary and Conclusions

We have gone into detail to identify evidence-based best practices for promoting resilient performance. Our literature review of resilience training state of the art suggests three recommended approaches that meet specific implementation criteria (including accounting for the evidence base, the lack of a need for expert administration, and ease of integration or self-instruction). These techniques are *focused breathing and relaxation*, since they are components of many other more specialized techniques, and they are easy to administer, learn, and practice; *simple biofeedback*, because its evidence shows rapid and sustained control over physiological processes; and *physical activity* (e.g., exercise, martial arts, yoga) for which evidence shows increased stress tolerance and resilience related to physical fitness. These three techniques closely mirror those found by van der Zwan et al. (2015) as having equivalent beneficial effects on reducing stress.

In our review of literature associated with resilience training techniques, we focused on prevention or enhancement of psychological aspects of individuals' resilience. That review fits into a larger picture, for which our concept is to identify evidence-based training content for use in our resilience and cognitive flexibility training curriculum, a framework which also includes two other components, the environments

in which training takes place and the tools used to measure learning. We characterize five types of learning environments, in which an individual might learn and practice resilience skills—the classroom, role plays, simulation-based systems, online platforms, and operational training exercises. These five are each representative of a host of similar or analogous conditions and thus together cover a large portion of possible learning environments. We also discuss how different means of assessing individuals' learning of resilience skills is possible via psychophysiological and behavioral measures. Part of assessment is to define what success looks like. It is extremely important to determine how to link an individual's behavior with physiological determinants within the learning environment, so that we can identify how the practice of a given resilience technique influences performance.

Different resilience-promotion techniques require different resources and thus have unique costs and benefits. What is friendly to individuals in a schoolhouse may be less practical in the live environment; the techniques should be adaptable to the context, with well-defined bounds on their use. To address instructors' varying training needs, our resilience and cognitive flexibility training curriculum is intended to provide guidance, combining information gathered from instructors and their students to provide a practical, yet empirically grounded recommendation specifying the most relevant resilience techniques to train, identifying additional training resources available to the instructor, and providing suggestions for feedback strategies for use during the course based on the unique needs of the students.

8 References

Acosta, J.D., Martin, L.T., Fisher, M.P., Harris, R., & Weinick, R.M. (2012). *Assessment of the content, design, and dissemination of the real warriors campaign.* RAND Center for Military Health Policy Research.

Adler, A.B., & Castro, C.A. (2013). An occupational mental health model for the military. *Military Behavioral Health*, *1*(1), 41-45.

Ahern, N.R., Kiehl, E.M., Sole, M.L., & Byers, J. (2006). A review of instruments measuring resilience. *Issues in Comprehensive Pediatric Nursing*, *29*(2), 103-125.

Andersen, J.P., Papazoglou, K., Koskelainen, M., Nyman, M., Gustafsberg, H., & Arnetz, B.B. (2015). Applying resilience promotion training among special forces police officers. *SAGE Open*, *5*(2), 1-8.

Baer, R.A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science & Practice*, *10*, 125-143.

Baer, R.A. (Ed.) (2014). *Mindfulness-based treatment approaches: Clinician's guide to evidence base and*

applications. Academic Press.

Bartone, P.T. (2006). Resilience under military operational stress: Can leaders influence hardiness? *Military Psychology*, *18*(Suppl. 3), 131-148.

Bedford, F.L. (2012). A perception theory in mind-body medicine: Guided imagery and mindful meditation as cross-modal adaptation. *Psychonomic Bulletin & Review*, *19*(1), 24-45.

Beutell, M.E., Glaesmer, H., Decker, O., Fischbeck, S., & Brahler, E. (2009). Life satisfaction, distress, and resiliency across the life span of women. *The Journal of North American Menopause Society*, *16*(6), 1132-1138.

Boettger, S., Puta, C., Yeragani, V.K., Donath, L., Müller, H.J., Gabriel, H.H.W., & Bär, K.J. (2010). Heart rate variability, QT variability, and electrodermal activity during exercise. *Medicine & Science in Sports Exercise*, *42*(3), 443-448.

Boucsein, W. (2012). *Electrodermal Activity.* Springer.

Brouwer, A.M., Neerincx, M.A., Kallen, V., van der Leer, L., & ten Brinke, M. (2011). EEG alpha asymmetry, heart rate variability and cortisol in response to virtual reality induced stress. *Journal of CyberTherapy and Rehabilitation*, *4*(1), 27-40.

Burns, R.A., & Anstey, K.J. (2010). The Connor-Davidson Resilience Scale (CD-RISC): Testing the invariance of a uni-dimensional resilience measure that is independent of positive and negative affect. *Personality and Individual Differences*, *48*(5), 527-531.

Butler, A.C., Chapman, J.E., Forman, E.M., & Beck, A.T. (2006). The empirical status of cognitive-behavioral therapy: A review of meta-analyses. *Clinical Psychology Review*, *26*(1), 17-31.

Cacioppo, J.T., Adler, A.B., Lester, P.B., McGurk, D., Thomas, J.L., Chen, H.Y., & Cacioppo, S. (2015). Building social resilience in soldiers: A double dissociative randomized controlled study. *Journal of Personality and Social Psychology*, *109*(1), 90-105.

Campbell-Sills, L., Cohan, S.L., & Stein, M.B. (2006). Relationship of resilience to personality, coping and psychiatric symptoms in young adults. *Behavior Research and Therapy*, *44*(4), 585-599.

Carroll, M., Hale, K., Stanney, K., Woodman, M., DeVore, L, Squire, P., & Sciarini, L. (2012). Framework for training adaptable and stress-resilient decision making. In *Proceedings of the Interservice/Industry Training, Simulation and Education Conference*. NDIA.

Carroll, M.B., Padron, C.K., DeVore, L.A., Winslow, B., Hannigan, F.P., Murphy, J.S., & Squire, P. (2013). Simulation training approach for small unit decision-making under stress. In *Proceedings of the Interservice/Industry Training, Simulation, and Education Conference*. NDIA.

Carroll, M.B., Winslow, B., Padron, C.K., Surpris, G., Wong, J., Squire, P., & Murphy, J.S. (2014). Inducing stress in warfighters during simulation-based training. In *Proceedings of the Interservice/Industry Training, Simulation,*

and Education Conference. NDIA.

Castro, C.A., & Adler, A.B. (2011). Military mental health training: Building resilience. In S.M. Southwick, B.T. Litz, D. Charney, & M.L. Friedman (Eds.), *Resilience and mental health: Challenges across the lifespan* (pp. 323-339). Cambridge University Press.

Castro, C.A., Hoge, C.W., & Cox, A.L. (2006). Battlemind training: Building soldier resiliency. In *Human dimensions in military operations: Military leaders' strategies for addressing stress and psychological support* (pp. 42.1-6). In Proceedings of RTO-MP-HFM-134, Paper 42.

Chittaro, L. (2013). Anxiety induction in virtual environments: An experimental comparison of three general techniques. *Interacting with Computers*, *26*(6), 528-539.

Clark, K., Cain, M.S., Adamo, S.H., & Mitroff, S.R. (2012). Overcoming hurdles in translating visual search research between the lab and the field. In M.D. Dodd & J.H. Flowers (Eds.), *The Influence of Attention, Learning, and Motivation on Visual Search* (pp. 147-181). Springer.

Cohn, J., Weltman, G., Ratwani, R., Chartrand, D., & McCraty, R. (2010). Stress inoculation through cognitive and biofeedback training. In *Proceedings of the Interservice/Industry Training, Simulation, and Education Conference*. NDIA.

Cohn, J.V., Morrison, T., Weltman, G., Chartrand, D., McCraty, R., Combs, D.J., Anglero, A., Johnson, B.R., Rozovski, D., Eggan, S., Cox, B., Carlson, K., & O'Neill E. (2013). Stress resilience training system (SRTS). *Communications in Computer and Information Science*, *373*, 584-588.

Connor, K.M., & Davidson, J.R. (2003). Development of a new resilience scale: The Connor-Davidson resilience scale (CD-RISC). *Depression and Anxiety*, *18*(2), 76-82.

Cornum, R., Matthews, M.D., & Seligman, M.E.P. (2011). Comprehensive soldier fitness: Building resilience in a challenging institutional context. *American Psychologist*, *66*(1), 4-9.

Crawford, C., Wallerstedt, D.B., Khorsan, R., Clausen, S.S., Jonas, W.B., & Walter, J.A.G. (2013). A systematic review of biopsychosocial training programs for the self-management of emotional stress: Potential applications for the military. *Evidence-Based Complementary and Alternative Medicine*, 747694.

Crocker, P.R.E., Tamminen, K.A., & Gaudreau, P. (2015). Coping in sport. In S.D. Mellalieu & S. Hanton (Eds.), *Contemporary Advances in Sport Psychology: A Review* (pp. 28-67). Routledge.

D'Zurilla, T.J., & Sheedy, C.F. (1991). Relation between social problem-solving ability and subsequent level of psychological stress in college students. *Journal of Personality and Social Psychology*, *61*(5), 841-846.

Dempsey, S.J., Szablewski, M., & Atkinson, D. (2015). Tactile sensing in human–computer interfaces: The inclusion of pressure sensitivity as a third dimension of user input. *Sensors and Actuators A: Physical*, *232*(1), 229-250.

Denning, L.A., Meisnere, M., & Warner, K.E. (Eds.) (2014). *Preventing psychological disorders in service members*

and their families: An assessment of programs. Washington, DC: National Academies Press.

Duckworth, A.L., & Quinn, P.D. (2009). Development and validation of the short grit scale (Grit-s). *Journal of Personality Assessment*, *91*(2), 166-174.

Duckworth, A.L., Peterson, C., Matthews, M.D., & Kelly, D.R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, *92*(6), 1087-1101.

Eidelson, R., Pilisuk, M., & Soldz, S. (2011). The dark side of comprehensive soldier fitness. *American Psychologist*, *66*(7), 643-644 & 646-647.

Evers, K.E., Prochaska, J.O., Johnson, J.L., Mauriello, L.M., Padula, J.A., & Prochaska, J.M. (2006). A randomized clinical trial of a population- and transtheoretical model-based stress-management intervention. *Health Psychology*, *25*(4), 521-529.

Fjorback, L.O., Arendt, M., Ørnbøl, E., Fink, P., & Walach, H. (2011). Mindfulness-based stress reduction and mindfulness-based cognitive therapy: A systematic review of randomized controlled trials. *Acta Psychiatrica Scandinavica*, *124*(2), 102-119.

Flay, B.R., Biglan, A., Boruch, R.F., Castro, F.G., Gottfredson, D., Kellam, S., Mościcki, E.K., Schinke, S., Valentine, J.C., & Ji, P. (2005). Standards of evidence: Criteria for efficacy, effectiveness and dissemination. *Prevention Science*, *6*(3), 151-175.

Fletcher, D., & Sarkar, M. (2013). Psychological resilience: A review and critique of definitions, concepts, and theory. *European Psychologist*, *18*(1), 12-23.

Frank, G., Whiteford, B., Hubal, R., Sonker, P., Perkins, K., Arnold, P., Presley, T., Jones, R., & Meeds, H. (2004). Performance assessment for distributed learning using after action review reports generated by simulations. In *Proceedings of the Interservice/Industry Training, Simulation and Education Conference* (pp. 808-817). NDIA.

Frank, G.A., Helms, R.F., & Voor, D. (2000). Determining the right mix of live, virtual, and constructive training. In *Proceedings of the Interservice/Industry Training, Simulation and Education Conference* (pp. 1268-1277). NDIA.

Gaggioli, A., Pallavicini, F., Morganti, L., Serino, S., Scaratti, C., Briguglio, M., Crifaci, G., Vetrano, N., Giulintano, A., Bernava, G., Tartarisco, G., Pioggia, G., Raspelli, S., Cipresso, P., Vigna, C., Grassi, A., Baruffi, M., Wiederhold, B., & Riva, G. (2014). Experiential virtual scenarios with real-time monitoring (interreality) for the management of psychological stress: A block randomized controlled trial. *Journal of Medical Internet Research*, *16*(7), e167.

Glanz, K., Rimer, B.K., & Lewis, F.M. (2002). *Health behavior and health education. Theory, research and practice.* John Wiley & Sons, Inc.

Gonzalez, G.C., Singh, R., Schell, T.L., & Weinick, R.M. (2014). *An evaluation of the implementation and perceived utility of the airman resilience training program.* RAND Center for Military Health Policy Research.

Graves, L.E.F., Ridgers, N.D., Williams, K., Stratton, G., Atkinson, G., & Cable, N.T. (2010). The physiological cost and enjoyment of Wii Fit in adolescents, young adults, and older adults. *Journal of Physical Activity & Health*, *7*(3), 393-401.

Grossman, D., & Christensen, L.W. (2004). *On combat: The psychology and physiology of deadly conflict in war and in peace.* PPCT Research Publications.

Gu, Q., & Day, C. (2007). Teachers resilience: A necessary condition for effectiveness. *Teaching and Teacher Education*, *23*(8), 1302-1316.

Halverson, K.C., Lucia, L., Horn, Z., Lande, B., Keeney, M., Weil, S., & Diedrich, F. (2015). Evaluation of social skills training approaches: APACTS and MAST. Technical report submitted by Aptima, Inc. to the U.S. Army Research Office, Research Triangle Park, NC, under DARPA Contract #W911NF-11-C-0266, March 6, 2015.

Hernandez, J., Paredes, P., Roseway, A., & Czerwinski, M. (2014). Under pressure: Sensing stress of computer users. In *Proceedings of the ACM Conference on Human Factors in Computing Systems* (pp. 51-60). ACM Press.

Hourani, L.L., Kizakevich, P.N., Hubal, R., Spira, J., Strange, L.B., Holiday, D.B., Bryant, S., & McLean, A.N. (2011). Predeployment stress inoculation training for primary prevention of combat-related stress disorders. *Journal of CyberTherapy & Rehabilitation*, *4*(1), 101-116.

Hubal, R. (2012). The imperative for social competency prediction. In S.J. Yang, A.M. Greenberg, & M. Endsley (Eds.), *Proceedings of the International Conference on Social Computing, Behavioral-Cultural Modeling, & Prediction* (pp. 188-195). Springer-Verlag.

Hubal, R., Kizakevich, P., McLean, A., & Hourani, L. (2010). A multimedia environment for stressing warfighters before they deploy. In *Proceedings of the Interservice/Industry Training, Simulation and Education Conference*. NDIA.

Hubal, R., van Lent, M., Marinier, B., Kawatsu, C., & Bechtel, B. (2015a). Enhancing good stranger skills: A method and study. To be published in *Proceedings of the Interservice/Industry Training, Simulation and Education Conference*. NDIA.

Hubal, R., van Lent, M., Wender, J., Lande, B., Flanagan, S., & Quinn, S. (2015b). What does it take to train a good stranger. *Procedia Manufacturing*, *3*, 3955-3962.

Hubal, R.C., Fishbein, D.H., & Paschall, M.J. (2004). Lessons learned using responsive virtual humans for assessing interaction skills. In *Proceedings of the Interservice/Industry Training, Simulation and Education Conference*. NDIA.

Hubbard, T.L. (2010). Auditory imagery: Empirical findings. *Psychological Bulletin*, *136*(2), 302-329.

Jeffries, F.W., & Davis, P. (2012). What is the role of eye movements in eye movement desensitization and reprocessing (EMDR) for post-traumatic stress disorder (PTSD)? A review. *Behavioural and Cognitive*

Psychotherapy, *41*(3), 290-300.

Jha, A.P., Stanley, E.A., Kiyonaga, A., Wong, L., & Gelfand, L. (2010). Examining the protective effects of mindfulness training on working memory capacity and affective experience. *Emotion*, *10*(1), 54-64.

Johnson, D.C., Thom, N.J., Stanley, E.A., Haase, L., Simmons, A.N., Shih, P.B., Thompson, W.K., Potterat, E.G., Minor, T.R., & Paulus, M.P. (2014). Modifying resilience mechanisms in at-risk individuals: A controlled study of mindfulness training in Marines preparing for deployment. *American Journal of Psychiatry*, *171*(8), 844-853.

Johnston, J.H., Napier, S., & Ross, W.A. (2015). Adapting immersive training environments to develop squad resilience skills. In D.D. Schmorrow & C.M. Fidopiastis (Eds.), *Foundations of augmented cognition* (pp. 616-627). Springer.

Kaplan, U., & Epstein, G.N. (2011-12). Psychophysiological coherence as a function of mental imagery practice. *Imagination, Cognition and Personality*, *31*(4), 297-312.

Kemper, K.J., & Khirallah, M. (in press). Acute effects of online mind-body skills training on resilience, mindfulness, and empathy. *Journal of Evidence-Based Complementary & Alternative Medicine*.

Kim, T., McFee, E., Olguin Olguin, D., Waber, B., & Pentland, A. (2012). Sociometric badges: Using sensor technology to capture new forms of collaboration. *Journal of Organizational Behavior*, *33*(3), 412-427.

Kizakevich, P.N., Eckhoff, R., Weger, S., Weeks, A., Brown, J., Bryant, S., Bakalov, V., Zhang, Y., Lyden, J., & Spira, J. (2014). A personal health information toolkit for health intervention research. In B.K. Wiederhold & G. Riva (Eds.), *Annual Review of Cybertherapy and Telemedicine* (pp. 35-39). IOS Press.

Kosslyn, S.M., Brunn, J., Cave, K.R., & Wallach, R.W. (1984). Individual differences in mental imagery ability: A computational analysis. *Cognition*, *18*(1-3), 195-243.

Lahad, M. (1997). BASIC Ph: The story of coping resources. In M. Lahad & A. Cohen (Eds.), *Community stress prevention* (pp. 117-145). Kiryat Sh'mona, Israel: Community Stress Prevention Center.

Lake, J. (2015). The integrative management of PTSD: A review of conventional and CAM approaches used to prevent and treat PTSD with emphasis on military personnel. *Advances in Integrative Medicine*, *2*(1), 13-23.

Lee, J.H., Nam, S.K., Kim, A., Kim, B., Lee, M.Y., & Lee, S.M. (2013). Resilience: A meta-analytic approach. *Journal of Counseling and Development*, *91*(3), 269-279.

Lester, P.B., McBride, S., & Cornum, R.L. (2013). Comprehensive soldier fitness: Underscoring the facts, dismantling the fiction. In R.R. Sinclair & T.W. Britt (Eds.), *Building psychological resilience in military personnel: Theory and practice* (pp. 193-220). American Psychological Association.

Lewis, G.F., Hourani, L., Tueller, S., Kizakevich, P., Bryant, S., Weimer, B., & Strange, L. (2015). Relaxation training assisted by heart rate variability biofeedback: Implication for a military predeployment stress inoculation protocol. *Psychophysiology*.

Li, A.W., & Goldsmith, C.A.W. (2012). The effects of yoga on anxiety and stress. *Alternative Medicine Review*, *17*(1), 21-35.

Luthar, S.S., & Cicchetti, D. (2000). The construct of resilience: Implications for interventions and social policies. *Development and Psychopathology*, *12*(4), 857-885.

MacCoon, D.G., MacLean, K.A., Davidson, R.J., Saron, C.D., Lutz, A. (2014). No sustained attention differences in a longitudinal randomized trial comparing mindfulness based stress reduction versus active control. *PLoS One*, *9*(6), e97551.

Malik, M., & the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (1996). Heart rate variability: Standards of measurement, physiological interpretation, and clinical use. *Circulation*, *93*(5), 1043-1065.

Mansdorf, I.J., Weinberg, J., & Wilik, A. (2007). Preventive psychological services in time of war: Controlled coping to foster resilience. *International Journal of Emergency Mental Health*, *9*(2), 123-132.

Masten, A.S. (2007). Resilience in developing systems: Progress and promise and the fourth wave arises. *Development and Psychopathology*, *19*(3), 921-930.

Masten, A.S., & Narayan, A.J. (2012). Child development in the context of disaster, war, and terrorism: Pathways of risk and resilience. *Annual Review of Psychology*, *63*(1), 227-257.

Matthieu, M.M., Cross, W., Batres, A.R., Flora, C.M., & Knox, K.L. (2008). Evaluation of gatekeeper training for suicide prevention in veterans. *Archives of Suicide Research*, *12*(2), 148-154.

McCraty, R., & Atkinson, M. (2012). Resilience training program reduces physiological and psychological stress in police officers. *Global Advances in Health and Medicine*, *1*(5), 42-64.

McCraty, R., & Shaffer, F. (2015). Heart rate variability: New perspectives on physiological mechanisms, assessment of self-regulatory capacity, and health risk. *Global Advances in Health and Medicine*, *4*(1), 46-61.

Menezes, C.B., Dalpiaz, N.R., Kiesow, L.G., Sperb, W., Hertzberg, J., & Oliveira, A.A. (2015). Yoga and emotion regulation: A review of primary psychological outcomes and their physiological correlates. *Psychology & Neuroscience*, *8*(1), 82-101.

Meredith, L.S., Sherbourne, C.D., Gaillot, S., Hansell, L., Ritschard, H.V., Parker, A.M., & Wrenn, G. (2011). *Promoting psychological resilience in the U.S. military.* RAND Center for Military Health Policy Research.

Miller, L. (2008). Stress and resilience in law enforcement training and practice. *International Journal of Emergency Mental Health*, *10*(2), 109-124.

Mills, K.C., & Hubal, R.C. (2001). Correlational data that support a constructive assessment of driving skills. In *Proceedings of the Interservice/Industry Training, Simulation and Education Conference*. NDIA.

Montain, S.J., Carvey, C.E., & Stephens, M.B. (2010). Nutritional fitness. *Military Medicine*, *175*, 65-72.

Morie, J.F., Chance, E., & Buckwalter, J.G. (2011). Report on a preliminary study using breath control and a virtual jogging scenario as biofeedback for resilience training. In J.A. Jacko (Ed.), *Human-Computer Interaction, Part II* (pp. 474-480). Springer-Verlag.

Nash, W.P. (2011). US Marine Corps and Navy combat and operational stress continuum model: A tool for leaders. In E.C. Ritchie (Ed.), *Combat and operational behavioral health* (pp. 107-119). Fort Detrick, MD.

Nash, W.P., Krantz, L., Stein, N., Westphal, R.J., & Litz, B. (2011). Comprehensive soldier fitness, Battlemind, and the stress continuum model: Military organizational approaches to prevention. In J.I. Ruzek, P.P. Schnurr, J.J. Vasterling, & M.J. Friedman (Eds.), *Caring for veterans with deployment-related stress disorders* (pp. 193-214). American Psychological Association.

Oded, Y. (2011). Biofeedback-based mental training in the military: The "Mental Gym (tm)" project. *Biofeedback*, *39*(3), 112-118.

Oken, B.S., Salinsky, M.C., & Elsas, S.M. (2006). Vigilance, alertness, or sustained attention: Physiological basis and measurement. *Clinical Neurophysiology*, *117*(9), 1885-1901.

Pangallo, A., Zibarras, L., Lewis, R., & Flaxman, P. (2015). Resilience through the lens of interactionism: A systematic review. *Psychological Assessment*, *27*(1), 1-20.

Pascoe, M.C., & Bauer, I.E. (2015). A systematic review of randomised control trials on the effects of yoga on stress measures and mood. *Journal of Psychiatric Research*, *68*, 270-282.

Poh, M.Z., Swenson, N.C., & Picard, R.W. (2010). A wearable sensor for unobtrusive, long-term assessment of electrodermal activity. *IEEE Transactions on Biomedical Engineering*, *57*(5), 1243-1252.

Quaglia, J.T., Goodman, R.J., & Brown, K.W. (2015). Trait mindfulness predicts efficient top-down attention to and discrimination of facial expressions. *Journal of Personality*.

Rees, B. (2011). Overview of outcome data of potential meditation training for Soldier resilience. *Military Medicine*, *176*, 1232-1242.

Reger, G.M., Holloway, K.M., Candy, C., Rothbaum, B.O., Difede, J., Rizzo, A.A., & Gahm, G.A. (2011). Effectiveness of virtual reality exposure therapy for active duty soldiers in a military mental health clinic. *Journal of Traumatic Stress*, *24*(1), 93-96.

Rizzo, A., Buckwalter, J.G., John, B., Newman, B., Parsons, T., Kenny, P., & Williams, J. (2012). STRIVE: Stress resilience in virtual environments: A pre-deployment VR system for training emotional coping skills and assessing chronic and acute stress responses. *Studies in Health Technology and Informatics*, *173*, 379-385.

Ross, K.G., Pierce, L.G., Haltermann, J.A., & Ross, W.A. (1998). Preparing for the instructional technology gap—A constructivist approach. In *Proceedings of the Interservice/Industry Training, Simulation and Education*

Conference. NDIA.

Rothbaum, B.O., Meadows, E.A., Resick, P., & Foy, D.W. (2000). Cognitive-behavioral therapy. In E.B. Foa, T.M. Keane, & M.J. Friedman (Eds.), *Effective treatments for PTSD: Practice guidelines from the International Society for Traumatic Stress Studies* (pp. 320-325). Guilford Press.

Ruiz, F.J. (2010). A review of acceptance and commitment therapy (ACT) empirical evidence: Correlational, experimental psychopathology, component and outcome studies. *International Journal of Psychology and Psychological Therapy*, *10*, 125-162.

Russell, M.C., & Figley, C.R. (2012). *Treating traumatic stress injuries in military personnel: An EMDR practitioner's guide.* Routledge.

Russoniello, C.V., Fish, M., & O'Brien, K. (2013). The efficacy of casual video game play in reducing symptoms of depression: A randomized controlled study. *Games for Health*, *2*(6), 1-6.

Russoniello, C.V., O'Brien, K., & Parks, J.M. (2009). The effectiveness of casual video games in improving mood and decreasing stress. *Journal of CyberTherapy & Rehabilitation*, *2*(1), 53-66.

Saccomani, M.G., Figueiredo, T., Kattenbraker, M.S., Simao, R., Forjaz, C.L.M., & Polito, M.D. (2014). Blood pressure and heart rate variability responses after isolated and combined sessions of aerobic and strength exercises. *International SportMed Journal*, *15*(2), 178-187.

Salmon, P. (2001). Effects of physical exercise on anxiety, depression, and sensitivity to stress: A unifying theory. *Clinical Psychology Review*, *21*(1), 33-61.

Salmon, P.G., Sephton, S.E., & Dreeben, S.J. (2011). Mindfulness-based stress reduction. In J.D. Herbert & E.M. Forman (Eds.), *Acceptance and mindfulness in cognitive behavior therapy: Understanding and applying the new therapies* (pp. 132-163). John Wiley & Sons, Inc.

Sargent, P.D., Campbell, J.S., Richter, K.E., McLay, R.N., & Koffman, R.L. (2013). Integrative medical practices for combat-related posttraumatic stress disorder. *Psychiatric Annals*, *43*(4), 181-187.

Schmitt, J.F. (1994). *Mastering tactics.* Marine Corps Association Bookstore.

Serino, S., Triberti, S., Villani, D., Cipresso, P., Gaggioli, A., & Riva, G. (2014). Toward a validation of cyber-interventions for stress disorders based on stress inoculation training: A systematic review. *Virtual Reality*, *18*(1), 73-87.

Shapiro, F. (2012). *Getting past your past: Take control of your life with self-help techniques from EMDR therapy.* Rodale.

Sharp, M.L., Fear, N.T., Rona, R.J., Wessely, S., Greenberg, N., Jones, N., & Goodwin, L. (2015). Stigma as a barrier to seeking health care among military personnel with mental health problems. *Epidemiologic Reviews*.

Shipherd, J. (2013). Enhancing Battlemind: Preventing PTSD by coping with intrusive thoughts. Annual Report, Project #W81XWH-09-1-0535. Boston VA Research Institute.

Siegel, S.R., Haddock, B.L., Dubois, A.M., & Wilkin, L.D. (2009). Active Video/Arcade Games (Exergaming) and Energy Expenditure in College Students. *International Journal of Exercise Science*, *2*(3), 165-174.

Smith, B.W., Epstein, E.M., Ortiz, J.A., Christopher, P.J., & Tooley, E.M. (2013). The foundations of resilience: What are the critical resources for bouncing back from stress? In S. Prince-Embury & D.H. Saklofske (Eds.), *Resilience in children, adolescents, and adults: Translating research into practice* (pp. 167-187). Springer.

Snodgrass, J.G., Lacy, M.G., Dengah, H.J.F., Fagan, J., & Most, D.E. (2011). Magical flight and monstrous stress: Technologies of absorption and mental wellness in Azeroth. *Cultural Medical Psychiatry*, *35*(1), 26-62.

Sotomayor, T. Mazzeo, M., Hill, A., & Hackett, M. (2013). Severe trauma stress inoculation training for combat medics using high fidelity simulation. In *Proceedings of the Interservice/Industry Training, Simulation and Education Conference*. NDIA.

Squire, P., Cohn, J., O'Neill, E., Weltman, G., Freedy, E., deVisser, E., McCraty, R., & Chartrand, D. (2014). Validated development of stress inoculation through cognitive and biofeedback training. In *Proceedings of the Interservice/Industry Training, Simulation, and Education Conference*. NDIA.

Stanley, E.A., Schaldach, J.M., Kiyonaga, A., & Jha, A.P. (2011). Mindfulness-based mind fitness training: A case study of a high-stress predeployment military cohort. *Cognitive and Behavioral Practice*, *18*(4), 566-576.

Steenkamp, M.M., Nash, W.P., & Litz, B.T. (2013). Post-traumatic stress disorder: Review of the comprehensive soldier fitness program. *American Journal of Preventive Medicine*, *44*(5), 507-512.

Tang, Y.Y., & Posner, M.I. (2014). Training brain networks and states. *Trends in Cognitive Sciences*, *18*(7), 345-350.

Tarrier, N. (2010). Broad minded affective coping (BMAC): A "positive" CBT approach to facilitating positive emotions. *International Journal of Cognitive Therapy*, *3*(1), 64-76.

Taylor, A.H., & Schatz, S. (2011). Measuring the effectiveness of stress prevention programs in military personnel. In D.D. Schmorrow & C.M. Fidopiastis (Eds.), *Foundations of augmented cognition* (pp. 636-646). Springer.

Teper, R., & Inzlicht, M. (2013). Meditation, mindfulness and executive control: The importance of emotional acceptance and brain-based performance monitoring. *Social Cognitive Affective Neuroscience*, *8*(1), 85-92.

Tharion, E., Samuel, P., Rajalakshmi, R., Gnanasenthil, G., & Subramanian, R.K. (2012). Influence of deep breathing exercise on spontaneous respiratory rate and heart rate variability: A randomised controlled trial in healthy subjects. *Indian Journal of Physiology and Pharmacology*, *56*(1), 80-87.

Thomas, K.H., & Taylor, S.P. (2015). Beyond trauma treatment: Mindfulness instruction in the training environment to prevent depression, lower suicide rates and improve resilience in the military and veteran communities. *Journal of Traumatic Stress Disorders & Treatment*, *4*(2).

Tu, P., Logan-Terry, A., Chen, J., Rubin, G., Chang, M.C., Hockett, J., Yu, T., & Tian, T.P. (2015). Cross-cultural training analysis via social science and computer vision methods. *Proceedings of the International Conference on Cross-Cultural Decision Making.* AHFE International.

U.S. Marine Corps & Reference Publication (MCRP) 6-11C; U.S. Navy Tactics, Techniques, and Procedures (NTTP) 1-15M. (2010). *Combat and operational stress control.*

Vakili, V., Brinkman, W.P., Morina, N., & Neerincx, M.A. (2014). Characteristics of successful technological interventions in mental resilience training. *Journal of Medical Systems*, *38*(9), 113.

van der Zwan, J.E., de Vente, W., Huizink, A.C., Bögels, S.M., & de Bruin, E.I. (2015). Physical activity, mindfulness meditation, or heart rate variability biofeedback for stress reduction: A randomized controlled trial. *Applied Psychophysiology and Biofeedback* (pp. 1-12).

Voshell, M., Trent, S., Prue, B., & Fern, L.C. (2008). Cultivating resilience in urban firefighting: Supporting skill acquisition through scenario design. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *52*(4), 423-427.

Wadlinger, H.A., & Isaacowitz, D.M. (2011). Fixing our focus: Training attention to regulate emotion. *Personality and Social Psychology Review*, *15*(1), 75-102.

Wagnild, G., & Young, H. (1993). Development and psychometric evaluation of the Resilience Scale. *Journal of Nursing Measurement 1,* 165-178.

Walsh, R. (2011). Lifestyle and mental health. *American Psychologist*, *66*(7), 579-592.

Weltman, G., Lamon, J., Freedy, E., & Chartrand, D. (2014). Police department personnel stress resilience training: An institutional case study. *Global Advances in Health and Medicine*, *3*(2), 72-79.

Wiederhold, B.K., & Wiederhold, M.D. (2008). Virtual reality for posttraumatic stress disorder and stress inoculation training. *Journal of Cybertherapy Rehabilitation*, *1*(1), 23-35.

Windle, G., Bennett, K.M., & Noyes, J. (2011). A methodological review of resilience measurement scales. *Health and Quality of Life Outcomes*, *9*(8).

Wright, M.O.D., Masten, A.S., & Narayan, A.J. (2013). Resilience processes in development: Four waves of research on positive adaptation in the context of adversity. In S. Goldstein & R.B. Brooks (Eds.), *Handbook of resilience in children* (pp. 15-37). Springer.

Xue, S.W., Tang, Y.Y., Tang, R., & Posner, M.I. (2014). Short-term meditation induces changes in brain resting EEG theta networks. *Brain and Cognition*, *87*, 1-6.

Yamada, A.M., Atuel, H.R., & Weiss, E.L. (2013). Military culture and multicultural diversity among military service members: Implications for mental health providers. In F.A. Paniagua & A.M. Yamada (Eds.), *Handbook of multicultural mental health: Assessment and treatment of diverse populations* (pp. 389-410). Academic Press.

Yi, J. (2004). MCMAP and the Marine warrior ethos. *Military Review*, November-December, 17-24.

Zotov, M., Forsythe, C., Voyt, A., Akhmedova, I., & Petrukovich, V. (2011). A dynamic approach to the physiological-based assessment of resilience to stressful conditions. In D.D. Schmorrow & C.M. Fidopiastis (Eds.), *Foundations of augmented cognition* (pp. 657-666). Springer.

Zubair, M., Yoon, C., Kim, H., Kim, J., & Kim, J. (2015). Smart wearable band for stress detection. In *Proceedings of the IEEE International Conference on IT Convergence and Security* (pp. 1-4). IEEE.

Table 1. Overview Of Resilience Techniques

Method	Citations (representative citations)	Administration (method of administration)	Setting	Timeframe	Practices (those involved, including other methods)	Characteristics (how method is adaptive, enables coping, or fosters recovery)	Relevance (for curriculum)
Mind-Body Practices							
▪ **Mindfulness**	Baer (2003) Salmon et al. (2011) Stanley et al. (2011)	Psychological health professional	Clinic or group/ classroom	Not brief (e.g., 8-week training sessions)	▪ Meditation ▪ Controlled breathing ▪ Guided imagery ▪ PMR ▪ Attentional training ▪ Physical movement (e.g., yoga)	▪ Cognitive control (e.g., focused thought patterns, as on goals); present moment awareness via attention and reflection ▪ Emotion regulation; emotional acceptance through lower rumination and higher savoring ▪ Positive effects on breathing rate, heart rate, HRV, other physiological measures	Not as a whole, but able to co-opt methods that are part of the practice
▪ **Meditation**	Rees (2011)	Individual	Group/ classroom or individual	Tailored by individual	▪ Concentration (breathing, mantra, gaze focus) ▪ Relaxation techniques		Yes, informally through elemental methods (attentional focus, relaxation breathing)

Table 1. Overview Of Resilience Techniques

Method	Citations	Administration	Setting	Timeframe	Practices	Characteristics	Relevance
SIT	Serino et al. (2014) Sotomayor et al. (2013) Wiederhold & Wiederhold (2008)	Psychological health professional	Laboratory setting, group/ classroom, or individual	Variable, though full training involves psychoeducation as well as skills development, and thus typically multiple sessions	▪ Relaxation ▪ Emotion regulation ▪ Breathing techniques ▪ Appraisal of events ▪ Desensitization	Promotes coping when administered prior to stresses, recovery when administered subsequent to stressful situations	Not as a whole, but able to co-opt methods that are part of the practice
CBT	Butler et al. (2006) Mansdorf (2007)	Psychological health professional	Individual w/ professional, often in clinic	Variable—it is a therapy—but generally not brief	▪ Breathing, relaxation exercises ▪ Goal-directed action ▪ Self-awareness ▪ Cognitive restructuring techniques ▪ PMR	Promotes self-directed adaptive management strategies to cope with and recover from distress	Not as a whole, but able to co-opt methods that are part of the practice
Arousal Control & Self-Regulation	Cohn et al. (2013) Crawford et al. (2013) Russoniello et al. (2013)	Psychological health professional	Laboratory setting w/ individual practice	Some basic techniques can be taught and learned in brief training sessions, others require more extensive practice	▪ Controlled breathing ▪ Mental imagery ▪ Self-help rhythmic eye movement ▪ Part of exposure therapy	▪ Biofeedback to control autonomic functions ▪ Limit effects of stressors	Yes, a subset of easily-practiced techniques
Complementary And Alternative Medicine							
▪ **Mind-Body**	(See above.)	Individual	Group/ classroom or individual	Tailored by individual	▪ Controlled breathing ▪ PMR ▪ Mental imagery	(See above.)	Yes, realizing that different techniques and exercises work

Table 1. Overview Of Resilience Techniques

Method	Citations	Administration	Setting	Timeframe	Practices	Characteristics	Relevance
▪ **Exercise Or Physical Exertion**	Walsh (2011)	Individual	Group/ classroom or individual	Any number of sessions	▪ Yoga ▪ Tai chi ▪ Stretching ▪ Martial arts ▪ Sports and recreation	Lifestyle factors have significant influence over individual well-being	for different individuals
Psychoeducational Programs							
▪ **R2C**	Johnston et al. (2015)	MRT (i.e., SME) or individual	Group/ classroom w/ professional as facilitator or online	Tailored to individual or to group; includes multiple ~1-hour sessions as well as take-home materials and practice	None	Intent is to engender coping and provide recovery mechanisms through passive and limited active learning	Some programmatic content is potentially useful as background or didactic materials
▪ **COSC**	Nash (2011)	OSCAR mentor (i.e., SME) or psychological health professional	Group/ classroom or individual w/ professional		None		
▪ **Sociocultural Skills Training**	—	SME or individual	Group/ classroom or online	Potentially tailored to individual	Training of important social terrain skills	Focused on adaptive perceptual and cognitive skills	No, content is generally not formalized

Table 2. Primary Stressors in High Risk Operations (from Bartone, 2006)

Stressor	Characteristics
1. Isolation	Remote location, foreign culture, distance from family, unreliable communication, unfamiliar coworkers
2. Ambiguity	Unclear mission, rules of engagement, leadership structure, role; unclear behavioral norms
3. Powerlessness	Movement restrictions, forced separation from local culture, unresponsive supply chain, indeterminate deployment length, differing standards, lack of influence on family at home
4. Boredom	Repetitive, meaningless work, unclear mission, little play/entertainment
5. Danger	Risk of injury or death (from many threats)
6. Workload	High frequency, pace, duration of deployments, long hours