Framework for Training Adaptable and Stress-Resilient Decision Making

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ABSTRACT

The uncertainty of today's battlefield and austerity of the fiscal environment requires the military to maximize existing methods used to prepare Warfighters for combat. Currently, significant emphasis is being placed on actively fostering resilience to stress, a key part of which is the ability to adapt to uncertainty and unfamiliar situations and recover or bounce-back to pre-stress levels as quickly as possible. The related constructs of stress, resilience, adaptability, and bounce-back as well as the knowledge of how best to influence these through training have been the focus of research for decades and have resulted in a plethora of models, metrics and learning strategies. The results of such efforts provide a disjointed toolbox of potential training interventions, yet, it remains unclear how to seamlessly integrate these tools into a training regime easily accessible to instructors/unit leaders to support effective and efficient training. The lack of this knowledge makes it difficult to systematically develop decision makers that can adapt to uncertainty in the combat environment, and are resilient to stress.

This paper presents a framework for training adaptable, stress-resilient decision-making. Specifically, the objective of the framework is to guide transition of those who succumb or marginally survive under stress at the cost of decreased performance, into those who have the ability to quickly adapt and bounce-back to original performance levels and eventually thrive under stressful conditions. This framework aims to achieve these goals by 1) decreasing the initial impact of stressors on performance through stress inoculation training and exposure techniques to improve observation, orientation and decision selection skills by instilling adaptability, and 2) increasing the rate at which performance bounce-back occurs by focusing on biofeedback methods and other coping strategies to enhance response under stress. Combined, these goals will increase the final resilience level achieved after the stressor allowing performance levels to reach pre-stressor levels or greater. Key to this framework are the ability to monitor how quickly a trainee is adapting to a stressor, predict if the trainee is going to succumb versus recover, and insert training interventions to optimize training opportunities.

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INTRODUCTION

Decisions once made by company or even battalion commanders are increasingly made by squad leaders and platoon commanders. These small unit leaders "must be prepared to excel in ambiguous and dangerous conditions, operate from a commander's intent, and with minimal direct supervision" (USMC, 2007). The Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) associated with a range of military operations require that small unit leaders be adaptable to such conditions and resilient to the stress it may induce in order to minimize negative impact on performance. Current military training objectives aim to develop training that can better prepare Warfighters to make effective decisions under these circumstances. For instance, the Marine Corps aims to "Improve Training and Education for Fog, Friction, and Uncertainty" (USMC, 2007, pp. 14):

> Our realistic training and education system will prepare Marines for complex conditions and to counter the unexpected. It will provide small unit leaders the tactical acumen and knowledge to develop and assess these conditions in order to make sound decisions… (USMC, 2007, pp. 14)

Moreover, as noted in the 2012 U.S. Marine Corps Science and Technology Strategic Plan one specific challenge, capability gap, is the area of small unit leader decision-making. The Strategic Plan requests "capabilities to support the entire T&E [Training and Education] continuum to assist in developing critical reasoning and ethical decision-making in scenarios spanning the full range of military operations" (USMC, 2012, pp. 34).

To achieve these training objectives and address the small unit gap, it is necessary to develop theoretically rigorous and operationally relevant training methods that enable small unit leaders to develop resilience to stress through skills that enhance adaptability and bounce-back in the presence of stressors, which positively impact a leader's decision making ability in the face of uncertainty in the battlefield. This is more complex than it may first appear, as the constructs of resilience and adaptability have been defined in a range of different ways and are often used interchangeably. Resilience has been defined as "a multi-dimensional construct that comprises a network of favourable attitudes and behaviours that enable adaptive coping strategies to acute and chronic stressful life events" (Burns & Anstey, 2010, p. 527). Adaptability is the capacity to respond quickly, flexibly, intelligently, and with agility and resilience to constant uncertainty, complexity, and rapid change (Grisogono, 2006a). Adaptability requires resilience and vice versa. Thus, these two constructs have yet to be disentangled. Further, many researchers have looked at these constructs separately when they are highly dependent. To have a full understanding of the impact of stress and uncertainty on decision making and determine how best to tailor training, there is a need to develop a comprehensive understanding of both constructs, their interdependencies and their impact on decision making.

DECISION MAKING UNDER STRESS

Although there are many factors that influence decision making effectiveness, the focus of this effort is on stress (e.g., uncertainty/VUCA). Stress can be described as occurring when a person appraises an environment as taxing or exceeding his resources and endangering his well-being (Lazarus and Folkman, 1984). Uncertainty and associated concepts, which have been coined VUCA by the U.S. Army War College, capture the dynamic instability that characterizes modern warfare, including its Volatility- nature, speed, volume, magnitude, and dynamics of change; Uncertainty – lack of predictability of issues and events; Complexity – confounding issues and chaos inherent in a situation; and Ambiguity – haziness and mixed meanings of reality (Magee, 1998; Yarger, 2006). The following sections describe the impacts of stress and VUCA on decision making performance and present strategies aimed at increasing resilience and adaptability to combat these effects.

Decision Making and Stress

In order to elucidate the effects of stress on decision making, it is first necessary to describe the decision making process. There are innumerable models of the decision making process; the majority of which detail a four step process. Models such as the OODA Loop (Observe, Orient, Decide, Act; Boyd, 1987), the SHOR model (Stimulus, Hypothesis, Options, Response; Wohl, 1981), and the CASE model (Collect data, Assess situation, Select response, Evaluate response; Johnston et al., 1998), decomposed the decision making process into these core processes: 1) collection and integration of sensory information, 2) interpretation of this sensory information to determine the current environment and situation, 3) evaluation of alternative courses of actions and response selection, and 4) planning and execution of response. Stressors of various types (physical, psychological) can negatively influence the decision making process, leading to physiological changes (e.g., increased cortisol, adrenaline, serotonin) as well as cognitive changes (e.g., decreased cognitive capacity and reasoning) (McNeil and Morgan, 2010). These effects may be seen at individual stages in the decision making process as outlined below.

The first stage of the decision making process, data collection/observation, requires appropriate and timely attention allocation to task relevant cues. Stress such as time pressure, workload and anxiety have been shown to lead to attentional narrowing by reducing cue utilization, shrinking the perceptive field, and reducing an individual's environmental scan (Staal, 2004). For instance, Entin and Serfaty (1990) found a reduction in the frequency and amount of information sought by decision makers under high-stress conditions. Further, stress creates distracting psychological (e.g., anxiety) and physiological (e.g., increased heart rate) responses, which can draw attention away from task relevant information (Baradell & Klein, 1993). Stress can also result in reversion of automated performance to conscious control, wherein attentional resources are consumed by step-by-step monitoring of task performance (Wickens & Hollands, 2000).

The next two steps in the decision making process, situation assessment and decision alternative evaluation, rely heavily on performers' working memory (Endsley, 1995). Stressors such as anxiety, noise, fatigue, extreme temperature and military combat significantly reduce working memory capacity and performance of working memory tasks, thereby limiting situation assessment (Staal, 2004). This reduced working memory capacity can also negatively impact the process of evaluating and selecting decision alternatives, leading to a reduction in the number and quality of alternatives considered (Staal, 2004). Further, stress can result in the tendency of a performer to perseverate on a decision alternative by continuing to attempt the same decision course despite lack of success (Woods et al., 1994).

Finally, the execution stage has also been shown to be influenced by stress. Decreased execution can come in many forms, such as increased errors and movement variability on perceptual-motor tracking tasks (van Galen & van Huygevoort, 2000) and increased errors in heading, steering, and reduced perceptual sensitivity on driving tasks (Matthews & Desmond, 2002).

In general, when people are under stress the decision making process is impaired, leading to reductions in quality of and confidence in decisions. These findings have been demonstrated across a variety of domains ranging from firefighting (Ozel, 2001) to aviation (Wickens, Stokes, Barnett, & Hyman, 1991). Thus, the challenge is to train Warfighters to be resilient to stress by enabling the development of strategies to counter the physiological and psychological impacts of stress and maintain performance while completing missions under high stress conditions.

Resilience to Stress

Resilience reflects one's ability to maintain stable equilibrium when confronted with stress or endure when presented with significant challenges (Bonnano, 2004; Masten & Narayan, 2012). Upon exposure to stress, resilient individuals are able to maintain focus by appropriately appraising the stressor(s) and implementing both physiological and psychological coping strategies as necessary, allowing for effective decision making skills regardless of stressor(s) present (Lazarus, 1966). Such individuals are able to avoid negative consequences of stress, and show minimal disturbance to performance – some individuals are even able to thrive under such conditions, showing greater self confidence and skills (Epel et al., 1998). These individuals have been shown to exhibit strengths in stress appraisal (i.e., assessing best/worst/likely outcomes to put stress into perspective).

Stress-Resilient Decision Makers

Decision makers who are resilient to stress are able to effectively 1) observe all critical cues in the environment, despite the physiological and psychological distraction of the stressor, 2) assess the situation including appropriate appraisal of the impact of the stressor on the situation, 3) evaluate decision alternatives, remaining focused through appropriate stress coping strategies, and 4) execute response and coping mechanisms to ensure successful response despite the presence of stressors.

Training to Build Resilience

Studies have shown that resilience can be improved through various methods, particularly when interventions are early in skill development (Feder, Nestler, and Charney, 2009). For instance, intermittent, acute stress exposure can have positive effects on physiology, allowing individuals to bounce-back and maintain tight allostasis (the process of maintaining a state of homeostasis; Epel, McEwen, & Ickovics, 1998). Within small unit leaders, this ability to demonstrate resilience in the face of a variety of operational stressors is critical to team and mission success. Thus, training Warfighter resilience during decision making training should focus on two main objectives 1) enhancing adaptability through stress appraisal skills, which involves focusing on identifying stressors present and appropriately assessing their perceived (and actual) impact and 2) developing physiological and psychological coping strategies that support recovery (i.e., bounceback) and effective performance despite the presence of stress. Training resilience to stress is expected to result in improved performance in decision making skills and beyond.

One of the two objectives of resilience training should be enhancing a warfighter's adaptability. Specifically, given the complex and continually changing stressors of warfare, a key success factor for military decision making is the rate at which warfighters are able to operationally recognize the need to change course of action (COA) under VUCA. In fact, in dynamic environments, the effective human decision maker can be looked at as an adaptive system that changes over time in a manner that tends to increase its success (e.g., survivability, lethality, etc.) under widely varying and stressful conditions. During the adaptive process, a warfighter must observe and predict what constitutes a 'success' versus a 'failure' within a specific context, and identify the sources of variation within the context that can drive this success or lead to failure (Grisogono, 2006b). The goal of adaptability training should thus be to train, and in turn measure, a warfighter's ability to engage 'intelligent' context-appropriate and flexible assessment of the environment, be robust to adverse and stressful events, create – when necessary - new strategies in real-time, as well as to learn from and adapt to lessons-learned via experience (i.e., encode information about the past and use it to be more effective in the face of future stressors [e.g., unforeseen actions and mishaps]).

The other objective of resilience training should be to enhance the ability of a warfighter to bounce-back from the impact of a stressor by developing physiological and psychological coping strategies that support recovery and effective performance despite the presence of stressors. This should, in turn, allow for selection from among plausible courses of action while preferentially retaining/discarding variations that enhance/decrease probability of success (Grisogono, 2006b). Over time the warfighter should internalize variations that tend to increase the probability of success, thus becoming a resilient decision maker.

Taken together, such training should provide individuals with the ability to respond quickly and intelligently to constant and stressful change by thinking critically and flexibly, being comfortable with ambiguity and decentralization of control, dealing with uncertainty and risk, and rapidly recovering and adjusting based on a continuous assessment of the situation (Wong, 2004).

MODEL FOR TRAINING ADAPTABLE, STRESS-RESILIENT DECISION MAKING

Based on the two objectives for resilience training – adaptability and bounce-back - we propose here a framework for training resilience in decision making based on the pathways model of resilience (adapted from Carver, 1998; See Figure 1). Resilience research has shown that in the face of a significantly stressful event, a person's performance will either 1) succumb to the stress and performance will degrade to the point of failure, 2) have degraded performance, but survive by maintaining performance levels that enable them to continue to operate sub-optimally, 3) recover to pre stressor levels, or 4) thrive in the face of the stressor (Carver, 1998; Bananno & Mancini, 2010; Masten, 2011). The goal of this training framework is to facilitate assessment of a trainee's resilience to stressors during decision making performance in order to adapt training to push the trainee up the expertise continuum.

In this model, we propose that adaptability is a component of a performer's resilience. Specifically, resilience can be modeled as a function of 1) the time needed to recognize that the environment has changed and the need to change action, which aligns with the initial performance drop resulting from a stressor – the adaptability phase and 2) the time to consider decision

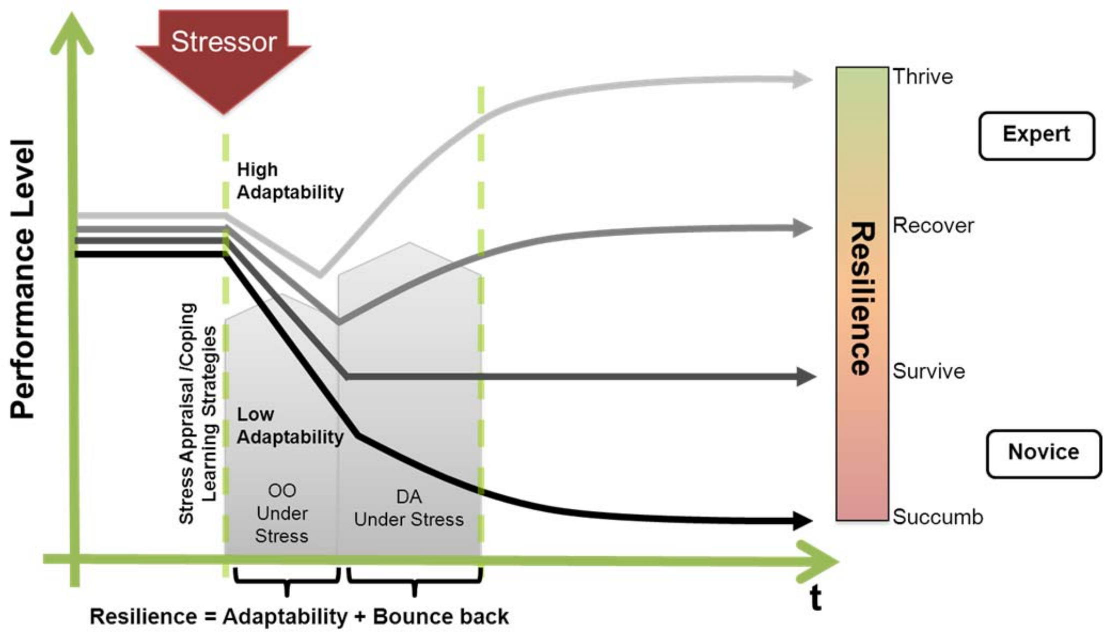

Figure 1. Model for Training Adaptable, Stress Resilient Decision Making

alternatives and act – the bounce-back phase. A person's level of adaptability is represented by the initial performance drop resulting from the stressor, wherein a highly adaptable person is able to recognize the stressor and need to change COA (e.g., as if there is ample time). This includes accurately assessing best case/worst case/most likely case as a result of exposure to the stressor, identifying performance elements required to achieve successful performance and recognizing when adjustment from one strategy to another is needed to address the stressor (Grisogono, 2006). Adaptability in the early stages of the decision making process (Observe/Orient), wherein an individual is perceiving environmental cues, including stressors and assessing the situation at hand is therefore critical. Once a person has recognized the effects of a stressor and identified strategies to address it, the second phase of resilience kicks in - a person's ability to recover from the stressor - a.k.a. the bounce-back phase. A person's ability to bounce-back is represented by both the amount and rate of bounce-back, wherein a highly resilient person is able to 1) maintain or regain balance physiologically in the presence of the stressor, 2) maintain or regain focus and change their thoughts/behaviors in a positive manner as needed to complete tasks despite presence of stress, and 3) recover from or adjust to the stressor, thereby maintaining or regaining effective performance levels across a range of tasks, situations, and conditions (Lazarus, 1966; see Table 1). Bounce-back is therefore critical for the latter stages of the decision making process (Decide/Act) wherein an individual is now evaluating decision alternatives under the stressful circumstance and selecting and executing courses of actions predicted to be most successful in the face of the stressor.

The underlying assumption of this model is that although many competent decision makers have been trained to adequate levels of decision making performance void of stressors, when they encounter a stressor their performance may be impacted in a variety of ways (See Figure 1) depending on their resilience – i.e., their adaptability and ability to bounce-back from stress. It is theorized that monitoring an individual's decision making performance, both process (e.g., decision making stages such as OODA) and outcome level, in hand with their physiological stress responses (e.g., heart rate, galvanic skin response) will enable progress along the theorized curve to be assessed and their resilience pathway (i.e., succumb, survive, etc.) to be diagnosed. Diagnosis of this pathway and where breakdowns in the decision making process occur will facilitate delivery of individualized learning strategies targeted to build resilience (i.e., adaptability and bounce-back) into the decision making process and trainee in general.

Learning Strategies

Individualized learning strategies can focus on building resilience into the decision making process by focusing on 1) enhancing stress appraisal skills, particularly in early stages of the decision making process, and 2) developing physiological and psychological coping strategies that support recovery (i.e., bounce-back) to effective performance levels. For instance, performers who display breakdowns under stress in early stages of the decision making process, such as the observation and orientation (adaptability) stages, may receive online or after action learning strategies that target stress appraisal and refocusing a performer's attention from the stressor to task relevant cues. This could be achieved through metacognitive strategies.

Specifically, according to Staal (2004), minimizing the perceived impact of stress is highly influenced by one's perceived control over a situation – if one has adequate recognition of stressors and appropriate coping strategies, they may be better situated to maintain performance under various conditions. Metacognition - being aware of how one perceives and thinks - about stressors has been shown to build resilience (Narayanan, 2009). This may involve both accurate appraisal of a presented stress by assessing best, worst, and most likely outcome, or could also involve strategies to increase attentional control and concentration when under stress, such as those taught in mindfulness training (Stanley, et al., 2011).

Further, during the later stages of decision making – the decision and action (bounce-back) stages - increased exposure dose could be used to build resilience. For example, studies have shown that intermittent exposure to acute stress that allows for time to recover may lead to resilience to future stressors (Epel, et al., 1998). This is the foundation of stress inoculation training – a cognitive behavioral therapy that uses a three step process to expose an individual to stress multiple times to increase coping strategies. Another strategy that could be used during the bounce-back phase is biofeedback, which involves providing physiological biofeedback to increase awareness of stress response and guide conscious evaluation and control over physiological state during decision making. Taken together, with respect to battlefield stressors, similar learning strategies could be employed to 1) increase stress appraisal skills and hence adaptability, including awareness of stress and how it may impact the decision making process, and 2) develop coping strategies that address psychological and physiological impacts of stress exposure on decision making performance. Measures and learning strategies which can be employed to effectively target

Table 1. Summary of Adaptability and Bounce-back Measures and Learning Strategies

	Adaptability	Bounceback
Measures	Recognition: Ability to recognize new threats / opportunities and orient to them as if ample time to plan and prepare	Perspective: Ability to maintain focus and change thoughts/behaviors in a positive manner as needed to complete tasks despite presence of stress
	Robustness: Ability to degrade gracefully under attack or as a result of partial failure	Recoverability: Ability to recover from decreased performance as a result of exposure to stressors
	Stress Appraisal: Ability to accurately assess best case, worst case and most likely case as a result of stress exposure	Flexibility: Ability to maintain/regain effectiveness across a range of tasks, situations, and conditions
	Allostatic Load: Ability to maintain balance physiologically in the presence of stress	Allostatic Load: Ability to regain balance physiologically in the presence of stress
	Agility: Ability to recognize when to shift from one strategy to another	
Learning Strategies for Stress Appraisal & Coping Skills	Metacognition Strategies: Guide reflective thought to identify best case, worst case, and most likely case that may result from stressor to put into perspective;	Stress Inoculation Training: Conceptualization and education regarding stressors, skill acquisition and rehearsal under stress, and encouraging application of coping skills
	Mindfulness Training: to increase attentional control and concentration under stress	Biofeedback: Provide physiological biofeedback to increase awareness of stress response and guide conscious evaluation and control over physiological state

the components of resilience (i.e., adaptability and bounce-back) are summarized in Table 1.

Further, learning strategies for resilience training - should it be classroom instruction, simulation/scenario-based training, or live exercises - should also require the critical elements of adaptivity – variation interaction, and feedback. VUCA is an inherent source of variation that creates tension tradeoffs that must be contended with, such as tradeoffs between power concentration versus power equality (i.e., authority/control parity or differentiation), one role versus multiple roles, problem focus versus dominant leader focus (i.e., when experiencing stress and disruption, warfighter may think, feel, and act in more constrained ways, being driven by a problem-focused mentality, as opposed to being directed by a clear line of authority, with power of delegation and ability to control subordinates' level of participation in decision making process), collective interest versus individual interest, etc. (McEver, Martin, & Hayes, 2008; Smith, Grisogono, & Clemente, 2008; Wong, 2004). These can become scenario variables that are designed to increase or decrease levels of complexity, unpredictability, and ambiguity, which require varying degrees of adaptability (Wong, 2004). Scenario-based training can, in turn, be used to encourage warfighters to envision the plausible bounds of VUCA and motivate adaptability and recovery.

From an interaction perspective, VUCA presents multilayered interactions (e.g., plan-centric versus intent-centric operations; static command posts versus situational awareness on the move; centralized versus distributed) that result in nonlinearities requiring adaptability and consideration of alternatives (Smith et al., 2008; Wong, 2004). From a feedback perspective, feedback should qualify and/or quantify how well warfighters handle each element of VUCA – how well they exercise influence over volatility and manage uncertainty, whether or not they simplify complexity and resolve ambiguity (Yarger, 2006). Their efficacy in meeting these objectives is best reflected in their decision making process; i.e., their selection of ends, ways, and means. Thus, feedback should be provided on ends (specified objectives), ways (methods/strategies required/used), and means (resources required/used). Also, feedback should be FAST - frequent, accurate, specific, and timely (Tulgan, 1998).

Use Case: Ambush Patrol Training Scenario

This use case describes an example simulated training scenario relevant to Infantry Small Unit Leader Training based on the framework presented above.

This simulated training event requires the squad to insert 650m south of the objective and conduct a deliberate ambush in vicinity of (IVO) the objective in order to destroy enemies attempting to mine/IED the Main Supply Route (MSR). This involves conducting dismounted movement to a selected Objective Rally Point (ORP), conducting leader's recon, loading the ambush site, observing and reporting activity, positively identifying the enemy, destroying enemy forces with direct fires and maneuver, conducting site exploitation of the kill zone, and return to ORP to call for extract. The squad leader is faced with a series of decisions throughout this training event under a number of different stressors. As his performance and heart rate are monitored, various training interventions are introduced to increase his decision effectiveness decisions under stress and uncertainty.

The training event and the squad leader's performance remain relatively routine until the point at which the squad leader must move his team from the ORP to the ambush site to determine optimal emplacement location of his teams. At this point, it begins to rain, limiting visibility (environmental stressor) and thus the number of effective emplacement opportunities. At the same time, the squad leader receives a message from headquarters that surveillance has detected heat signatures along the ridgeline and the team must be set for the ambush within 15 minutes (time pressure stressor). The squad leader's heart rate quickens (allostatic load metric is high) and he begins a hasty and limited scan of the area, neglecting a few opportune emplacement locations as his perceptive field has narrowed under stress.

The training system, detecting the deterioration of the squad leader's performance and state, directs his attention to the emplacement opportunities neglected in his scan to ensure training opportunities are not lost due to early errors in mission performance and to highlight the attentional narrowing resulting from the stressor. The squad leader scans the areas highlighted by the system, choosing effective locations for all teams. The squad and fire team leads then move the security, support and assault teams into position.

Shortly after emplacement, the enemy is identified; however, it appears the enemy is split into two elements with an advanced element 100-200 meters ahead of the main body. As the rain intensifies and visibility becomes even more limited, it is difficult to determine the size of the main element (uncertainty), and the squad leader is faced with the decision of whether to engage the advance element, the main body (which is potentially significantly larger than the squad), or abort the mission.

As the main body moves closer, it becomes apparent that the main body is a much larger force. Despite this, the squad leader perseverates on the decision between engaging the forward element or main body (perspective metric is low). His heart rate quickens. The squad leader is not able to recover from his performance loss; thus, the instructor, monitoring the discussion of the squad leader with his team, interjects to suggest the squad leader consider an additional alternative of aborting the mission. The squad leader concedes that is the best decision, aborts the mission and successfully guides his team through extraction.

Upon completion of the scenario, the instructor guides the squad leader through a metacognition-based debrief session in which each decision is revisited, along with associated stressors and both physiological and performance stress effects detected by the system. The instructor walks the squad leader through these effects and potential coping strategies to minimize these effects in the future.

Based on the results of the training event, the instructor selects the next scenario to have 1) a greater level of complexity by selecting an open terrain with limited available cover and concealment and 2) increased ambiguity by increasing difficulty of positive identification of the enemy. Further, the stressors to be present are varied from weather and time pressure to the threat of penalty. As the squad leader performs the next scenario, his observation performance is improved as he is now aware of his previous attentional narrowing under stress, and he responds to the scenario stressors more effectively as he is familiar with his stress response and has begun to implement learned stress coping strategies across different situations (flexibility metric is high).

CONCLUSION

The framework presented herein aims to clearly differentiate and quantify the relationship between resilience and adaptability. Developing a method to quantify these two key skills required for effective decision making under stress and uncertainty provides training designers with an opportunity to not only measure adaptability and resilience in real-time, but also to align appropriate learning strategies dynamically throughout training to address specific issues and provide individualized training. The use case outlined in this paper provides an example of how such real-time, adaptive training may be implemented based on the presented framework, identifying key measures related to decision points, diagnosis of performance, and real-time scenario adaptations to target deficiencies in skills. Furthermore, AAR strategies are highlighted to provide summative review and focus on key feedback points for future training. Operationalizing such a framework is hypothesized to result in more adaptable, resilient warfighters better prepared to perform under the VUCA experienced on the battlefield.

FUTURE WORK

Future work on this effort will operationalize this training framework for implementation in both the classroom and simulation environments. Further, empirical validation of the framework will include a series of experiments to be conducted in the laboratory and field environment with both undergraduates and active duty Marines. Research questions to be addressed include: 1) Can the resilience pathway be modeled with an algorithm based on initial drop (adaptability), bounce-back and rate of bounce-back, and 2) Can the pathway be impacted by individualized learning strategies which aim to build adaptability and resilience into the decision making process and the decision maker in general.

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