Simulation Training Approach for Small Unit Decision-Making Under Stress

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ABSTRACT

The wars in Iraq and Afghanistan highlighted the need for small unit leaders to have the skills necessary to effectively operate in increasingly distributed and autonomous operations. Critical to this is development of skills to make effective decisions under the stress of the battlefield. To address this need, the Marine Corps is implementing the Infantry Small Unit Leaders Course (ISULC) to train Infantry Sergeants to "identify problems, develop problems/situations, formulate and communicate decisions, [and] adapt to changing conditions (Fitzpatrick, 2011, p.1). In this paper we describe a simulation-based training approach to aid in the development of small unit leader decision-making skills that are resilient to stress. This approach is based on the previously presented theoretical framework (Carroll et al., 2012) and incorporates validated stress induction and training techniques into a simulation-based training curriculum. The approach is being developed to effectively train small unit leaders within the time, staffing, and technology constraints of schoolhouse environments and integrates three components to achieve this goal. The basis of the approach is an event-based methodology in which simulation scenarios incorporate a series of related decision events based on target training objectives. Next, innovative assessment techniques are used to capture behavioral measures of decision-making at the process level (i.e., Observe, Orient, Decide, Act (OODA)) and physiological measures of stress response to facilitate an understanding of breakdowns in decision-making under stress. Finally, the approach incorporates learning strategies (e.g., pre-training, feedback) designed to target the decision-making process as well as stress appraisal and coping skills. This paper will describe the simulation-based training approach, including scenario design techniques, decision-making and stress measures, and learning strategies. Conclusions and future work will then be discussed.

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INTRODUCTION

The wars in Iraq and Afghanistan highlighted the need for small unit leaders to have the skills necessary to effectively operate in increasingly distributed and autonomous operations and to assume responsibilities previously held by a higher echelon. This movement towards increased small unit responsibility and leader competence levels is expected to continue into the future. In the Marine Corps Vision & Strategy 2025 Implementation Planning Guidance, General Conway directed that, "Deputy Commandant, Combat Development and Integration (DC CD&I) develop a plan to improve the ability of small unit leaders across the Marine Air-Ground Task Force (MAGTF) to improve their intuitive ability to assess, decide, and act while operating in a more decentralized manner" (Conway, 2009). Critical to this is development of skills to make effective decisions under the stress of the battlefield. To address this need, the Marine Corps is implementing the Infantry Small Unit Leaders Course (ISULC) to train Infantry Sergeants to "identify problems, develop problems/situations, formulate and communicate decisions, [and] adapt to changing conditions" (Fitzpatrick, 2011, p.1). This paper presents a simulation-based training approach being developed to aid ISULC instructors in meeting this goal by successfully training small unit leaders to make effective decisions under stress.

Whereas traditional Programs of Instruction (POIs) focus on specific technical and tactical skills, the purpose of ISULC is to propel experienced Sergeants (E-5 with squad leader experience) to high decision-making expertise levels by creating opportunities for the trainees to leverage their previously gained experience and technical and tactical knowledge to more effectively assess situations and make decisions. Thus, ISULC is a POI focused on application – specifically to develop expert decision makers who can excel in combat at the small unit level. All ISULC training is rooted in Training and Readiness (T&R) Manual tasks with a heavy focus on guided discussions, decision forcing cases, tactical decision games , sand-table exercises, and simulation-based training (USMC, 2011). This garrison training feeds into several field exercises and live-fire training ranges where the Sergeants rotate through a variety of billets from Platoon Commander to Squad Leader, providing them the opportunity to make a variety of decisions across a large range of situations.

ISULC's use of live ranges provides a unique opportunity for trainees to practice making decisions under stressful events in which live rounds are dropping at their feet and unruly villagers are impeding their mission objectives. These exercises are a significant investment of both time and money. To fully realize the training benefit, trainees must be highly prepared, otherwise time and training opportunities are wasted. Simulation-based training provides an opportunity for trainees to consolidate decision-making skills learned in the classroom (Cohn et al., 2007) and to practice making decisions in stressful environments (Cannon Bowers and Salas, 1998) prior to entering these resource intensive exercises. Simulation-based training also provides the opportunity to expose trainees to a large array of situations, environments and decision points not possible in live exercises due to logistical and resource constraints. Such experience supports building up a trainee's experience base – a necessity in moving an individual from a novice, analytic decision-maker to a more expert, recognition-based decision-maker (Marine Corps Institute, 2010). No collective and consolidated guidance, however, is available on how to utilize simulation to train small unit leader decision-making under stress. Guidance is needed in several key areas to ensure effective simulation-based training, including: 1) merging standards-based training (e.g., T&R standards) with decision-making-based training, 2) inducing stress at levels that impact the decision process and force coping strategies, 3) integrating objective and quantitative assessment to understand performance deficiencies and 4) incorporation of learning strategies that can enhance decision-making skills and increase their resilience to stress (USMC, 2012). The effort described herein addresses this need by developing a simulation based training approach which outlines methods for scenario design, stress induction, assessment and learning strategy integration.

Carroll et al. (2012) present a general framework for training adaptable, stress-resilient decision-making that aims to both decrease the initial impact of stressors on performance and increase the rate at which performance rebounds after stress exposure. The aim of the framework is to accomplish this by monitoring decision-making performance and stress response in order to insert targeted training interventions. The next step is transforming this framework into a practical simulation-based training approach to aid in the development of small unit leader decision-making skills that are resilient to stress. This approach aims to provide guidance in the key challenge areas presented above through the integration of 1) scenario design techniques to facilitate merging standards-based training with decision making training while effectively inducing stress, 2) performance and state assessment and 3) targeted learning strategies. The following sections describe this approach in detail.

METHOD

The simulation-based training approach presented herein is being designed specifically to enhance small unit leader decision-making skills and the resilience of these skills to stress. There are three key aspects of this approach, including: 1) effective scenario design to ensure that training advances decision-making skills that are relevant to target training objectives and can effectively induce stress, 2) integration of objective and quantitative measures of decision-making performance at the process level and associated stress response, 3) incorporation of learning strategies that have been validated to improve decision-making performance and bolster a trainee's response to stress. The following sections present these three approach aspects in detail.

Scenario Design

In developing scenarios to train small unit leaders to make effective decisions under stress, it is essential that the scenarios seamlessly integrate instructionally-sound and operationally-relevant decision events (i.e., opportunities to make decisions) into immersive narratives that induce stress.

Decision Events

The first step in achieving this is identification of target training objectives. Analysis of training documentation such as the POI or training manuals typically reveals the training goals of the course such as the types of missions and Tactics, Techniques and Procedures to be trained. However, in cases in which the documentation does not provide these, additional analysis may be required to effectively identify the training goals (see Milham, Carroll, Stanney & Becker (2008) for detailed discussion of training needs analysis). For instance, the ISULC POI identifies a set of T&R standards (e.g., lead a squad on a patrol) to be targeted. This provides a framework and scope for the types of decisions to incorporate into the scenarios. The second step is to identify a representative set of relevant decisions. Through course observation (e.g., what are the decisions embedded into training events), training content review (e.g., what are the decision anecdotes, and situations and environments incorporated) and Subject Matter Expert (SME) interviews (e.g., descriptions of decisions they have made in past deployments and surrounding circumstances and outcomes), a set of relevant and realistic small unit leader decisions that are relevant to the training objectives can be identified. This provides a library of decision types, circumstances, and environments from which to pull scenario decision events and decision factors to embed in the environment. The third step is scenario storyboarding in which a high level mission description (e.g., Area of Operation (AO), type of Military Operation, etc.) is created and scenario decisions are selected and tied together with a realistic and engaging narrative. Each scenario is designed using an event-based methodology (Fowlkes et al., 1998) in which five decision events are incorporated to provide five opportunities for a trainee to practice decision skills as well as five opportunities to assess decision-making at the process levels. Each of the five discrete decision events build upon each other and can have either positive or negative consequences for the participant later in the scenario, based on the quality of the decision that was made. The scenarios are designed such that decision-making performance impacts mission outcome, therefore the more effective the decision-making performance, the more likely the trainee is to succeed in their mission. These events then act as an outline for the full mission narrative to be created. Working in hand with SMEs, a narrative is interwoven around these events. Each scenario is designed to maximize decision opportunities in a short period of time with situations unfolding very quickly and each scenario taking approximately 15-30 minutes to complete.

Stressors

In addition to decision events, contextually-relevant simulation-based stress induction techniques (e.g., dead bodies, artillery fire; See Bouchard et al., 2012) must be integrated to induce stress. Research to date has found that stressors such as seeing dead bodies, receiving artillery or small arms fire, knowing someone is seriously injured or killed are stressful combat experiences that translate into simulation-based stressors because they are frequent, strong psychological challenges that last long enough to be used in narratives (Bouchard, Baus, Bernier, & McCreary, 2010). Key aspects of these stressors which have been shown to impact level of stress response include unpredictability, novelty and lack of control (Dickerson & Kemeny, 2004). The scenarios incorporate stressors such as these in the narratives to induce varying levels of stress. An attempt is made to vary stress levels induced by the scenarios by varying the number, severity and duration of stressors encountered throughout the scenario (e.g., taking almost continuous gunfire or artillery rounds from various locations out of sight).

Assessment

Each scenario incorporates mission performance outcome measures to assess overall performance such as whether the mission objectives were achieved, time to complete the mission, and number of civilian and friendly causalities resulting. However, to effectively improve an individual's decision-making performance under stressful conditions, it is necessary to assess decision-making at the process level (i.e., not only decision outcome, but are they effectively observing, orienting to the situation, etc.), including the associated stress response in order to understand where and why breakdowns in the decision-making cycle occur. By monitoring stress levels throughout the scenarios and having the ability to link them to steps in the decision-making process based on time, a deeper understanding of the level of stress experienced as well as effects on decision-making performance can be gleaned. This ultimately allows for remediation to be tailored to the individual. Table 1 presents measures designed to achieve this and a detailed discussion follows.

Table 1. Summary of Assessment Measures

Target Construct	
Decision-making	**Stress Response**
<u>Observe</u> % of critical Areas of Interest (AOIs) fixated # of fixations on critical AOIs Average/total fixation duration on critical AOIs <u>Orient/Decide</u> Contextually relevant online queries Inference-based assessment <u>Act</u> Response Effectiveness	<u>Physiological Measures</u> Heart Rate Variability (HRV) Pulse Transit Time (PTT) Respiratory Sinus Arrhythmia (RSA) Electromyogram (EMG) Root Mean Square (RMS) Electrodermal activity (EDA)

Decision-making Assessment

The framework for assessing decision-making performance is based on the OODA Loop (Boyd, 1987) which decomposes the decision-making process into four key stages: 1) Observe (collection and integration of sensory information), 2) Orient (interpretation of sensory information to determine the current environment and situation), 3) Decide (evaluation of alternative courses of actions and response selection), and 4) Act (planning and execution of response). Decomposition of the decision-making process into these four stages allows decision-making to be assessed at the process level in order to understand the root cause of decision breakdowns. So, in addition to typical decision outcome measures of decision effectiveness and time to decide, each stage of the decision process can be assessed independently. For the Observe stage, there are critical Areas Of Interest (AOIs) which should be attended to effectively inform a situation. Current efforts developed the ability to utilize eye tracking with the Virtual Battlespace2 (VBS2) simulation and identify gaze fixation on simulation entities in order to collect metrics to assess the Observe stage, including percent of critical AOIs fixated and percent of critical AOIs fixated for greater than 300ms (i.e., significant attention allocation, see Carroll, 2010). Additional Observe measures are currently being investigated for their relevancy to decision-making performance, including number of fixations and average and total fixation duration on critical AOIs (for metric details, see Carroll, Kokini and Moss, 2013). The Orient and Decide stages are much more challenging to assess as these are for the most part internal and unobservable processes. A combination of two techniques is used to assess these stages of the decision-making process. First, contextually relevant online queries (Gugerty, in press; Klein & Hoffman, 1992) in the form of information "pull" from higher command are incorporated into the scenario in which decision makers are prompted to answer questions related to the events unfolding as they perform. These queries are designed to imitate the process of radio communication with higher command so as to minimize interference with task performance. Second, by carefully crafting scenarios designed to elicit certain responses, inference-based measures (Gugerty, in press) are utilized to infer Orient and Decide stages based on monitoring communications and actions. For instance, in order to assess the Orient stage, at various points throughout the scenario the trainee is asked to verbally report what they see and what it means. Based on the percentage of critical situation factors reported, orientation effectiveness level is assessed. In order to assess the Decide stage, the trainee is asked to verbally report the possible courses of action they can take. Based on the courses of action reported and the actions taken, the effectiveness of the decide stage is assessed. The Action phase is assessed based on how effectively the response is carried out; however, Action is not a major focus of this effort as it is typically an indication of tactical/technical skills, not decision effectiveness. These measures facilitate the assessment of each stage independently and provide granularity in assessment to understand where breakdowns in the decision-making process originated and identify patterns of these breakdowns across decisions (e.g., does a performer have issues with situation assessment that need to be remediated).

Stress Assessment

Stress can impair the decision-making process leading to reductions in quality of and confidence in decisions (for review of impacts of stress on decision-making see Carroll et al., 2012). Assessment of an individual's stress response during decision-making performance can assist in determining if performance decrements are due to basic skill deficiencies or failure of the skill to be resilient to stress and therefore how to remediate performance decrements. Stress response can be objectively and quantitatively assessed, in near real time, without disruption to task performance by utilizing physiological measures. When an individual encounters a significant stressor, the sympathetic or "fight or flight" division of the autonomic nervous system (ANS) increases in activity, resulting in hormone release and subsequent physiological effects on multiple organ systems. Among a myriad of effects, heart rate increases, pupils dilate, blood vessels constrict, and sweat glands become active.

The goal of this effort is to identify the most robust physiological indicators of stress response in order to develop a classification method for identifying periods during training when an individual is experiencing significant levels of stress. To assess an individual's stress response, measures of ANS activity are collected throughout decision-making performance. A BioNomadix sensor suite (Biopac Systems, Goleta, CA) is used to gather physiological data non-invasively from multiple body sites and locations. Three-lead electrocardiogram (ECG) sensors are applied to the chest to record the ECG (i.e. heart data), and a respiration strap is placed across the chest to gather breathing intensity and kinetics. Electromyogram (EMG) sensors are placed on the trapezius muscle (the muscle that extends from the shoulders to the neck and back) to gather electrical activation and tension of this muscle group. Electrodermal activity (EDA) sensors are placed on the fingers of the non-dominant hand to gather electrodermal responses (EDR; i.e., skin perspiration), and a pulse plethysmography (PPG) sensor is placed on the thumb to gather pulse. All of these sensors stream data simultaneously and are currently being investigated to identify the most robust measures indicative of stress response. Those which can most effectively capture changes associated with variation in scenario stressors, performance levels and perceived stress will be selected for incorporation. Measures being evaluated include: 1) heart rate variability (HRV), 2) pulse transit time (PTT), which is the time it takes the pulse waveform to propagate from the heart to the periphery (i.e., the thumb), and 3) respiratory sinus arrhythmia (RSA), which is a naturally occurring variation in heart rate that occurs during a breathing cycle, 4) EMG root mean square to capture neck and back tension, and 5) Electrodermal Response (EDR), spikes which occur 1 - 3 seconds following stimulation and are due to autonomic innervation

Research is currently underway to evaluate the effectiveness of the decision-making and stress measures to inform which measures will be integrated into the final approach. The integration of these measures provides the capability to monitor decision-making performance under stress in order to: 1) identify when and where breakdowns in the decision-making process occur, 2) determine if these breakdowns are due to basic skill deficiencies or inability of the skill to withstand stressful performance conditions, and 3) tailor training interventions by leveraging learning strategies validated to either improve decision-making skills or increase resilience to stress.

Learning Strategies

There are innumerable learning strategies which have been explored in the laboratory and the field and have shown varying degrees of success at effectively training decision-making and/or stress skills (e.g., Klein, 1993; Lipshitz, Klein, Orasanu, Salas, 2001; Batha & Carroll 2007; Calderone & Thompson, 2004). However, the challenge is identifying the most effective as well as the most feasible strategies to implement in a military school house setting. Carroll et al. (2012) presented a preliminary set of learning strategies designed to build resilience into the decision-making process by focusing on enhancing stress appraisal skills, developing physiological and psychological coping strategies that support recovery (i.e., bounce-back) and promoting adaptability. Work to date refined this set based on operational constraints while expanding it to include learning strategies that also target the decision-making process. These strategies are presented in Table 2 along with the associated training phase (i.e., pre, during, post). A detailed discussion follows including integration of these strategies into a simulation-based training approach.

Table 2. Summary of Learning Strategies

Target Construct		
Decision-making	**Stress Response**	**Adaptability**
<u>Pre Training</u> Planning Exercises Crystal Ball Exercises Premortem Exercises Advanced Organizers <u>During Training</u> Event-based Training <u>Post Training</u> Error-based Feedback Causal-based feedback \\ Attribute Isolation	<u>Pre Training</u> Bio Feedback <u>During Training</u> Stress Exposure Training (SET) /Stress Inoculation Training (SIT) <u>Post Training</u> Metacognition Strategies	<u>Pre Training</u> Motivation Strategies <u>During Training</u> Emotional Engagement Variety/Increasing Complexity Novelty, Unexpected Challenges High fidelity Scenarios <u>Post Training</u> Mastery Orientation

Decision-making Learning Strategies

There are several learning strategies which can be used to enhance decision-making skills. Pre-training exercises, such as planning exercises which require trainees to identify and layout the plan for how they will accomplish a goal have been effectively utilized (Blackburn et al., 2004). Additional learning strategies which have been shown effective include crystal ball exercises in which a plan is scrutinized for potential failure points by assuming that a ‘crystal ball’ indicates the current assessment is wrong and it is necessary to explain why (Cohen, Freeman, & Thompson, 1998) and premortem exercises which assume a plan has failed and require the trainee to identify plausible reasons for the failure in order to critique the plan (Veinott, Klien, Gary, & Wiggins, 2010). Advanced Organizers, such as outlines, narratives, and audio or video multimedia, are an additional pre-training method which can be used to assist learners in attending to the most appropriate stimuli and effectively interpreting information during training (Vogel-Walcutt, Marino Carper, Bowers, & Nicholson, 2010; Mueller-Hanson, White, Dorsey, Pulakos, 2005). A key learning strategy which can be utilized during training is an Event-Based Approach to Training (EBAT; Fowlkes et al., 1998) in which training opportunities are systematically created by presenting events designed to elicit specific skills or behaviors (e.g., decision-making). EBAT has been shown effective at training decision-making skill across a range of domains (Fowlkes & Dwyer, 1998). After action review techniques such as error-based or causal-based feedback (Carroll et al., 2008, Carroll, 2010) provide the opportunity to target decision-making at the process level. Errors are considered to be valuable opportunities to clarify misunderstandings in learners (Mory, 2004) and the identification of underlying causes of deficient processes allows instructors to provide meaningful feedback to correct these deficiencies (Salas, Rosen, Burke, Nicholson, & Howse, 2007). This can be combined with specific learning strategies such as attribute isolation in which central attributes of target concepts (e.g., why cues are critical for a situations or indicative of an impending threat) are highlighted to improve general understanding of phenomenon (Mason & Bruning, 2001).

Stress Response Learning Strategies

There are also multiple learning strategies that can be used to target an individual's stress response during decision-making training. Biofeedback is a process by which individuals learn to control certain ANS functions such as blood pressure, salivation, sweat gland activity, and cardiac activity through feedback signals from sensors monitoring physiological responses (Calderon & Thompson, 2004). Bio Feedback Training (BFT) techniques typically encompass three stages wherein a trainee 1) acquires awareness of maladaptive physiological responses, 2) learns to control the response utilizing techniques such as deep breathing and muscle relaxation and 3) learns to transfer this control to everyday life (Lehrer & Wolfolk, 1993). Stress exposure strategies such as Stress Inoculation Training (SIT; Saunders et al., 1996) and Stress Exposure Training (SET; Driskell and Johnston, 1998) also incorporate three phases, except in this case they involve 1) an education phase to help the trainee better understand the nature of stress and stress effects, 2) a skill acquisition and rehearsal phase to facilitate development and practice a repertoire of coping skills and 3) an application phase in which coping skills are applied in conditions that increasingly approximate the transfer environment. Both techniques have been shown effective in increasing a trainee's ability to cope with stress (Sheehy & Horan, 2004; Saunders, Driskell, Hall, & Salas, 1996; Meichenbaum & Deffenbacher, 1988). Metacognition strategies can be utilized to facilitate awareness of how one perceives and thinks about stressors as well as accurate appraisal of a stressor by assessing best, worst, and most likely outcomes (Narayanan, 2009). Further, metacognitive strategies can also be utilized to increase awareness of the detrimental impact the stressor is having on an individual's decision-making process (e.g., narrowing the perceptive field).

Adaptability Learning Strategies

There are also several learning strategies which can be used to increase the adaptability of a decision maker. Mueller-Hanson et al. (2010) conducted a thorough review of the adaptability and training literatures to identify learning strategies that have been shown to improve adaptability. Of those strategies presented in the Adaptability Training Analysis Tool, several are applicable to this effort, including pre-training strategies such as techniques to increase a trainee's motivation to learn, active engagement in training, and recognition of relevancy to their job (Mueller-Hanson et al., 2010). Further, there are several learning strategies which can be applied during simulation training exercises, including emotional engagement (e.g., stress exposure), variety (e.g., variation of situations, decisions), increasing difficulty/complexity over time, novel and unexpected challenges presented to stretch the trainee, and the use of high fidelity scenarios that closely mimic the types of situations they will encounter in the field (Mueller-Hanson et al., 2010). Post training learning strategies such as mastery orientation driven feedback which focuses on the process, not that outcome can also be utilized to increase adaptability.

Integrated Simulation-based Training Approach

The above presented learning strategies are all feasible to implement in a military schoolhouse setting, however, the challenge remains how to seamlessly integrate into current training curriculum in an easy-to-use simulation-based approach. To achieve this, the "Do Something" instructional approach was utilized (DeVore, 2010). The "Do Something" approach is a concise instructional method that incorporates four components in which 1) the mission is presented via a video narrative, 2) the trainee is given a brief period to create and brief their plan, 3) the plan is executed in a simulation-based scenario and 4) an instructor and peer-based after action review is conducted utilizing a series of tools (e.g., performance replay). This approach provides a framework for anchoring the pre, during and post training strategies referenced above into a simulation based training package.

First, a video narrative presents the orientation, situation, mission objective and tactical dilemma. The video provides an outline of the mission goals and cues the trainees to critical factors to which they should attend (*Advance Organizer*). This is delivered in a realistic and immersive video designed to increase engagement and motivation (*Motivation Strategy*).

Second, the trainee performs a planning exercise in which they analyze the situation, devise a mission plan and develop and deliver orders to their team. The instructor then alerts the trainee of an incorrect situation assessment or failure point of the plan (*Crystal Ball, Premortem Exercise*). The trainee must re-plan and re-issue tasks to the team. This is conducted under time constraints and in the presence of unit leadership to induce stress. This is a form of social-evaluative stress, which can be induced when others negatively judge ones performance and has been found to elicit significant and reliable physiological stress responses (Dickerson & Kemeny, 2004). During the training, the trainee is equipped with a limited set of invasive physiological sensors (e.g., hear rate, EDA) whose output is displayed for the instructor and trainee to see (*BioFeedback)*. As the plan is briefed, the instructor can point out to the trainee times their physiological state is elevated, the resulting physiological response (e.g., HR increase, sweat present, tense shoulders) and present one or two quick and easy coping strategies to reduce stress response (i.e., deep breathing, muscle relaxation) which the trainee can practice and is then encouraged to employ at any time during the training when they recognize the physiological response to stress they just learned about.

Third, after the plan has been briefed, the trainee leads his team through the execution of the plan in a simulation based scenario designed to elicit adaptive decision-making skills under stress. The trainee encounters five decision events as he performs the mission, requiring him to effectively observe, orient, decide and act (*Event-based Training)* while process level decision-making performance is assessed via measures discussed above*.* During scenario execution, the trainee experiences a series of simulation-based stressors such as limited visual perception (night missions), sudden noise exposure, equipment failures, and receiving enemy fire, as well as cognitive stressors (e.g., time pressure) and emotion induction procedures (e.g., dead combatants, soldiers and civilians (Dickerson, et al. 2004; *Emotional Engagement/ Stress Exposure).* The scenarios are *high fidelity*, include a *variety* of *novel, unexpected challenges* and *increase in complexity* as training progresses.

Fourth, an After Action Review (AAR) is conducted utilizing a series of tools. While mission outcome performance is briefly reviewed, the AAR focuses on the process level decision-making performance metrics, emphasizing the root cause of decision breakdowns which propagated to mission failure (e.g., consistent failure to detect critical cues; *Mastery Orientation, Error-based, Causal-based Feedback*). For errors identified, central attributes of target concepts (e.g., why decision alternative selected was poor choice) are highlighted to improve decision skills (*Attribute Isolation).* Additionally, times when errors are accompanied by significant stress response, as indicated by physiological measures, are highlighted to increase awareness of the impact stress response has on the individual's decision-making process (*Metacognitive Strategies*).

Training packages will contain three to five scenarios and therefore three to five iterations of the above four step cycle. This allows the trainee several opportunities to experience stress response, practice and apply coping skills under decision-making performance conditions that approximate the transfer environment (*SIT/SET)*. Planning is currently underway for conduct of a study to evaluate the effectiveness of this training approach as well as effectiveness of component learning strategies to identify the optimal means of integrating them for use within a military schoolhouse.

GUIDANCE FOR IMPLEMENTING APPROACH

During development and evaluation of this approach, multiple challenges have arisen in trying to balance the various objectives of the approach (e.g. decision events that are operationally-relevant, assessment of process-level decision measures). This section will describe some of those challenges as well as provide guidance on how to mitigate them.

Scenario Design Guidance

One challenge in developing simulation training to target small unit leader decision making is that many squad leaders today have extensive experience operationally across a range of different AOs and this impacts both the face validity of the training scenarios with the Warfighters as well their interpretation of the scenarios. For example, in one scenario in which the unit leader was tasked with selecting the optimal path to lead a squad from one building to another at night in a particular province in Afghanistan, either along a road (the longest distance), through a field with some cover and concealment (medium distance), or through a poppy field with a lot of cover and concealment (shortest distance), SMEs consulted during scenario and metrics development indicated that the poppy field was the best route because of the cover and concealment and the short distance (seemingly the correct answer based on their training and experience). However, during demonstration of the scenario and measures to another former squad leader who had experience in that particular Afghani province and direct knowledge of the limitations of patrolling through poppy fields in that area, he indicated this was the worst option and that the representation of the poppy fields within the simulation was not accurate. While this does provide an interesting AO-specific learning opportunity, it presents a distraction to the trainee and a challenge in developing objective performance measures of decision making. To mitigate this challenge, two recommendations are made: 1) use AOs that are similar to places the trainees may have deployed without using names of particular locations, and 2) consult as many SMEs as feasibly possible who have deployment experiences across a variety of AOs to validate the relevancy of the decision events as well as the accuracy and acceptance of the range of decision alternatives and correct responses.

Assessment Measures Development Guidance

In order to develop objective process- and outcome-level decision making measures, it is necessary to have a means of scoring the effectiveness of decision alternatives selected and courses of actions taken. However, this presents two challenges: first, determining all likely decision alternatives the trainees may consider/select and second, determining the degree of effectiveness of each of the potential courses of action. To mitigate these, multiple SMEs performed a cognitive walkthrough of the decisions events, and were prompted to indicate what they were observing, how they were assessing the situation, what the decision alternatives were, the effectiveness or "goodness" of each alternative and mistakes a novice would most likely make. Further, the scenarios were pilot tested to determine any possible courses of actions not previously identified and the metrics were revised to ensure these potential courses of action and their associated effectiveness were integrated into the assessments.

Learning Strategies Implementation Guidance

There are two key challenges with integrating learning strategies from the literature into military training curricula: logistics and buy-in. Military training courses are always extremely limited with respect to time and instructor resources and often have limited access to technology to support simulation-based training. In order to ensure the training being developed for transition to the schoolhouse will be successfully transitioned and used, the developers must work very closely with the instructors to ensure training fits into the allotted time constraints and works with the technology available. Another major challenge is gaining instructor buy-in so the training will actually be utilized after it is transitioned. There are two key steps to ensure this: 1) involve the instructors from the ground up; greater user involvement will lead to user ownership and greater user acceptance, and 2) ensure the training is in line with the general "feel" of the course (e.g., does not feel out of place and interrupt flow of the course). Instructors work very hard to design a course that seamlessly integrates classroom, simulation and live components while maintaining a fluid development of trainee expertise.

CONCLUSIONS AND FUTURE WORK

The approach discussed herein has the potential to significantly improve the ability of small unit leaders to make effective decisions under stress by providing an opportunity to train these skills prior to entering live environments. It is anticipated that by trainees being better prepared to make decisions under stress in live environments that the benefit of live training exercises can be fully realized, resulting in increased readiness to make effective decisions under the stress of the battlefield, leading to wars won and lives saved. Further, current military schoolhouse training environments are limited by restricted training time and limited staff and technological resources. The approach described here attempts to overcome these constraints by designing materials to facilitate the development of turn-key simulation training packages that require very little preparation time by instructors, provide tailored and effective training and can increase the trainee's experience base over a period of hours.

This approach has applicability beyond the Marine Corps for other small unit leaders (e.g. Army, Special Forces, etc.) as well as other domains that use simulation-based training and must make critical decisions in stressful conditions, such as many in the medical field (e.g. emergency medical personnel, surgeons), law enforcement, aviation domain, and air traffic control. Future work under this effort includes a series of studies to validate the training effectiveness of the integrated approach both in the lab and in the field (at ISULC, USMC School of Infantry East). The first laboratory study aims to specifically validate process- and outcome-level decision-making measures, determine which physiological data best assess stress levels, and validate that stress can be induced through simulation-based scenarios. The second laboratory study will then employ the validated scenarios and measures and build in relevant learning strategies to validate that the learning strategies can be used to train adaptability and resilience in decision-making under stress. Finally, a third study will be conducted in the field with Marines to confirm that the approach is also successful in training Marines, both in simulation-based training, as well as in transfer to the field.

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