EFFECT OF A STRESS INOCULATION TRAINING INTERVENTION ON STUDENT
REGISTERED NURSE ANESTHETIST PERFORMANCE IN A CRISIS SIMULATION

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Abstract

This study investigated the effect of a single Stress Inoculation Training intervention on Student Registered Nurse Anesthetists (SRNAs) in a high-fidelity crisis simulation. The primary objective was to improve technical and non-technical performance. The secondary objective was to decrease the subjective experience of stress. The Neuman Systems Model provided the theoretical framework for this study. This was a prospective randomized single-blinded study of senior SRNAs enrolled in a Crisis Resource Management course. Independent samples t-test, multiple correlation, and MANCOVA were used for statistical analysis. The intervention group showed a non-statistically significant trend toward higher mean performance, with less of an increase in heart rate. Increased age was significantly correlated with worse performance and higher likelihood of an acute stress response. SRNAs with more critical care experience had significantly less baseline stress resilience and were more likely to report perceiving the simulation as stressful. This project highlights the potential positive impact of training SRNAs for the stress of clinical practice. Future research is necessary following a similar protocol but with a larger sample size, incorporating multiple sessions, and including junior SRNAs. The ease of implementation combined with the myriad potential benefits warrants consideration for incorporation into an existing Nurse Anesthetist program.
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Background

Stress is a common part of life. Almost 90% of people in the United States will experience at least one traumatic event in their lifetime (Everly, Davy, Smith, Lating, & Nucifora, 2011). Unfortunately, experiencing an acutely stressful or traumatic event is even more likely in the healthcare field (Iliceto et al., 2013). Anesthesia providers work in an unpredictable environment that requires unrelenting vigilance (Riad, Mansour, & Moussa, 2011). On a minute-to-minute basis, the patient could experience a life-altering or ending catastrophe. Most of the time these crises are obviated with simple adjustments. Unfortunately, the threat of a disaster constantly looms overhead, and when it does occur, the anesthetist needs to be able to respond and act. This is what distinguishes the clinician from the average person. The anesthetist may be in the midst of a situation that is perceived as stressful or threatening, but their actions also have an immediate and tangible effect on someone else’s life.

There has been a significant amount of literature published about the effects of stress on nurse anesthetists and trainees (Chipas et al., 2012; Chipas & McKenna, 2011; Conner, 2015; Dumouchel, Boytim, Gorman, & Weismuller, 2015; Kendrick, 2000; Perry, 2005; Radzvin, 2011). Unfortunately, most of this literature focuses on chronic stress, burnout, and job satisfaction. While addressing chronic stress is important to improve overall well-being, this is not the whole story. It would be ideal if everyone had a fulfilling hobby on the weekend, a strong social support system, a “type A” personality, a supportive working environment, or an optimistic demeanor, all of which are chronic stress resilient traits (Iliceto et al., 2013). Nevertheless, these will not necessarily help the acutely stressed and overwhelmed clinician save a patient’s life. The majority of the stress-focused literature does not help the individual manage
the effects of acute stress in the moment, when both the patient and anesthetist are most vulnerable.

Stress is commonly defined as an imbalance between perceived demands and resources (Rama-Maceiras, Jokinen, & Kranke, 2015). When someone is faced with a stressor, they unknowingly do what is called a subjective cognitive appraisal (Harvey, Nathens, Bandiera, & Leblanc, 2010). First, the individual assesses the stressor to determine what is expected from them. The second step is assessing whether there are adequate resources available. If resources meet or exceed demands, the stressor is labeled a “challenge.” In this circumstance, stress serves to help performance. However, if resources do not meet demands, the stressor is instead a “threat.” When a stressor is labeled as a threat, activation of the hypothalamic-pituitary-adrenal axis (HPA) occurs, resulting in increased serum cortisol, and activation of responses like the sympathetic autonomic nervous system (Harvey et al., 2010).

The reason acute stress is a concern, particularly when labeled a “threat,” is that it has a profoundly negative affect on the ability to perform. Specifically, acute stress and activation of the HPA impairs creativity, problem solving, memory, and spatial referencing; this further negatively affects the ability to make thoughtful decisions, or even do something simple like a drug calculations (Chipas & McKenna, 2011; LeBlanc, MacDonald, McArthur, King, & Lepine, 2005; Liston, McEwen, & Casey, 2009; Olver, Pinney, Maruff, & Norman, 2015; Soares et al., 2012). The overall result of an acute stressor on a clinician is that their ability to incorporate information is limited, and their response is likely to be reflexive or instinctual, something based on routine or habit instead of consideration of consequences and outcomes (Liston et al., 2009; Soares et al., 2012). In recognition of this very problem, programs like TeamStepps and Crisis
Resource Management have emerged, but they only tackle part of the issue at hand (McClelland & Smith, 2016).

The field of psychology has long found Stress Inoculation Training (SIT) or a variation like Stress Exposure Training or Stress Resilience Training to be a beneficial modality for helping patients prepare for and cope with stressors (Holcomb, 1986; Saunders, Driskell, Johnston, & Salas, 1996). In recent years, industries where performance is essential under acute stress, like aviation, law enforcement, and the military, have looked at the effects of acute stress, and how to train for it (Ilnicki et al., 2012; Stanley, Hom, & Joiner, 2016; Vine et al., 2015). They have investigated and adopted variations of SIT with impressive results (de Visser et al., 2016; Hourani et al., 2016; Weltman, Lamon, Freedy, & Chartrand, 2014). Accordingly, there has been increasing interest and literature published on this topic for our physician colleagues in anesthesia and other specialties (Clarke, Horeczko, Cotton, & Bair, 2014; Eisenach et al., 2014; Hochberg et al., 2013; Hunziker et al., 2013; Hunziker et al., 2012; LeBlanc, 2009; LeBlanc et al., 2005; Petrosoniak & Hicks, 2013; West, Tan, Habermann, Sloan, & Shanafelt, 2009). A similar depth of literature, however, does not exist for nurse anesthetists (McKay, Buen, Bohan, & Maye, 2010). Overall, there remains a need for more literature on this topic.

The general conception behind SIT is that the training provides the individual with tools to mitigate the negative effects of stress to improve performance when necessary. The training acts as a sort of immunization against the negative effects of stress. The intervention consists of three sequential phases. The first phase provides preparatory information to the learner, helping form a mental model of stress, reactions to stress, and specifically what to expect with the training (Petrosoniak & Hicks, 2013; Saunders et al., 1996). The second phase is delivering the skills for stress reduction and allowing for rehearsal (Petrosoniak & Hicks, 2013; Saunders et al.,
1996). These skills involve forms of cognitive reframing, where the trainee identifies and reformats negative thoughts. They also include techniques like structured breathing, mindfulness, self-talk, visualization, or intentional use of body posture (Lauria et al., 2017; Lauria, Rush, Weingart, Brooks, & Gallo, 2016). The third phase puts the skills into practice. This consisted of the crisis simulation, which gradually built in the creation of a stressful case and environment (Petrosoniak & Hicks, 2013; Saunders et al., 1996). The intentional use of a gradually increasing stressful scenario allows SRNAs to become familiar with the environment, and build confidence in their skills without immediately overwhelming them.

Purpose

Student Registered Nurse Anesthetists (SRNAs) receive extensive training on technical skills. While these skills are necessary for performance, especially in a crisis, they are not sufficient (Riem, Boet, Bould, Tavares, & Naik, 2012). In recent years, there has been an increasing emphasis placed on incorporating supportive non-technical skills, but overall these efforts are insufficient to meet the performance demands of a crisis (Lyk-Jensen, Jepsen, Spanager, Dieckmann, & Ostergaard, 2014). Even with technical and non-technical skills training, without directly and thoroughly addressing the specific response to acute stress, the anesthetist’s perception may delay, confound, or dramatically hinder their performance (Driskell, Johnston, & Salas, 2001; Harvey, Bandiera, Nathens, & Le Blanc, 2012; Hunziker et al., 2011; Hunziker et al., 2013; Hunziker et al., 2012).

Accordingly, the purpose of this project was to provide training to SRNAs to improve their ability to perform in a crisis under stress. The population that was investigated consisted of University at Buffalo SRNA’s in their final year of training. The intervention was a brief Stress Inoculation Training session. There was a control and intervention group, with the control group
receiving the intervention after the crisis simulation. The primary outcome was whether the intervention resulted in an improvement in performance as defined by technical and non-technical skill scores. The secondary outcome was to determine if the intervention decreased the SRNA’s subjective experience of stress.

Fostering and improving the ability to perform when seconds count will have enormous downstream implications for the individual and profession. Additionally, the skills involved in SIT have been shown to transfer to other domains (Driskell et al., 2001). This may provide an extra layer of chronic stress and burnout prevention, increase job satisfaction, and lessen the negative health effects of stress. On a profession-level, this will only serve to increase the future desirability and indispensability of nurse anesthetists.

Review of the Literature

Saunders, Driskell, Johnston, and Salas (1996) conducted a literature review and meta-analysis. The authors aimed to determine the effectiveness of SIT, specifically looking at whether the number of training sessions, type of skills practice, group size, and trainer experience had an impact on efficacy (Saunders et al., 1996). They found that the “overall effect of stress inoculation training on reducing performance anxiety was of strong magnitude and significant,” with a moderate magnitude of improvement on performance (Saunders et al., 1996). They found the effect on reducing performance anxiety was not moderated by the number of training sessions (Saunders et al., 1996). They also found that the experience level of the trainer did not change the effectiveness of the intervention. This study describes how one training session of SIT yielded meaningful results, and could actually be “more effective at reducing performance anxiety as the size of the group increases” (Saunders et al., 1996). Further, being a
true expert at SIT was not necessary for training and obtaining a positive effect on performance (Saunders et al., 1996).

Driskell, Johnston, and Salas (2001) conducted a study using an intervention similar to SIT, using stressors of noise, time restriction, and tasks of different domains. They found that subjective stress levels decreased when a novel stressor was encountered after receiving the training, and this effect generalized across tasks and to new stressor (Driskell et al., 2001). This study demonstrated that even though it is impossible to simulate every crisis, there is still a benefit on performance under stress in novel circumstances (Driskell et al., 2001).

Murray and colleagues (2004) conducted a prospective study of 28 anesthesiology residents in simulation with the goal of developing a technical skill-scoring tool. They found that “regardless of scoring system… the senior resident group outperformed the junior resident group” (Murray et al., 2004). They found that “almost 80% of the variance in the weighted checklist scores could be explained by the global scores,” finding that the global scoring tool had higher reliability and was more reproducible than a checklist (Murray et al., 2004). They found that “time to key action” is useful in differentiating experience level of the trainee, and that checklists do not capture full performance (Murray et al., 2004). “Given that other scoring modalities (e.g. global ratings, key actions) adequately captures levels of performance, the use of “objective” checklists might not be necessary” (Murray et al., 2004). This highlights that for future studies looking at performance, global scoring and key item checklists are valid.

Furthering the body of literature on SIT, was a literature review aimed at investigating the impact of acute stress on performance as it relates to clinical performance and medical education (LeBlanc, 2009). Findings from this study support that acute stress, like that experienced in a crisis, negatively affects performance, highlighting how individual assessment
of the situation as “challenge or threat” mediates these effects (LeBlanc, 2009). The publication found that using a problem-focused coping strategy was most effective, and recommended SIT be used in the healthcare setting. The author stated that there are contradictory but coexisting “beliefs that stress can enhance learning” and “that learning is optimized in conditions that are free of anxiety or stress” (LeBlanc, 2009). This hints at our lack of understanding and that we may be failing “to adequately prepare individuals to function in emergency or crisis situations” (LeBlanc, 2009).

One of the very few studies closest to conducting SIT intervention (McKay et al., 2010) was a prospective non-randomized, non-blinded trial where 78 SRNA’s were assessed before, during, and after a simulated induction sequence. Overall, there were no statistically significant difference in the physiologic measures of stress between performers. Simply measuring heart rate, or salivary amylase, is not an adequate objective measurement of stress. Instead, measuring perception of stress as a “threat” versus “challenge” may be more meaningful. Additionally, the results suggest that the previous experience of the SRNA plays a role in mediating their stress-response and performance. This is congruent with SIT, and indicates that experience may be serving to help stress inoculate. Lastly this study was limited as induction is a routine technical skill that should not provoke a “threat” appraisal and stress-response.

Chipas and colleagues (2012) conducted a qualitative cross-sectional study that assessed SRNA’s stress levels. The assessment tool was novel, and relied exclusively on self-report. The authors found that among SRNAs, there were statistically significant levels of stress, to the point of causing negative health effects. Another finding was that SRNAs had higher levels of self-reported stress than CRNAs. One of the major recommendations by SRNAs to the American Association of Nurse Anesthetists via this study was to increase “stress management tips”
(Chipas et al., 2012). SIT can directly combat the negative effects of acute stress, and in conjunction with chronic stress management tips help increase the well-being of anesthetists. This study relied on self-reported stress levels. Accordingly, it lends validity to the notion of SRNA’s and CRNAs being able to identify and self-report both stress levels and the negative effects of stress via survey.

In a retrospective analysis of anesthesiology residents’ technical and nontechnical skills in simulation, a group investigated whether these two domains of skills were related (Riem et al., 2012). They found that both technical and non-technical skills were significantly correlated, stating that “performance in one domain explains as much as 23% of the variance of the other,” introducing cognitive load theory (Riem et al., 2012). This theory holds that working memory is limited, thus any improvement of a skill in one domain decreases the overall cognitive load while under stress and thus leads to an increase in free working memory, leading to improved performance (Riem et al., 2012). This study links both technical and non-technical skills in crisis simulation. It further strengthens the argument that SIT can decrease the cognitive load on trainees, thereby increasing their working memory, allowing for better technical and non-technical skill application, and thus performance.

In a randomized controlled proof of concept study, Varker and Devilly (2012) randomized 80 people from the community to receive SIT or “pragmatic” training. The SIT intervention emphasized increasing controllability, provided education regarding the physiologic stress response, provided negative thought-stopping techniques, and incorporated serial approximation (Varker & Devilly, 2012). The authors used a standardized stress and anxiety measurement tool in addition to a novel Likert-type scale, which could be adapted for future
studies on SIT (Varker & Devilly, 2012). The intervention group had larger drops in stress scores, and the intervention did not show negative effects (Varker & Devilly, 2012).

A recent prospective randomized controlled trial investigated the impact of a stress coping strategy intervention on participants in an Advanced Cardiac Life Support (ACLS) simulation (Hunziker et al., 2013). In this study, 124 participants were randomized to a 10-minute stress-coping intervention that included elements of SIT (Hunziker et al., 2013). The authors found that the intervention group experienced significantly less stress and better performance (Hunziker et al., 2013). Unsurprisingly, they found that the participants “in the highest stress quartile” had the largest benefit (Hunziker et al., 2013). The authors report, “As stress increases, the ability to filter out irrelevant information may decrease,” and there is an increase in irrational decision-making (Hunziker et al., 2013). This study reinforced a need for stress training, and that it is important crisis simulations are not solely based on highly scripted and algorithmic material like ACLS in order to increase fidelity.

A recent study investigated the development of stress resilience training software for military personnel (de Visser et al., 2016). The authors aimed to demonstrate that training and effective stress coping skills can mediate the negative effects of stress. The authors found that the intervention resulted in a 29% reduction in perceived stress, increased heart rate variation, improved outcomes on standardized psychological assessment tools, and that SIT techniques can increase the ability to perform while under stress and also decrease incidence of post-traumatic stress disorder (de Visser et al., 2016). The authors also state that trainees “should actively engage in the process of stress inoculation… to increase their performance and well-being, rather than view stress as a weakness that needs to be treated” (de Visser et al., 2016).
Theoretical Framework

Central to SIT is the idea that when the individual is faced with a stressor, they assess it and determine whether it is a challenge or a threat. When the situation is labeled a challenge, the individual perceives and expects that they have the necessary resources to complete the task or resolve the situation. Stress may still be experienced, but it does not overwhelm the anesthetist, and may even be helpful. When a situation is deemed a threat, the individual perceives that they do not have adequate resources available. In practice, this is when a crisis may develop. This causes the individual to experience a maladaptive physiological reaction. As mentioned above, heart rate increases, vision becomes blurry, fine motor skills and the ability to critically think deteriorate (Hood, Pulvers, Spady, Kliebenstein, & Bachand, 2015; Liston et al., 2009; Lyons, Parker, Katz, & Schatzberg, 2009; Maier & Watkins, 2010; Soares et al., 2012). This causes a rapid waning in the individual’s ability to perform, leading further into a positive-feedback loop of increasing stress and decreasing performance (Diamond, Campbell, Park, Halonen, & Zoladz, 2007).

The Neuman Systems Model (NSM) is an ideal theoretical framework. NSM views the individual as “holistic beings in constant interaction with their environment” (Neslihan Partlak, Ustun, & Gigliotti, 2009). The individual comprises five variables: “physiological, psychological, sociocultural, developmental, and spiritual” (McClure & Gigliotti, 2012). The person’s overall level of wellbeing consisting of these variables is protected by a series of layers, responses, and adaptations. The layers from the outermost to innermost are the flexible line of the defense (FLD), the normal line of defense (NLD), lines of resistance (LOR), and finally the central core.
The flexible line of defense is a series of habits or adaptations that aim to halt the effects of perceived stressors from the environment (McClure & Gigliotti, 2012; Neslihan Partlak et al., 2009). This can consist of things like social support, resilience, and spiritual wellbeing (Neslihan Partlak et al., 2009). NLD invasion by the stressor results in both the experience of stress, and the initial stress response (Gigliotti, 2012; Neslihan Partlak et al., 2009). The LOR is the final layer protecting the central core. These are the actual stress-coping strategies that the person has developed (Gigliotti, 2012). If a stressor bypasses this layer and reaches the central core, a core response occurs. The central core consists of basic survival mechanisms, like heart rate, blood pressure, respirations and shivering (Neslihan Partlak et al., 2009). A core response is not only pathophysiologic changes, but also states like burnout (Neslihan Partlak et al., 2009).

When the anesthetist is put into a crisis scenario, the flexible lines of defense are immediately overwhelmed. The crisis and need to intervene causes an invasion of the NLD, creating the experience of stress and initiating a stress response. The individual then employs their LOR in an attempt to cope with this stress. If the individual does have sufficient coping mechanisms (LOR), the situation is cognitively appraised as a challenge, and performance is less likely to suffer from the effects of the stress, and a core response is unlikely. Conversely, if the LOR fail or are assessed as imminently failing, the situation instead becomes labeled a threat, and a core response occurs. The core response is the maladaptive physiological and psychological manifestations that cause a dramatic decrease in the ability to perform.

Stress Inoculation Training (SIT) is not able to prevent invasion of the NLD, or the experience of stress. It does however strengthen the individual’s LOR by expanding and reinforcing their stress-coping mechanisms. This prevents the individual from experiencing a core response, thereby preventing a dramatic decrease in performance. This effectively helps
shift the threat-performance curve to the right. The individual still experiences stress, but situations that were once labeled a threat are now labeled a challenge.

**Methods**

The project was implemented within the framework of the anesthesia crisis resource management (ACRM) course. Data was collected prospectively, and SRNAs were randomly assigned to the control or intervention group. The control group completed the crisis scenario in the usual ACRM fashion. While in the debriefing room, the SRNA answered an initial survey to establish a baseline subjective cognitive appraisal of the upcoming simulation, baseline psychological resilience to stress (RSES-4), demographic information, and select vital signs. The simulation lasted for up to 10 minutes, and the SRNA then immediately completed a post-simulation survey that consisted of the subjective cognitive appraisal and repeat vital signs. After the control group finished the simulation, both groups received the Stress Inoculation Training in a classroom. The intervention group then underwent the same simulation protocol. After all the data was collected, two reviewers blinded to group allocation evaluated the technical and non-technical skills of each SRNA.

The independent variable consisted of the Stress Inoculation Training intervention. This was an all or none phenomenon, and thus a nominal measurement. The dependent variables included SRNA’s subjective cognitive appraisal, and performance, which comprises an amalgamation of technical (TS) and non-technical skills (NTS). Basic demographic data such as age, gender, length of ICU experience, and baseline stress resiliency (RSES-4) were also collected.

Performance comprised technical and non-technical skills. The two trained observers used the Anesthesia Non-Technical Skills (ANTS) tool. This tool demonstrates 88-97%
accuracy, and potentially inter-rater agreement above 0.7, with internal consistency of 0.79-0.86 (Fletcher et al., 2003). While there are four distinct categories in this tool, comprising task management, team working, situation awareness, and decision making, the total score was used for analysis (Fletcher et al., 2003; Flin, Patey, Glavin, & Maran, 2010; Lyk-Jensen et al., 2014; Yee et al., 2005).

Measuring the technical skills of SRNAs in simulation is a burgeoning topic in the literature, but there are currently no widely used assessment tools specific to that of a crisis simulation (Dixon & Burns, 2015). The sole measurement of time to recognition or intervention, or use a checklist does not fully account for the nuances of the performance variable. This uncovered a current gap in the literature. Currently, technical performance is evaluated based on the development of an Objective Structured Assessment of Technical Skills (OSATS) tool, a subjective global rating scale (GRS), or some combination of the two (Dixon & Burns, 2015; Murray et al., 2004). Creating a combined OSATS tool with corresponding GRS would have been ideal, but an entire capstone project in itself. Thus, a modified global ratings scale (modified assessment of technical skills scale (MATSS)) was used.

It consisted of five prompts with a Likert scale. The questions prompted the reviewers to consider the SRNA’s: patient assessment, recognition of a crisis, appropriateness of actions, re-evaluation, timeliness of actions, and overall performance. This is essentially a global ratings scale tool with the added benefit of weighted prompts. Global ratings scales have a high internal consistency by a Cronbach’s alpha of 0.97 and reliability coefficient of 0.95 (Dixon & Burns, 2015). These categories reflect the nursing process and allow for a time-sensitive variable. The total score of these categories was a number 0 through 10, allowing for a ratio measurement. Combining technical and non-technical skills scores allowed for the use of a single inclusive
performance variable, while still allowing for analysis of the intervention effect on either skillset. The TS and NTS scores were added together and divided by the total number of potential points, yielding a percentage. This combined performance scale (CPS) remained an interval measure.

Another dependent variable consisted of the SRNA’s subjective cognitive appraisal of the crisis. In order for the intervention to cause improvement in performance or improved subjective experience of stress, it was hypothesized the intervention group would more frequently label the crisis a “challenge” instead of a “threat,” or there would be a decrease in the magnitude of the “threat” appraisal. The cognitive appraisal variable had been used in a similar study investigating stress response to simulation (Harvey et al., 2012). This consisted of two questions on a 10-point Likert scale with anchor prompts. The first question asked, “How demanding was the scenario?” and the second asked, “How well were you able to cope with the scenario?” (Harvey et al., 2012). A ratio between the responses was generated, with < 1 indicating “challenge,” and > 1 indicating a “threat.” This was considered an interval measurement. The first question established the subjective level of stress experienced or anticipated, while the second question provide additional context regarding the perception of resources. After all data was obtained, the pre-simulation appraisal was subtracted from the post-simulation appraisal to indicate the direction and magnitude of change.

Additionally, the baseline level of psychological resilience to stress was important to measure. Individuals who already possessed adequate stress-management skills may have otherwise been labeled “nonresponders” or skewed results. The baseline level of resilience was assessed in the demographics section through a self-report survey tool called the Response to Stressful Events Scale (RSES-4) (De La Rosa, Webb-Murphy, & Johnston, 2016). This short 4-question tool prompted response on a Likert scale. A higher total score indicated greater
psychological stress resilience. Comparing this scale to its 22-question parent scale, it had a Cronbach’s alpha of 0.77 on initial evaluation, and had statistically significant correlation of 0.942 at the level of 0.01 (De La Rosa et al., 2016). These levels were acceptable for establishing a baseline value of resilience in SRNAs while considering the overall survey intent and burden. This variable was considered an interval-level measurement.

SRNA’s also had baseline and post-simulation measurements taken of heart rate and blood pressure (Andreatta, Hillard, & Krain, 2010). The literature demonstrates heart rate alone does not correlate well with performance or perceived stress (Clarke et al., 2014; Harvey et al., 2012; Hunziker et al., 2012; Maher et al., 2013). Thus, these two vital signs together add a physiologic response variable to the analysis, allowing for measurement and quantification of the SRNA response to a crisis simulation. Blood pressure and heart rate both were considered interval measurements.

**Data Analysis**

There was a separate control and intervention group. Accordingly, an independent samples t-test was completed. As this capstone was focused on testing the hypothesis that the intervention was positively correlated with performance and inversely related to stress, a one-tailed test was appropriate (Polit, 2010). A multiple correlation coefficient was calculated using assigned group, age, years of critical care experience, baseline resilience, overall performance, the pre-and post-cognitive appraisals, as well as the change in cognitive appraisal, change in HR, and change in blood pressure. This was done to reinforce that it was indeed the intervention having an effect on SRNA performance (Polit, 2010). Additionally, a MANCOVA test was done. This was chosen as it created a composite dependent variable, could help determine importance and degree of correlation amid dependent variables, and account for covariates. It
was likely that the dependent variables were correlated, and this test could help decipher whether a difference in scores occurred by chance (Polit, 2010).

**Results**

The convenience sample of 14 senior SRNA’s enrolled in ACRM were randomized to control (n=7) or intervention group (n=7). This demographic data may be seen in Table 1. The mean ages were similar in the control and intervention groups (31.29 ± 4.89 vs. 32.14 ± 6.09), as were the years of ICU experience (3.64 ± 1.55 vs. 4.07 ± 2.52), pre-simulation subjective cognitive appraisal (1.30 ± 0.41 vs. 1.49 ± 0.49) and self-reported baseline psychological stress resilience measured by RSES-4 (12.71 ± 2.06 vs. 12.43± 2.64). Baseline HR was lower in the control group compared to the intervention group (68.14 ± 7.69 vs. 79.0 ± 14.32) but not statistically significant ($p = 0.10$, $CI = -24.24$ – 2.53). Baseline blood pressure indicated by mean arterial pressure (MAP) was higher in the control group (102.29 ± 20.19 vs. 99.86 ± 3.72) but was not statistically significant ($p = 0.76$, $CI = -14.48$ – 19.33).

Independent t-tests investigating at the effect of the independent variable on the dependent variables of performance, change in HR, change in MAP, and change in subjective cognitive appraisal did not yield statistically significant results and may be seen in Table 2.1 and 2.2. A multiple correlation coefficient was calculated using assigned group, age, years of ICU experience, RSES-4, overall performance, the pre- and post-subjective cognitive appraisals, as well as the calculated changes in HR, MAP, and cognitive appraisal. These results may be viewed in Table 3. Increased SRNA age was associated with worse overall performance ($r = -0.695$, $p < 0.01$), and higher likelihood to report perceiving the simulation as a “threat” in the post-simulation subjective cognitive appraisal ($r = 0.54$, $p < 0.05$). More years of ICU experience prior to entering the Nurse Anesthetist program was associated with reporting a worse baseline
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psychological resilience (RSES-4) \( r = -0.59, p < 0.05 \), and a higher likelihood of perceiving the simulation as a “threat” \( r = 0.71, p < 0.01 \). A higher RSES-4 approached a statistically significant association with worse performance \( r = -0.532, p = 0.050 \). Post-simulation subjective cognitive appraisal was directly associated with the calculated change in subjective cognitive appraisal \( r = 0.789, p < 0.01 \). Additionally, higher pre-simulation “threat” appraisals trended toward an association with higher post-simulation “threat” scores \( r = 0.493, p = 0.07 \) which may also be seen in figure 1.

A MANCOVA was calculated with the independent variable of group, the combined dependent variables of overall performance, the calculated change in cognitive appraisal, change in HR, and change in MAP, controlling for the variables of ICU experience, RSES-4, age, and pre-simulation subjective cognitive appraisal. No statistically significant difference was found between the control or intervention group \( F(4, 5) = 3.737, p = 0.090 \), Wilks’ \( \Lambda = 0.251 \), partial \( \eta^2 = 0.749 \).

Discussion

This was a novel study investigating the effect of a Stress Inoculation Training intervention on the performance and perception of stress of student registered nurses in a crisis simulation. The mean performance of SRNAs in the intervention group was higher than the control group. Additionally, the mean heart rate of the intervention group did not increase as much as the control group. While these results were not statistically significant, they may indeed be clinically relevant.

As discussed above, the literature does not support solely looking at heart rate as a measure of perceived stress, thus no definitive statements can be made when viewing this discrete finding. However, having a less profound tachycardia while experiencing stress may
indeed be beneficial in completing tasks that require fine motor skills and hand-eye coordination such as laryngoscopy in a difficult intubation or obtaining vascular access. Further, even a modest improvement in the ability to perform in a crisis provides an enormous advantage to both the anesthetist and the patient. When analyzed further, the mean scores of both the non-technical skills and technical skills were higher in the intervention group, shown in Figure 2. This is reassuring, as both of these skill domains are essential to the anesthetist being part of high performing team and potentially securing better patient outcomes (Briggs et al., 2015; Jung et al., 2017; Krage et al., 2017).

The multiple correlation coefficient yielded several unanticipated results that warrant additional scrutiny. First, increasing age was associated with a worse overall performance and being more likely to rate the crisis simulation as a “threat.” The association between age and worse performance or perceiving the simulation as a “threat” may be mediated by a self-imposed expectation of superior performance (Gaab, Rohleder, Nater, & Ehlert, 2005), an overestimation of resources, or both. This may have a counter-productive effect in that during the crisis simulation the actual resources fall short of expected resources and do not meet the perceived demands, and thus an amplified threat appraisal occurs. This then may have a negative effect on performance. This finding supports the theory that “threat” appraisals and acute stress are associated with worse performance. In this case, however, it may be accentuated by the individual’s expectations of their abilities to perform, or a contrast between the perceived resources they expected and those that were actually available. This reinforces the need for proper stress preparation, which will allow the individual to better assess and utilize their resources and either improve their performance, or help them experience less of a decline when stressed.
Secondly, more years of ICU experience prior to entering the Nurse Anesthetist program was associated with reporting a lower level of baseline psychological resilience and being more likely to rate the crisis simulation as a “threat.” Those working in critical care for longer periods may be exposed to a higher number of challenging situations. The lower self-reported resilience among those with longer ICU tenure may be a reflection that these individuals are more likely to recognize their limitations in light of the unknown. The association between ICU experience and perceiving the simulation as a “threat” may be similar to the relationship between age, performance, and the threat appraisal discussed above. This may be a phenomenon where the individual over-estimates their resources based on previous experience. Thus, when confronted with a novel or complex crisis scenario the perceived demands far exceed the resources actually available, leading to a worse “threat” appraisal, more stress, and declining performance.

Lastly, a higher reported baseline psychological resilience approached a statistically significant association with a lower performance score. This as well as the other unanticipated findings may be explained when attributing them to the SRNA improperly assessing their perceived resources or abilities. The Dunning-Kruger phenomenon describes how those who are high performers may tend to underestimate their abilities, while those who are lower performers may tend to over-estimate their abilities (Dunning, Johnson, Ehrlinger, & Kruger, 2003). A gross over estimation of abilities or resources in a lower-performing individual may have led to an adverse feedback spiral between performance and a “threat” appraisal.

Implications

While the primary and secondary objectives did not yield statistically significant results, there were trends towards improved performance and less of an increase in heart rate in the intervention group. These findings warrant additional investigation with a larger sample size, and
including junior SRNAs. Incorporating junior students may help account for the fact that senior students have more clinical experience, and thus have a higher likelihood of experiencing a real crisis and undergoing an unstructured or haphazard form of stress inoculation training, which may have confounded the results. Overall, participants favorably rated the intervention, but a common theme emerged on recommending extending it beyond a single training session. Accordingly, the effect of the intervention may be improved by giving students more time to practice and incorporate the educational component, instead of restricting delivery to a single session.

Many of the unanticipated statistically significant interactions between variables support the hypothesis of a Dunning-Kruger effect. If this signal is valid, it further accentuates the importance of ensuring SRNA’s receive appropriate and timely feedback from faculty and preceptors, as well as ensuring they engage in self-reflection. Incorporation of the principles in this study and the educational component, such as recognizing the effects of acute stress and familiarization with the individual SRNA’s response to acute stress may help ensure future students are more accurately estimating their abilities and prepared for acutely stressful situations. Additionally, the findings from this study potentially highlight the important interaction of expectations and the perceived experience or ability to perform in a crisis.

**Strengths and Limitations**

This study addressed both a clinical need and a gap in the nursing and anesthesia literature. It was impractical to blind SRNA’s, but they were randomly assigned to a group, and performance reviewers were blinded. The dependent variables took into account both non-technical and technical skills, giving a more complete picture of how the SRNA performed when stressed. The physiological variables of HR and MAP added an objective measurement to the
students’ perception and experience of stress. The use of a pre- and post-subjective cognitive appraisal helped reinforce the validity of the project by determining that SRNAs indeed experienced stress during the simulation. Lastly, the use of a single cohort of senior SRNAs ensured that each participant had extensive clinical experience and was familiar with the simulation equipment and environment, limiting possible confounders. Overall, the ease and low burden of implementation facilitates future studies on this essential topic.

Limitations of this study include a small sample size, it was conducted at a single institution, and comprised only senior SRNAs. As mentioned above, senior SRNAs have extensive clinical experience, increasing the likelihood of experiencing acute stress or a crisis. This may result in an incoherent or dysfunctional form of Stress Inoculation Training. Students and necessary simulation personnel were not blinded to group allocation. While the crisis scenario was conducted in a high fidelity simulator, the sheer nature that it was a simulation may have led students to behave differently than they would while practicing in a clinical setting. Additionally, due to logistics, the educational intervention was delivered in a single session, and there was a paucity of anesthesia literature to help guide the development of this project.

**Ethical Issues**

One of the main concerns regarding SIT was that it may cause unnecessary stress on the student. As part of the current educational curriculum, SRNAs undergo ACRM, which consists of stressful simulations focusing on non-technical skills. This project simply added the Stress Inoculation Training, vital signs, and brief surveys. Further, while the graduate program currently facilitates the acquisition of both technical and non-technical skills, there is room for improvement. While technical skills and non-technical skills are correlated with performance, this relationship does not account for perceived stress or situation complexity (Riem et al., 2012).
SIT aims to provide additional education and stress preparation. Thus, this capstone project did not cause superfluous stress on the SRNA’s, and it helped fill an educational gap. Involvement was voluntary, and students were made aware of the nature of the project. Additionally, participants were followed-up asking whether they found the intervention helpful, if they had any recommendations, and encouraged anyone experiencing perceived ill effects to contact their primary care provider or student health services.
Table 1. Demographic Data

<table>
<thead>
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Table 2.1 Comparison of Group Means, Standard Deviation, and Standard Error Mean for Key Variables

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<td>65.7143</td>
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Table 2.2 Independent Samples t Test Investigating the Effect of Group on the Dependent Variables

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<th>t-test for Equality of Means</th>
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<td>Sig.</td>
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Table 3. Correlation Matrix of Independent and Dependent Variables

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<td>4. RSES-4</td>
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<td>5. Performance</td>
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<td>0.016</td>
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<td>7. Post-SCAP</td>
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<td>0.540*</td>
<td>0.711**</td>
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<td>8. Change in SCAP</td>
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<td>0.367</td>
<td>0.480</td>
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<td>-0.145</td>
<td>0.789**</td>
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<td>9. Change in HR</td>
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<td>0.518</td>
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<td>10. Change in MAP</td>
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<td>0.180</td>
<td>0.373</td>
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</table>

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Correlation is approaching statistical significance (0.050) (2-tailed).
Figure 1. Higher Pre-Appraisal Scores Trend Toward Higher Post-Appraisal scores ($p=0.073$, $r = 0.493$, $N = 14$)
Figure 2. Comparison of Mean Performance of Technical and Non-Technical Skills by Group
References:


doi:10.1097/ACM.0b013e3181b37b8f


doi:10.7453/gahmj.2014.015


EFFECT OF STRESS INOCULATION TRAINING ON SRNAS

September 4, 2017

Dear DAVID HEDMAN:

On 9/4/2017, the IRB reviewed the following submission:

<table>
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<th>Type of Review:</th>
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<tr>
<td>Title of Study:</td>
<td>Effect of a Stress Inoculation Training Intervention on the Performance of Student Registered Nurse Anesthetists in a Crisis Simulation</td>
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<tr>
<td>Investigator:</td>
<td>DAVID HEDMAN</td>
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<tr>
<td>IRB ID:</td>
<td>STUDY00001742</td>
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<td>IND, IDE, or HDE:</td>
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Documents Reviewed:
- Hedman. HRP 502. Consent.pdf, Category: Consent Form;
- Hedman. HRP 503 Template Protocol.docx, Category: IRB Protocol;
- Hedman. Measurement Tools.docx, Category: Surveys/Questionnaires;

The IRB approved the study from 9/4/2017 to 9/3/2018 inclusive. Before 9/3/2018 or within 30 days of study closure, whichever is earlier, you are to submit a continuing review with required explanations. You can submit a continuing review by navigating to the active study and clicking Create Modification / CR.

If continuing review approval is not granted before the expiration date of 9/3/2018, approval of this study expires on that date. The Initial Study materials for the project referenced above were reviewed and approved by the SUNY University at Buffalo IRB (UBIRB) by Initial Study Review. Before to 9/3/2018 inclusive. Before 9/3/2018 or within 30 days of study closure, whichever is earlier, you are to submit a continuing review with required explanations. You can submit a continuing review by navigating to the active study and clicking Create Modification / CR.

If continuing review approval is not granted before the expiration date of 9/3/2018, approval of this study expires on that date. or within 30 days of study closure, whichever is earlier, you are to submit a continuing review application with required explanations. You can submit a continuing review application by navigating to the active study in Click
IRB and clicking Create Modification / Continuing Review. Studies cannot be conducted beyond the expiration date without re-approval by the UBIRB.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system.

**HIPAA Authorization combined with consent document**

The consent form document includes the HIPAA authorization for use/disclosure of personal health information and has met the required elements of the federal regulations of HIPAA.

UB IRB approval is given with the understanding that the most recently approved procedures will be followed and the most recently approved consenting documents will be used. If modifications are needed, those changes may not be initiated until such modifications have been submitted to the UBIRB for review and have been granted approval.

Prior to the expiration of this approval, you will receive notification that it is time for the UBIRB to conduct its periodic review of your study. Studies cannot be conducted beyond expiration date without re-approval by the UBIRB.

As principal investigator for this study involving human participants, you have responsibilities to the SUNY University at Buffalo IRB (UBIRB) as follows:

1. Ensuring that no subjects are enrolled prior to the IRB approval date.
2. Ensuring that the study is not conducted beyond the expiration date without re-approval by the UBIRB.
3. Ensuring that the UBIRB is notified of:
   • All Reportable Information in accordance with the Reportable New Information Form Smart Form.
   • Project closure/completion by the Continuing Review/Modification/ Study Closure smart form.
4. Ensuring that the protocol is followed as approved by UBIRB unless a protocol amendment is prospectively approved.
5. Ensuring that changes in research procedures, recruitment or consent processes are not initiated without prior UBIRB review and approval, except where necessary to eliminate apparent immediate hazards to subjects.
6. Ensuring that the study is conducted in compliance with all UBIRB decisions, conditions, and requirements.

7. Bearing responsibility for all actions of the staff and sub-investigators with regard to the protocol.

8. Bearing responsibility for securing any other required approvals before research begins.

If you have any questions, please contact the UBIRB at 716-888-4888 or ub-irb@buffalo.edu.
Impact of a Stress Inoculation Training Intervention on SRNA Performance in a Crisis Simulation

David B. Hedman BSN, RN, CCRN, CEN

Introduction
Certified Registered Nurse Anesthetists (CRNAs) must be prepared to manage a wide range of crises that may occur at any moment. Inherent to these crises is acute stress, which becomes problematic when demands are perceived as greater than the resources. Acute stress beyond a certain point impairs the ability to think, act, and communicate, leading to increased patient morbidity and mortality, and may contribute to chronic stress and burnout (LeBlanc, 2009; Scares et al., 2012). Unfortunately, little training is specifically devoted to preparing for the acute stress that will inevitably be experienced in the clinical setting.

Stress Inoculation Training (SIT) has been adopted by performance-driven industries with great success (Stanley, Horn, & Joiner, 2016) and is implemented in three sequential phases (Petrosnak & Hicks, 2013; Saunders, Driskel, Johnston, & Salas, 1996).

- Provide information regarding stress, the stress response, and encourage the learner to identify their specific stress response
- Deliver skills for stress management (i.e., structural breathing, self-talk, mental rehearsal, and using a trigger word) and allows rehearsal
- Facilitate skills practice in increasingly stressful and realistic situations

Objectives
Primary - To determine if the intervention resulted in improved Student Registered Nurse Anesthetist (SRNA) performance defined by a grading of their technical and non-technical skills
Secondary - To evaluate if the training decreased the SRNAs' subjective experience of stress, defined by a subjective cognitive appraisal, and changes in heart rate and blood pressure from baseline measurement

Methods
- Prospective single-blinded randomized controlled
- Convenience sample of 14 SRNAs enrolled in the Anesthesia Crisis Resource Management course
- The control group (n=7) performed the crisis simulation first. Both groups received the educational training, then the intervention group (n=7) completed the simulation
- Pre-simulation surveys established baseline heart rate (HR), blood pressure (MAP), psychological resilience (RSES-4), and subjective cognitive appraisal (post-SCAP).

Data Analysis
This study investigated the hypothesis that a single-session of SIT would improve SRNA performance and perception of stress in a crisis simulation.

- Descriptive statistics were used to describe the sample population
- Data was analyzed using SPSS version 24
- Independent-samples t-tests and multiple correlation coefficients were calculated to determine the relationship between group (IV), baseline variables of RSES-4, age, and years of ICU experience, and the dependent variables of performance, changes in HR, MAP, and SCAP
- Pearson’s r was used to correlate strength and direction of these relationships
- Significance was set at P < 0.05

Results
- Performance was higher in the intervention group, but did not reach statistical significance (M = 72.8%, SD = 22.2, t(12) = -0.99, p = 0.578)

References

Table 1 - Demographic Data

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Table 2 - Correlation Matrix of Independent and Dependent Variables

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<td>Age</td>
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<td>Years ICU Experience</td>
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<td>RSES-4</td>
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<td>0.230</td>
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<td>Performance</td>
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<td>0.016</td>
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<td>Pre-SCAP</td>
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<td>0.350</td>
<td>0.466</td>
<td>-0.396</td>
<td>0.916</td>
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<td>Post-SCAP</td>
<td>0.221</td>
<td>0.540</td>
<td>-0.711</td>
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<td>Change in SCAP</td>
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<td>0.367</td>
<td>0.480</td>
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<td>Change in HR</td>
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<td>0.518</td>
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<td>Change in MAP</td>
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* Correlation is significant at the 0.01 level (2-tailed).
* Correlation is approaching statistical significance (0.050) (2-tailed).

Conclusion
The intervention group showed a trend toward better scores on performance and less of an increase in heart rate. Increased age was correlated with being more likely to perceive the simulation as a “threat,” and worse performance scores. Greater length of ICU experience was associated with a decreased reported psychological resilience and higher likelihood to perceive the simulation as a “threat.” Higher resilience scores had a non-significant trend toward worse performance.

Discussion
These results may be partially explained by the Dunning-Kruger effect, where high performers underestimate their abilities, and low performers overestimate theirs (Dunning, Johnson, & Ehrlinger, 2003). Additionally, higher pre-simulation “threat” appraisals trended toward a correlation with higher post-simulation “threat” scores (p = 0.07) highlighting the important interaction of expectations on our experience and corresponding ability to perform in a crisis.

Future studies are needed with a larger sample size of junior SRNAs to enhance the effect size. Participants favorably rated the intervention but recommended extending beyond a single training session. Additional training sessions could allow for more gradual approaches to increasing acute stress and skills practice. Assuming the Dunning-Kruger signal is valid, this acclaims the importance of ensuring SRNA’s receive appropriate training.