Efficacy of Transfer in Simulation-Based Training: Implications for Stress Exposure Training

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Abstract

Transfer of training from simulators to the real-world has recently come under investigation as the generalizability of task-specific training has come into question. New hypotheses recommend that, to ensure effective performance under stress in real-world environments, one should supplement skill-based training with stress exposure training. Stress exposure training has further benefits in that it may serve as a more generalizable form of training and transfer across tasks and stressors. The impact of improving performance and reducing perceived stress and workload is of vital importance to many military operations, especially in high technology and high workload situations such as the Landwarrier or Unmanned Arial Vehicles (UAVs), in which mistakes are costly in terms of economics as well as life. In this article the premise of and future implications of Stress Exposure Training are discussed.

Simulation Training

Simulation has been successfully employed in military and commercial sectors to train individuals (e.g., pilots, soldiers, doctors) with the objective of increasing their performance accuracy in real-world situations. The primary method of performance improvement in these contexts is to provide simulator-based practice of situations and conditions similar to those expected to be encountered in a real-world Stress Exposure Training. However, the extent to which simulator-based training transfers to real-world application has recently been questioned (Driskell, Johnston, & Salas, 2001). New theories of simulator training challenge traditional task-based simulation training, claiming that skill acquisition is highly task-specific and not readily transferable to different tasks and situations (Sims & Mayer, 2002). This limitation decreases the applicability of simulator training transferring to performance in a real-world Stress Exposure Training, which is highly complex, dynamic, and virtually impossible to anticipate all potential task/accident scenarios that may occur. In a review by Ivancevich and colleagues (1990), recommendations were made that training programs should be designed to address performance outcomes associated with specific stressors. Indeed, such disasters as Three Mile Island, Chernobyl, and the USS Vincennes have underscored the importance of developing training interventions to offset the impact of stressors on complex cognitive tasks (Johnston & Cannon-Bowers, 1996).

Stress Exposure Training

One avenue of increasing the generalizability of simulator-based training has been through empirical work which has been conducted on Stress Exposure Training (Klepac, Hauge, Dowling, & McDonald, 1981; Saunders, 1993; Saunders, Driskell, Johnston, Salas, 1996). Considerable evidence has shown that stressors cause decrements in attitudes and performance, which are related to outcomes that are emotional, behavioral, or physiological in nature (Greenhaus & Parasuraman, 1987). Stress Exposure Training works by training individuals on factors that are more generalizable than task skills, such as controlling perceived stress and workload by providing intervention information on stressors, sensory information on physiological and emotional reactions to stress, and procedural information on how stress effects task performance. These three phases of stress exposure training will be further discussed later in the paper.

History Stress Exposure Training

Since the inception of stress exposure from Wolpe's work (as cited in Johnston & Cannon-Bowers, 1996) and eventually cognitive/behavioral stress-coping training in the early 1970s, the application of stress exposure training has generally been clinical, and applied chiefly to uses, as alleviating physical pain, anxiety, depression, and anger (Deffenbacher & Suinn, 1988). Gradually, stress-coping training was expanded to include training to a number of occupations (e.g., nurses, police officers, oil-rig trainees), and to enhance athletic performance (Johnston & Cannon-Bowers, 1996). In a meta-analysis by Saunders, Driskell, Johnston, and Salas (1996; See also Saunders, 1993) it was demonstrated that this type of training is an effective means for reducing state anxiety, reducing skill-specific anxiety, and enhancing performance under stress.

Johnston & Cannon-Bowers (1996) argues that there is not sufficient research to suggest that training developers adopt the strategies used in cognitive/behavioral stress coping training programs. This was due to two reasons: first traditional stress exposure research had too narrow a focus (clinical and sports), and second, little work had been done to integrate research findings into a conceptual framework to guide the development of incorporating stressors into training and examining coping skills training for complex cognitive tasks. Therefore, they advocated the use of the term Stress Exposure Training to extend the focus of 'cognitive/behavioral stress coping' beyond its original clinical domain.

Stress Exposure Training has three main objectives, 1) to build skills that promote effective performance under stress, 2) to build performance confidence, and 3) to enhance familiarity with the stress environment. According to Meichenbaum (1985) these three objectives can be accomplished by employing two components: 1) stress-coping training – features developing skills that reduce potential cognitive and psychomotor performance deficiencies resulting from specific stressors (Driskell & Salas, 1991) and 2) instructional design – features a process of gradual exposure to realistic stressors that enhance learning of coping skills, and is based on basic principles of training design for skills acquisition. The two integrated components have resulted in a three-phase process (See Table 1; Meichenbaum, 1985).

The Three Phases of Stress Exposure Training

Phase 1. The first phase in stress exposure training typically involves a discussion of common reactions people have to specific stressors they encounter, with the objective to help the individual understand that they will be able to stop the negative thoughts and behaviours that contribute to stress. It is expected that as the individual's anxiety is reduced, perceived control increases, and consequently ones efficacy in dealing with problem stressors is improved (Johnston & Cannon-Bowers, 1996). Interestingly, violations of expectations have been found to be universally detrimental to performance, even when participants' expectations are violated by their situation being better than expected (Keinan & Friedland, 1996). The effect of credible prepatory information on performance has been found to result in reduced subjective stress, enhanced task confidence, and fewer errors (Inzana, Driskell, Salas, & Johnston, 1996).

Phase 2. The second phase focuses on learning stress coping skills through practice and feedback. The objective is to train the individual to maintain an awareness of stress reactions in order to invoke appropriate skills to reduce stress. The act of maintaining an awareness of thoughts and actions is referred to as "metacognition" (Glaser & Bassok, 1989). Therefore, metacognitive skills; such as, thought restructuring (replacing negative thoughts and reactions that are triggered by a stressor with positive coping thoughts and reactions), problem solving (reduce task performance errors), & physiological control (involves deep breathing and muscle relaxation methods to calm physiological reactions to stressful encounters) support the execution of competent performance.

Phase 3. The third phase involves practicing the coping skills in a setting that simulates or reproduces the problem stressors. Ways of coping with stress are often classified into three areas: task-focused coping, emotion-focused coping, and avoidant-focused coping (Lazarus & Folkman, 1984). Task-focused coping circumvents negative affect through cognitive and behavioural activity that minimizes or modifies the stressor. In this case the individual focuses on dealing with the task and develops strategies aimed at accomplishing the goals of the task (Thropp, Szalma, Ross, & Hancock, 2003). Emotion-focused coping consists of attempts to alleviate or eliminate emotions elicited by a stressor directly, with little attention paid to the characteristics of the situation or to the nature of the threat it poses (Keinan & Friedland, 1996). While, emotion-focused coping has been found to be effective in preparing individuals to cope with stressors that they cannot control and which are brief in duration, it has proved less effective/relevant for training people to withstand and cope with combat stressors. This more prolonged and controllable situations requires mixed or problem-focused coping. The third coping strategy, avoidant coping, involves diverting one's attention from the stressful situation (see also Cox & Ferguson, 1991). Expected outcomes from this phase are reduced anxiety, increased perceived efficacy toward performance, and improved cognitive and psychomotor performance. Further research involves examining phased-training procedures that divide task acquisition without stress exposure from practice of newly acquired skills under stress. Other methods of skill practice under stress include graduated-intensity training (Keinan & Friedland, 1996).

Table 1: Stress Exposure Training Design (as cited from Johnston & Cannon-Bowers, 1996).

Stress Exposure Training Design			
	Phase 1	Phase 2	Phase 3
	Presentation of requisite knowledge	Skill practice with feedback	Skill practice with stressors
Objectives	• Knowledge of typical reactions to stressors.	Develop metacognitive skills • Positive coping thoughts and behaviors • Use relaxation techniques to calm physiological reactions • Develop cognitive skills • Use problem solving skills	• Use phase 2 skills while exposed to stressors.
Outcomes	• Increased perceived efficacy in dealing with stressors.	• Reduced Negative attitudes toward self and stressors. • Increased use of positive thoughts and behaviors. • Reduced blood pressure, heart rate, and increased psychomotor steadiness. • Successful coping skill performance.	• Reduced anxiety. • Increased efficacy. • Successful application of skills while exposed to stressors. • Improved cognitive and psychomotor performance under stress.

Theory behind Stress Exposure Training

One can examine the mechanism of Stress Exposure Training through the transactional model of stress. In this view stress occurs when the perceived demands of the situation tax or exceed the perceived resources of the individual to meet those demands (Lazarus & Folkman, 1984). Based on this theory, Meichenbaum (1993; as cited in Johnston & Cannon-Bowers, 1996) has proposed that Stress Exposure Training provides the skills that should reduce the imbalance between the demands of the stressful situations and the individual's coping resources. The benefits of decreasing this discrepancy have a far-reaching impact on stress and performance.

One can further, examine the relationship between stress and performance by referring to the Hancock and Warm dynamic model of stress and sustained attention (1989). In this model, performance is directly influenced by workload and stress factors, where stress is integrally related to environment (Hockey, 1983), appraisal/coping mechanisms of the exposed individual (Lazarus, 1966), and the general response of the physiological system (Selye, 1956; see Figure 1). As these factors combine and lead to debilitative levels of hyper- or hypo-stress the operative state begins to degrade first psychologically, in increased perceived stress and workload, and then physically through impaired performance. Support for this view has been found across two meta-analyses. In a meta-analysis, by Driskell and colleagues, the effects of stressors on self-reported stress and performance was examined, and it was found that people were more likely to report "feeling stressed" before showing evidence of performance impairment (as cited in Saunders, 1993). In a separate meta-analysis conducted by Saunders (1993) moderate magnitude effects were found for stress inoculation training (a similar three phase stress exposure training methodology) for state and skill based anxiety, but only small magnitude effects for performance. From this Saunders drew the conclusion that subjective reports of stress were more sensitive to the effects of stress inoculation training than performance; that is, reports of lower perceived stress would occur before signs of performance improvement.

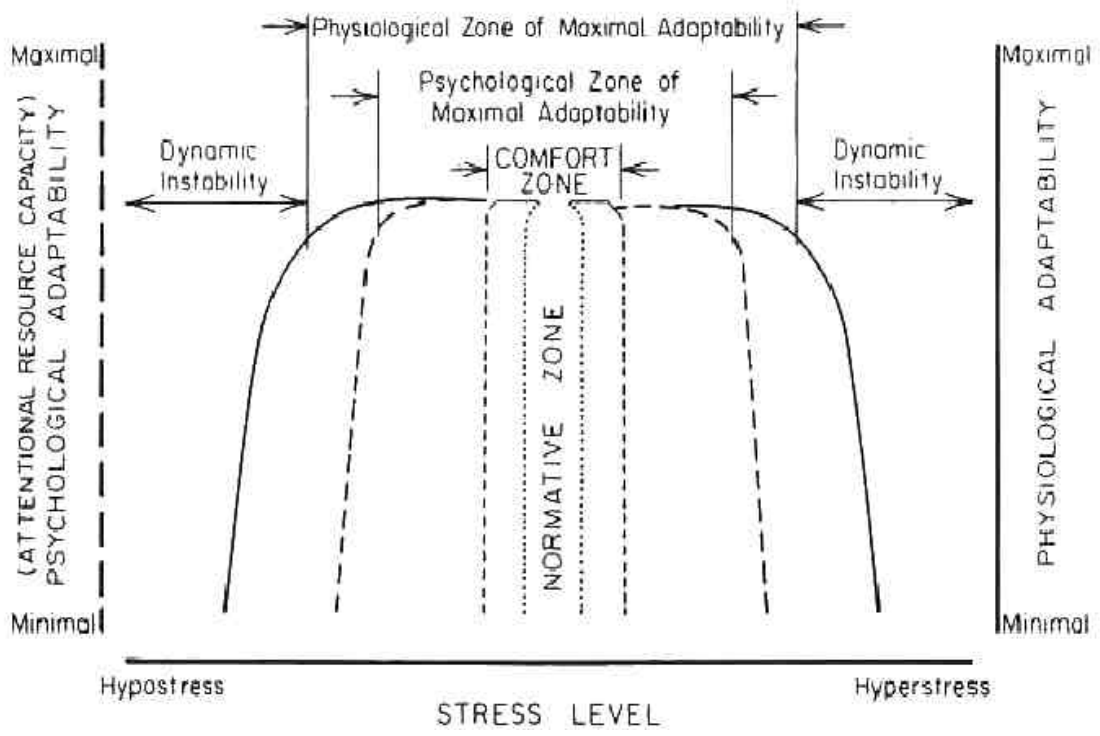

Figure 1: Hancock and Warm dynamic model of stress and sustained attention (as cited from Hancock & Warm, 1989).

New Directions

Research examined in the meta-analysis conducted by Saunders and colleagues (1993, 1996) has supported the view that stress impacts observers psychological before performance begins to degrade. While, these hypotheses support the Hancock and Warm model of dynamic stress and sustained attention, it would be critical to examine the degree to which task-based environmental factors and coping strategies as moderators of Stress Exposure Training efficacy. It is further imperative to investigate limits of transfer of training between field and laboratory training. Studies are currently under investigation to examine the effects of spatial-temporal perceptions on performance and perceived stress/workload with and without stress exposure training. The effects of individual differences in coping strategy will be used in regression to examine the moderating factors of this variable on Stress Exposure Training efficacy. Finally, while Saunders (1993) found Stress Exposure Training to beneficially affect performance in the lab and the field, they did not examine the transfer of Stress Exposure Training from a lab to a field task. Indeed, as simulations used in training environments become more realistic the question of specificity becomes more important. That is as realism is improved; this could lead to lower generalizability and hampered transfer of training. These factors represent new avenues of research that must be examined to fully develop the construct of Stress Exposure Training. Figure 2 represents a proposed model to test Stress Exposure Training as related by the moderating variables of environmental factors (i.e., spatial or temporal task demands), individual differences in coping style, and training transfer.

Conclusion

The generalizations of training effects from one task/stressor to another are of critical concern. Future research must examine how Stress Exposure Training principles transfer from the training to the operational environment, and which factors facilitate or inhibit this transfer. Clearly, the cost of training might be prohibitive if research shows that the effectiveness of stress training is limited to specific stressor-task combinations.

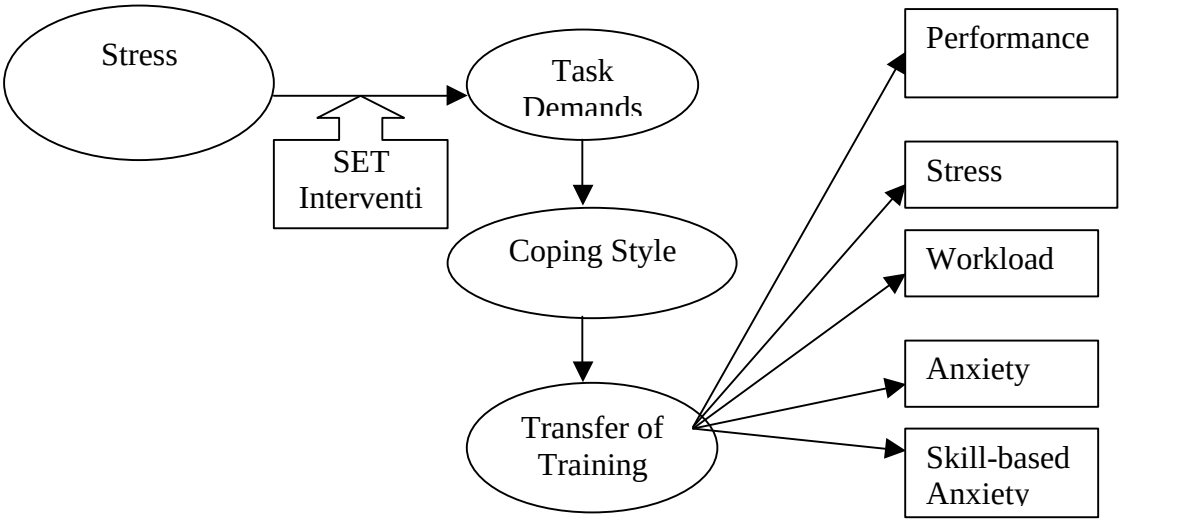

Figure 2: Hypothesized relationship between Stress Exposure Training and Moderators of environmental task demands, individual differences in coping style, and training transfer.

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