DISSERTATION

DEVELOPMENT AND EVALUATION OF PHYSICAL AND MENTAL READINESS TRAINING PROGRAMS FOR ARMY RESERVE OFFICER TRAINING CADETS

Submitted by

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ABSTRACT

DEVELOPMENT AND EVALUATION OF PHYSICAL AND MENTAL READINESS TRAINING PROGRAMS FOR ARMY RESERVE OFFICER TRAINING CADETS

Military personnel face myriad stressors in both the combat and training environments, including the singular and combined effects of physical exertion, cognitive overload, sleep restriction, energy insufficiency, ambiguous operational environments, as well as emotional and psychological stress. Though the demands of modern military operations continue to shift with technological advances, humans remain the central element and to be successful in the volatile and uncertain modern operating environments, high levels of both physical and psychological readiness and resilience are required.

As failure to meet these demands can have catastrophic consequences, the military has placed a high emphasis on the development of physical and mental fitness, with each branch developing their own programs and initiatives. In 2019, the Army introduced its Holistic Health and Fitness (H2F) system, with the aim of improving individual warfighter health and wellbeing as well as overall operational readiness. While H2F is a step in the right direction for the Army as a whole, non-Active-Duty components may have difficulty implementing the system. Reserve Officer Training Corps (ROTC) programs often have limited access to the space, time, equipment, and expertise needed to optimally promote physical and mental readiness. ROTC cadets will commission as officers upon their graduation, will serve in leadership roles, and will be expected to perform at a high level both physically and mentally. Importantly, ROTC programs produce approximately 70% of the officers entering the Army each year and their preparedness, or lack thereof, has substantial impact on those they lead.

The feasibility of delivering physical and mental readiness training programs in real-time within the Army ROTC environment and under the time and resource constraints is unclear. One possible mechanism for implementing readiness training in ROTC programs is through collaboration with university partners. By developing cross-campus collaborations, ROTC programs can access necessary resources, especially fitness programing, supervision, and support, to bolster readiness and prepare cadets for success as future Officers.

The purpose of this dissertation is to explore the development and implementation of physical and mental readiness training programs in an Army ROTC program, specifically through a collaborative effort between Colorado State University's Health and Exercise Science Department and Army ROTC programs. Study 1 evaluated two training programs designed to improve ACFT performance. The first was an adaptation of programs from Army Training Publication 7-22: Holistic Health and Fitness (ATP 7-22) and the other was designed by HES staff. HES staff, including a Certified Strength and Conditioning Coach and undergraduate practicum students, supervised all physical training sessions alongside Army ROTC cadre. While we saw no significant differences between groups, we found a statistically significant improvement in ACFT scores in our collective study cohort. We faced several challenges over the course of the study period, including a global pandemic and severe weather that impacted and cancelled training sessions. Despite this, we showed that it is feasible to provide effective, multidimensional physical training with limited time and equipment, even in the face of unforeseen challenges.

In Study 2, we delivered an 8-week mental skills training (MST) program to first- and second-year Army ROTC cadets. Our qualitative findings suggest that the intervention was impactful and that the participants were able to learn and apply the skills taught during the intervention in physical training and academic settings, as well as during their ROTC training. While we did not find any statistically significant performance outcomes, the results of this study

demonstrate a positive impact of MST in this population and provide support for the integration of increased MST into the ROTC curriculum.

Collectively, these studies show the impact of both physical and mental readiness training interventions in ROTC cadets. Perhaps more importantly, these studies demonstrate the feasibility of conducting such programs in real time, even with limited time and resources, as well as the capacity for a partnership between ROTC and other university academic departments. We believe that this collaboration is a successful model for the integration of H2F into ROTC programs and could be an effective solution to the challenges faced in delivering comprehensive readiness programming to ROTC cadets.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 – INTRODUCTION

Military personnel face myriad stressors in both the combat and training environments, including the singular and combined effects of physical exertion, cognitive overload, sleep restriction, energy insufficiency, ambiguous operational environments, as well as emotional and psychological stress [1, 2]. Though the demands of modern military operations continue to shift with technological advances, humans remain the central element [3] and to be successful in the volatile and uncertain modern operating environments, high levels of both physical and psychological readiness and resilience are required [1].

As failure to meet these demands can have catastrophic consequences, the military has placed a high emphasis on the development of physical and mental fitness, with each branch developing their own programs and initiatives. In 2019, the Army introduced its Holistic Health and Fitness (H2F) system, with the aim of improving individual warfighter health and wellbeing as well as overall operational readiness.

While H2F is a step in the right direction for the Army as a whole, non-Active-Duty components may have difficulty implementing the system. Reserve Officer Training Corps (ROTC) programs often have limited access to the space, time, equipment, and expertise needed to optimally promote physical and mental readiness. ROTC cadets will commission as officers upon their graduation, will serve in leadership roles, and will be expected to perform at a high level both physically and mentally. Importantly, ROTC programs produce approximately 70% of the officers entering the Army each year [4] and their preparedness, or lack thereof, has substantial impact on those they lead.

The feasibility of delivering physical and mental readiness training programs in real-time within the Army ROTC environment and under the time and resource constraints is unclear.

PHYSICAL READINESS

Physical readiness in the US Army is defined as “the ability to meet the physical demands of any duty or combat position, move lethally on the battlefield, accomplish the mission and continue to fight, win, and come home healthy” [5]. Success in modern combat requires high levels of physical preparedness and a wide range of physical capacities. Service members must have the ability to adapt to and overcome physical stressors such as thermal extremes, high workload, inadequate rest, insufficient energy intake, often for prolonged periods [1].

While combat presents a significant physical challenge, noncombat musculoskeletal injuries (MSKIs) threaten readiness more than any other medical issue, accounting for millions of limited duty days and 65% of all medically nondeployable soldiers [6]. A substantial number of these injuries are incurred through physical training; from 2001 through 2013, sports and physical training were the leading cause of noncombat injuries requiring medical evacuation [6]. These injuries also have enormous financial impact across the Army, contribute to medical disability discharges, and can cause long-term disabilities [6]. Low fitness is a significant risk factor for musculoskeletal injury [7] and soldiers who lack sufficient levels of physical fitness can be a liability to their fellow service members in physically demanding circumstances.

With the implementation of the H2F system, the Army introduced the Army Combat Fitness Test (ACFT) to better assess physical readiness for the demands of combat, as well as to begin to shift the culture of fitness in the Army [5]. The ACFT is a 6-event test (described in Appendix A) that assesses muscular strength, power, endurance, agility, and cardiovascular fitness, and requires a more rigorous and intentional approach to training than the Army’s previous assessment of physical fitness. Like Active-Duty soldiers, ROTC cadets are required to take the ACFT for record. In addition to assessing their fitness for duty, their score on the ACFT will directly impact their post-graduation career options. Optimal preparation for this assessment is best facilitated by ample training time, space, equipment, and expertise, which are not

available to many ROTC programs. Cadets typically have limited structured training time, and while they are encouraged to train outside of these sessions, they also must meet high academic expectations, participate in extracurricular activities, and may also be employed at least part time. Developing a time-effective program that can be implemented with minimal equipment and limited space would be of great benefit to these programs.

High-Intensity Functional Training (HIFT) may be a beneficial approach for ROTC cadets, as HIFT increases fitness with lower total volume and time commitment per session than traditional military fitness programs [8, 9]. HIFT has been an effective approach for increasing both endurance [9] and strength [10], as well as improving body composition [11].

MENTAL READINESS

Mental readiness in the US Army is defined as “the capacity to adapt successfully in the presence of risk and adversity”, and “includes the ability to integrate cognitive, emotional, and interpersonal capabilities” [5]. High levels of mental readiness are necessary for coping with the cognitive, emotional, and social stressors associated with military operations [1], and may serve as an emotional buffer against traumatic events [12]. The physical and mental stressors present in both training and combat environments can deplete the mental resources needed to function effectively in these environments [13], leading to attentional lapses, short-term memory impairment, impaired information processing. Separately and in combination, these may lead to errors in judgment, performance, and overall operational effectiveness [3, 14] with consequences including loss of life and mission failure.

In recent years, the military has prioritized equipping service members with the psychological capacity to perform at a high level across a range of diverse challenges. However, many of these efforts have emphasized psychological resilience as a preventative measure against post-traumatic stress and other psychological difficulties, rather than framing mental readiness as a tool to enhance operational performance, which may inadvertently be limiting their effectiveness [3].

While active-duty personnel have access to mental and cognitive performance experts through H2F, it is not clear when and how these resources will become available to ROTC cadets. Unlike the comprehensive guidance provided for physical training in the H2F Field Manual (FM 7-22) [5], there are no structured training programs for mental readiness development. Further, as both students and soldiers, ROTC cadets may face different challenges than their active-duty counterparts and may need a program specifically tailored to their needs. With the majority of officers entering the Army each year coming from ROTC programs, understanding how to promote mental readiness among these future leaders is imperative.

A promising approach to developing mental readiness in the military is through mental skills training [15, 16]. Mental skills training (MST) is comprised of a variety of psychological and behavioral strategies to promote effective performance in a variety of situations, including effective goal setting, attentional control, energy management, self-talk and imagery [17], as well as self- and emotion regulation skills [16]. MST has been used broadly in sport settings and has been associated with improvements of various measures of performance across team and endurance sports [18], and there is general agreement that successful athletes have a broader array of mental skills and are able to use these skills more effectively than their less successful peers [19]. In addition to performance, mental skills are also positively associated with a variety of cognitive, affective, and behavioral outcomes, including some components of general wellbeing [20]. Further, the addition of MST has been shown to help limit the body's dysfunctional physiological response to stress and thus may provide important protective physical effects [21].

Previous studies demonstrate that MST in military personnel promotes enhanced performance on military tasks [2, 22], physical fitness assessments [19], improve self-regulatory behaviors and use of mental skills, as well as decreasing anxiety in pilot trainees [18]. MST also shows promise for the attenuation of stress-induced declines in cognition in Marines [21] and

improving confidence during both basic training [2] and Survival, Evasion, Resistance, and Escape training [23]. Further, participants have recognized that these skills may be applicable to other aspects of military life [24].

A specific type of MST, mindfulness training (MT), has also shown promise for improved performance under stress. MT may attenuate the strength of the dysfunctional physiological stress response, limit cognitive decline in the face of a stressor, and may reduce the amount of perceived stress in a given situation [21, 25]. Across various protocols, MT was associated with attenuated decline of cognitive function, including working memory and attention [14, 26, 27], even in the high stress pre-deployment phase, with benefits correlating with increases in practice time [13, 26, 28]. Similarly, soldiers engaging in mindfulness practice 3 or more days per week demonstrated improved marksmanship under physical stress as compared with those who did not practice any mindfulness [13]. There is further evidence that MT may promote overall psychological wellbeing [13, 28, 29] and may contribute to improved group functioning as well [28].

For ROTC cadets, embedding mental skills training into physical training may be an efficient and effective way to enhance both physical and mental readiness. Fletcher and Sarkar [30] suggest that resilience interventions should take place in an environment that provides both adequate challenge and support, where individuals can learn and practice coping skills in the face of real difficulties. Physical training could serve as this challenging but supportive environment and may be an advantageous platform for teaching and reinforcing the mental skills needed for resilient outcomes. Physical training can present acute frustrations, both organically and added intentionally into a training session. Training sessions can provide an unknown, challenging, and competitive environment that can be intensified or eased to facilitate learning. In this way, individuals can be presented with opportunities to practice mental skills under various degrees of stress with the support of their peers, cadre, and coaches. Building this training into regular operations provides the opportunity for continuous, regular practice, and

allows individuals to practice their mental skills under a variety of conditions, with the hope that the skills eventually become second nature and may be utilized with little to no higher order cognition, as both attentional impairment and executive dysfunction occur in high-stress situations [31].

Similar to traditional sport where athletes have practice sessions and competition in which to practice their mental skills, ROTC cadets have physical training sessions, laboratory activities, and field training events that could be leveraged to teach mental skills. The integration of mental skills and mental readiness training into these environments may be an effective way to bolster mental readiness in this population, and practicing these skills in dynamic training environments may better highlight their applicability to operationally relevant contexts. Additionally, because mental skills usage is associated with better physical performance, it is possible that MST will elicit greater training adaptations during physical training, leading to improved physical preparedness.

THE CURRENT STUDIES

Many ROTC programs are limited in time, resources, and physical/mental training expertise, and the establishment of time- and resource-effective programs is necessary. To date, there are no established programs or best practices for promoting physical or mental readiness within ROTC programs. Development of ROTC-specific physical and mental readiness programs could be used by other programs nationally, and with the majority of Army officers coming out of ROTC, teaching these concepts to these individuals could have broad impacts throughout the force. Therefore, the purpose of the proposed studies is to develop, implement, and assess delivery of physical and mental readiness training specific to ROTC cadets. The overarching goal is to evaluate the feasibility of delivering these readiness training programs through a partnership between Colorado State University's Department of Health and Exercise Science and Army ROTC programs.

AIMS AND HYPOTHESES

Study 1

Aim 1: Compare a High-Intensity Functional Training (HIFT) training to a standard military fitness training program developed by the Department of Defense (DOD) on Army Combat Fitness Test (ACFT) performance among ROTC cadets.

H1: A HIFT training program will be more effective in improving ACFT scores than the standard fitness program.

Aim 2: Compare a HIFT training to a standard military fitness training program developed by the Department of Defense (DOD) on an assessment of common Warrior Tasks and Battle Drills (WTBDs) among ROTC cadets.

H2: A HIFT training program will be more effective in improving performance of WTBDs than the standard military fitness program.

Study 2

Aim 1: Compare a mental skills training program to an active control condition, consisting of exercise programming instruction, on attainment of mental skills knowledge and use among ROTC cadets.

H1: A mental skills training program will be more effective in increasing mental skills knowledge and use than the active control condition among ROTC cadets.

Aim 2: Compare a mental skills training program to an active control condition on operationally relevant assessments of physical, psychological and cognitive performance among ROTC cadets.

H2: Mental skills training will elicit greater improvements in physical, psychological and cognitive performance than the active control condition among ROTC cadets.

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CHAPTER 2 – EVALUATION OF TWO TRAINING PROGRAMS DESIGNED TO ENHANCE PERFORMANCE ON THE ARMY COMBAT FITNESS TEST AMONG ROTC CADETS

INTRODUCTION

Physical readiness in the US Army is defined as "the ability to meet the physical demands of any duty or combat position, move lethally on the battlefield, accomplish the mission and continue to fight, win and come home healthy [9]. To this end, a fitness program that improves health outcomes, reduces injury risk, and promotes combat readiness is a vital component of any military preparedness program.

As testing soldiers in actual battlefield conditions is difficult, surrogate measures of physical readiness are required. Until recently, the Army Physical Fitness Test (APFT) was the standard measure of fitness, consisting of maximum pushups and sit-ups (2 minutes each) and a timed 2-mile run. Because higher levels of strength, power, and endurance are necessary to meet the demands of modern warfare, the Army has implemented the Army Combat Fitness Test (ACFT) to more accurately assesses these abilities and promote the development of a more combat-ready force. To reflect the age and gender-independent nature of combat, the ACFT is graded on an age and gender-neutral scale. ACFT performance has important implications for promotions and career options for Army soldiers and will be a key factor in determining post-graduation placement for cadets in the Reserve Officer Training Corps (ROTC).

ROTC programs nationwide are often challenged by limited structured training time, access to equipment and training space, and decreasing fitness levels among college students [14]. Development and/or adaptation of a training program that addresses these limitations and is scalable for a variety of fitness levels would benefit ROTC programs. High-Intensity

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Functional Training (HIFT) is worth consideration as HIFT increases fitness with lower exercise volume and less time commitment per session than traditional military fitness programs [6,11]. In several studies, HIFT enhanced endurance performance [11], increased strength [4], and improved body composition [18]. Further, HIFT may be more enjoyable, which could promote better adherence [10].

Directly testing different approaches to preparing for the ACFT are necessary to develop effective training programs. Therefore, the purpose of this study was to compare a standard military fitness training program to HIFT in ROTC cadets. We hypothesized that a HIFT program designed specifically to enhance performance on the ACFT would be more effective than the standard military program developed by the Department of Defense (DOD). Additionally, we tested how effectively each approach facilitated skill transfer between the ACFT and common Warrior Tasks and Battle Drills (WTBDs).

METHODS

General Overview of the Study

This study was approved by the Institutional Review Board at Colorado State University (CSU). Participants were recruited from CSU's Army ROTC program. Prior to and upon completion of the training intervention, participants completed a battery of testing, conducted on 3 separate occasions. The first visit consisted of body composition assessment and measurement of aerobic capacity. Visit 2 was the ACFT and Visit 3 was a "benchmark test" to assess WTBD performance. Participants then completed 10 weeks of group training. Once weekly, participants completed a survey inquiring about their perceived physical and emotional wellbeing to monitor risk of overtraining.

Participants

Forty-four participants volunteered for this study, 31 males and 13 females. Using REDcap electronic data capture tools [7,8], all participants were screened for current or previous significant medical history or musculoskeletal injury that would be exacerbated by

intense exercise, use of medications or supplements that may impact exercise adaptations, and willingness to abide by the study protocol. Participants were excluded if they were younger than 18 years old or over 30, currently injured, unable or unwilling to complete vigorous exercise, or if they were not part of the campus ROTC program. All participants gave their informed consent to participate in this study.

Body Composition and Aerobic Capacity

Height was measured using a wall stadiometer and weight was assessed using a digital physician's scale. Body composition, including measures of fat mass, fat free mass, and lean mass, was assessed using dual energy x-ray absorptiometry (DEXA; Hologic, Bedford, MA). Maximal oxygen consumption (VO2max) was assessed using indirect calorimetry (Parvo Medics, Sandy, UT) during incremental treadmill exercise to volitional fatigue, using the Bruce Protocol [2].

Army Combat Fitness Test

The ACFT was conducted in accordance with the ACFT Initial Operation Capability Fiscal Year 2020 [19]. All grading personnel received necessary training to make sure all participants met Army standards for each event. The ACFT is comprised of a 3-repetition maximum deadlift, a standing power throw with a 10-lb medicine ball, maximum hand-release pushups in 2 minutes, a 250-meter shuttle involving sprinting, dragging a weighted sled, and a farmers carry, maximum leg tucks in 2 minutes, and a 2-mile run for time. Soldiers who are unable to complete a leg tuck can substitute a maximum duration plank. Each event is scored out of 100 points, and the maximum score on the test in its entirety is 600 points. Instructions for the test are provided in Appendix A.

Benchmark Assessment

To assess WTBDs, the investigators developed a 3-part test. The first portion of this test was an 8-event obstacle course, consisting of a sprint, sandbag throw, wall climb, tire flip, sled drag, farmers carry, agility run, and a low crawl, all while wearing a 20-pound backpack. This

portion of the test was capped at 5 minutes. Participants were allowed 1 minute of rest prior to the second portion of the test, a 1600m run as fast as possible wearing the 20# backpack. Once the run was complete, participants immediately completed a target engagement simulation, the third portion of the test, as quickly and as accurately as possible. For the first portion of the test, participants were awarded 1 point for every obstacle completed within the time limit. If participants were unable to complete an obstacle, they were awarded 0 points and assessed a penalty of 7 burpees before moving on to the next obstacle. Participants were required to attempt each obstacle at least once and allowed unlimited attempts at any given obstacle.

Physical Training

Participants were randomized to one of two training groups. The High Intensity Functional Training (HIFT) group completed a training program developed by human performance staff within CSU's Health and Exercise Science (HES) Department, and the DOD group followed training programs outlined in Army Training Publication 7-22 Holistic Health and Fitness (ATP 7-22). The DOD group followed the *Build 1* program for 7 weeks, followed by the *Fitness Training Unit ACFT Improvement* program for the remaining 3 weeks of the intervention. To replicate typical training programs across the AROTC National Program, these programs were modified from 5 days of exercise per week to 3 days per week. HIFT training sessions primarily consisted of strength training, metabolic conditioning circuits, and short interval running. DOD training sessions primarily consisted of calisthenics, strength training circuits, running, and movement drills.

Participants were asked to complete 3x 60-minute training sessions per week. Participants who missed more than 5 sessions were disenrolled from the study. Additionally, participants were asked to complete no more than 90 minutes of moderate intensity exercise per week outside of group training. This limit was imposed to minimize confounding factors and reduce injuries and fatigue outside of programmed days. All training sessions took place MWF from 6-7am, under the supervision of CSU HES undergraduate students, a Certified Strength

and Conditioning Coach, and Army ROTC Cadre. Participants recorded their Rating of Perceived Exertion (RPE) on a 1-10 scale at the end of every workout.

DALDA

To monitor overall well-being and early signs of overtraining, participants completed the Daily Analysis of Life Demands for Athletes (DALDA) survey [17] on a weekly basis before, during, and following the training protocol. This survey is a simple, effective tool for monitoring stress, fatigue and recovery in athletes [3]. The survey asks the participant to rate general sources of life stress, as well as specific symptoms related to stress or overtraining. While intended for daily use, Robson-Ansley and colleagues [16] found that weekly distribution of the DALDA survey was comparable to daily use in terms of sensitivity to stress response. To reduce participant burden, the survey was distributed weekly via REDcap electronic data capture tools [7,8]. The original version of the survey asks participants to rate each variable on a 3-point scale ('worse than normal', 'normal', 'better than normal'). For this study, the variables were presented on a 100-point visual analog scale, with 0 representing 'worst possible', 50 representing 'normal', and 100 representing 'best possible'. By increasing the resolution of the scale, we hoped to better capture subtle changes from baseline (i.e. if participants reported a symptom as slightly worse than normal or significantly worse than normal).

Statistical Analysis

Individual results within each training group were combined to assess group differences; we also combined the groups to measure the overall response to training. Responses to training and survey responses were examined using two-way ANOVA (time x group) with repeated measures. Baseline characteristics were compared using Student's T-Test to assess pre-intervention differences between groups. Pearson Product correlations were used to test relationships between ACFT performance, body composition, performance on the benchmark assessment and 1600m ruck for time. The significance level alpha, i.e. the probability of

rejecting the null hypothesis when it is true, was set at $p<0.05$. Calculations were performed using SPSS 26.0 (Statistical Package for Social Science, SPSS Inc., Chicago, IL) for Windows.

RESULTS

Participants

From an original cohort of 44 participants, 9 were disenrolled (6 men and 3 women). Two were disenrolled prior to the intervention due to contraction of COVID-19, 6 were disenrolled during the intervention due to COVID-19, and 1 was disenrolled due to an unrelated injury. Twenty-five men and 10 women competed the study (n=35). Mean age was 19.8±1.3 years, range 18-23.

Aerobic Capacity and Body Composition

VO2max and body composition data are presented in Table 1. There were no significant changes in absolute or relative aerobic capacity following 10 weeks of training within a group, and no significant differences between groups. We found no difference in body mass over time or between groups. There was a small but statistically significant decrease in percent body fat and an increase in lean mass, with no difference between groups.

Table 1. *Pre- and post-intervention body composition, aerobic capacity, and ACFT event results. MDL = 3 rep max deadlift, SPT = standing power throw, HRP = hand release pushups, SDC = sprint-drag-carry, LTK = leg tuck, 2MR = 2 mile run. Data are presented as mean ± standard deviation. *significant main effect of time, p<0.005*

	HIFT (n=19, f=5)		DOD (n=16, f=5)		Total (n=35, f=10)	
	Pre	Post	Pre	Post	Pre	Post
Height (m)	1.75 (0.08)	1.75 (0.08)	1.72 (0.04)	1.72 (0.08)	1.74 (0.08)	1.74 (0.08)
Body mass (kg)	75.98 (8.5)	75.94 (8.1)	73.28 (12.5)	73.78 (11.1)	74.74 (10.5)	74.96 (9.5)
BMI	24.7 (2.1)	24.5 (1.8)	24.6 (3.4)	24.6 (3.0)	24.7 (2.7)	24.6 (2.4)
Fat Mass (kg)	20.0 (4.2)	18.6 (3.3)	19.4 (7.1)	18.8 (6.3)	19.7 (5.6)	18.7* (4.8)
Fat Free Mass (kg)	57.9 (8.8)	58.2 (7.8)	55.7 (9.3)	55.7 (9.0)	56.9 (9.0)	57.0 (8.3)
BF%	25.7 (5.1)	24.3 (4.4)	26.1 (6.6)	25.2 (6.4)	25.9 (5.8)	24.7* (5.3)

VO2max (L/min)	3.2 (0.7)	3.5 (0.5)	3.1 (0.7)	3.1 (0.6)	3.1 (0.7)	3.3 (0.6)
VO2max (ml/kg/min)	42.4 (8.1)	46.1 (6.0)	41.9 (8.0)	43.1 (6.0)	42.2 (7.9)	44.8 (6.1)
MDL (lbs)	237.6 (66.3)	265.8 (53.4)	231.9 (65.2)	262.5 (61.0)	235 (64.9)	264.3 *(56.2)
SPT (m)	8.6 (2.1)	9.1 (2.2)	7.8 (1.9)	8.2 (2.1)	8.2 (2.1)	8.7* (2.2)
HRP (reps)	27.8 (11.0)	34.3 (9.3)	32.3 (13.7)	39.8 (11.9)	29.8 (12.3)	36.8* (10.8)
SDC (sec)	117.8 (17.7)	106.1 (14.3)	121.4 (17.5)	111.0 (13.8)	119.4 (17.4)	108.3* (14.1)
LTK (reps)	5.3 (5.8)	6.8 (6.4)	7.00 (6.0)	8.4 (6.8)	6 .1 (5.9)	7.5* (6.5)
2MR (min)	18.26 (1.99)	17.98 (1.97)	18.2 (4.1)	17.0 (5.7)	18.24 (3.1)	17.53 (4.1)

Army Combat Fitness Test

Group ACFT scores and individual event scores are presented in Figure 1 and Figure 2, respectively. Absolute event results are presented in Table 1. Overall scores and scores in five of the six events increased significantly across both groups, with no significant differences between groups.

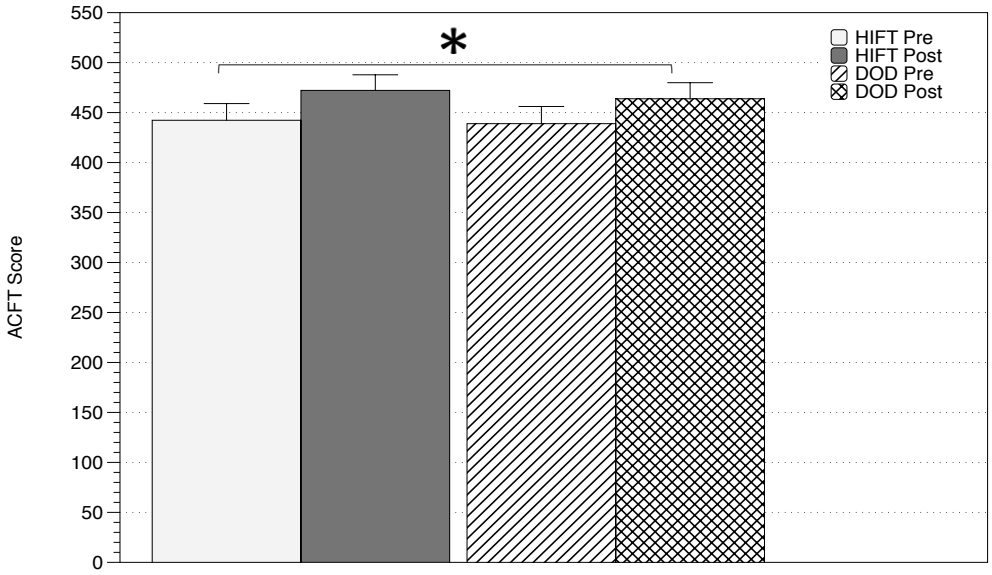

***Figure 1**. Pre and Post ACFT score (total of all 6 events) for both training groups. There was a significant improvement in ACFT for both groups combined (pre-training = 440.6 ± 23.9; post-training = 468.1 ± 22.5. There were no differences between groups. * = significant main effect of time for both groups combined, p<0.001.*

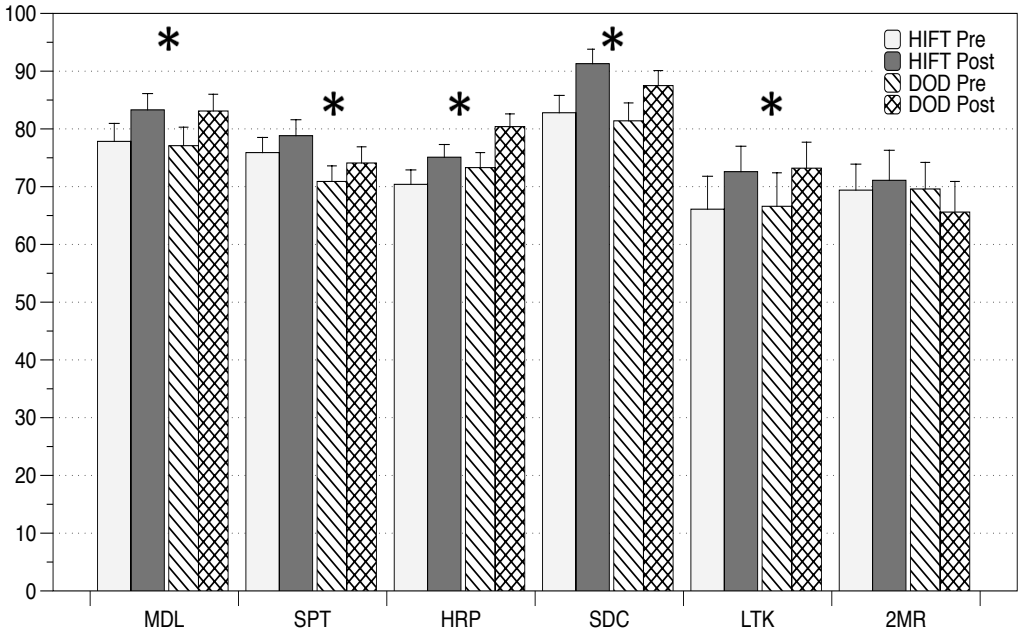

***Figure 2**. Pre- and post-intervention individual event scores for both training groups. There was a significant main effect of time for both groups combined for 5 of the 6 events, with no differences between groups. MDL = 3 rep max deadlift, SPT = standing power throw, HRP = hand release pushups, SDC = sprint-drag-carry, LTK = leg tuck, 2MR = 2 mile run. * = main effect of time, p<0.05 for all.*

Benchmark Assessment

Benchmark results are found in Table 2. One participant did not complete the baseline assessment and two did not complete the post-intervention assessment; all 3 were removed from analysis. There was no significant difference between pre- and post-intervention benchmark scores, time to completion, 1600m-ruck time, or accuracy. Prior to training, 5 women and 3 men failed to complete the 8-event obstacle course within the time limit. Following training, 5 women and 2 men failed to complete the obstacle course within the time limit.

Table 2*. Pre and post-intervention benchmark scores. Benchmark Total reflects total points accrued on the 8-event obstacle course within the 5-minute time limit, Benchmark Time reflects time to complete the obstacle course, Accuracy % reflects the target engagement test following the completion of the obstacle course and the 1600m run. Data are presented as mean ± standard deviation. There were no significant main effects of time or group.*

	HIFT (n=18, f=5)		DOD (n=14, f=5)		Total (n=32, f=10)	
	Pre	Post	Pre	Post	Pre	Post
Benchmark Total (points)	6.8 (1.1)	6.6 (1.7)	6.6 (1.3)	6.4 (1.4)	6.7 (1.2)	6.5 (1.6)
Benchmark Time (min)	4.0 (0.9)	3.8 (0.9)	3.8 (0.9)	4.1 (0.9)	3.9 (0.9)	3.9 (0.9)
1600 m Weighted Run (min)	10.4 (1.4)	10.6 (1.1)	10.9 (2.6)	10.6 (1.9)	10.6 (2.0)	10.7 (1.5)
Accuracy %	67.2 (14.0)	57.8 (18.0)	50.6 (22.0)	52.6 (18.9)	59.9 (19.5)	55.6 (18.3)

Relationship Between Benchmark and ACFT

We found moderate to strong correlations between scores on all 6 ACFT events, Total ACFT score, Benchmark Time, and 1600m Ruck Time, both pre- and post-intervention. These relationships are presented in Tables 7 and 8 in Appendix B.

Physical Training

There was high compliance with training protocols as participants completed an average of 25 of 27 prescribed training days (92.5%). Due to COVID precautions and severe weather, participants completed three training sessions remotely. Rating of Perceived Exertion (RPE)

scores between groups were similar across the training period (6.9±0.7 for HIFT, 6.6±0.8 for DOD, p=0.26).

DALDA Survey

Due to nonresponse, 4 participants were excluded from this analysis. For both groups combined, we found a significant effect of time on sources of stress, including home life and training/exercise, as well as on symptoms of stress, including overall health and interest in training. Overall health and home life were rated lower pre-intervention and during Week 1 and returned to a rating of “normal" during week 2 and for the remainder of the intervention. Interest in training and training/exercise were rated highly at the beginning of the intervention and returned to a rating of “normal” after 2 weeks. We found no significant differences between groups and no interaction between group and time (data not shown here for the sake of clarity). While we found no significant effect of time or group, participants consistently rated their overall sleep, quantity of sleep, and tiredness as ‘worse than normal’.

DISCUSSION

The purpose of this study was to evaluate two training protocols designed to enhance performance on the ACFT in ROTC cadets, who are often training in an environment limited by time, space, and available equipment. Secondarily, we assessed the transfer of improvement on the ACFT to performance on WTBDs. A bottom-line finding is that both training protocols were effective and contrary to our hypothesis, we did not see a significant difference between them.

Although there are no studies that provide a direct comparison in ROTC cadets, there is no clear consensus in the literature that a HIFT program is more effective than a more traditional training program composed of aerobic and resistance training [5]. The closest comparison is McWeeny et al., who similarly reported no performance differences after 6 weeks between a HIFT training group and a more traditional resistance-training program in college-age participants [13]. One rationale for greater efficacy with HIFT is the higher overall exercise

intensity, and as both groups reported similar training intensity throughout the intervention, it is possible that improvements were similar between groups because the intensity was similar.

While there was no difference between groups, it is clear that the combined population significantly improved their ACFT scores with 10 weeks of training. Out of 35 participants who completed this study, only two did not improve their score; one came within 2 points of their previous score, and the other was unable to complete the 2-mile run due to an injury. We found significant improvement on every event except the 2-mile run. Run times did improve by about 4%, but this was not statistically significant. This surprised us because prior research suggests that the physiological response to a bout of HIFT is similar to that of a time-equivalent bout of treadmill running [12] and HIFT can elicit improvements in endurance performance [11]. However, the biomechanical demands of running likely require specific training, and as the 2-mile run is the final event of the ACFT and occurs in a fatigued state, improving run performance may require more specific training.

There were strong relationships between ACFT performance and benchmark performance. This is unsurprising as both tests were designed to simulate similar challenges; the ACFT to reflect combat tasks and the benchmark to reflect WTBDs. Given that there was concordance between scores on the ACFT and scores on the benchmark, we were surprised to see no effect of training on benchmark performance. This result could be explained by an unexpected challenge; due to COVID and severe weather, participants completed the benchmark test only 2-4 days after taking the ACFT. Anecdotally, many participants reported mild to moderate musculoskeletal fatigue. We are encouraged to see that participants maintained their pre-test performance levels despite this fatigue. In the context of combat, soldiers will not always have the luxury of being completely rested, so the ability to maintain performance under fatigue is important. It is also possible that we did not see improvements because there were skill-based components (i.e. scaling a wall) that participants did not practice in either training group.

We found a small but statistically significant improvement in body composition. Due to limited research on HIFT interventions and much variability in the training protocols used, the literature provides no clear consensus on whether HIFT changes body composition. Our results are concordant with an 8-week HIFT intervention showing a modest but statistically significant decrease in fat mass and increase in lean mass [1]. In our study, the post-training rise in lean mass was significantly correlated with better performance on the ACFT and the benchmark. Given that the majority of the tasks on both tests require muscular strength and endurance, this relationship makes sense and reflects the focus of both training interventions. There was a small increase in aerobic capacity that was not statistically significant, in line with other <10-week HIFT interventions [4,11] and suggesting it may not be necessary to significantly improvement VO2max to improve on the ACFT.

Results from the DALDA survey indicate no significant concerns for overtraining for either group, despite the moderate to high session intensity. Participants consistently rated their overall tiredness, getting enough sleep, and sleep overall as 'worse than normal'. Previous pilot data collected in our lab in this population (not shown) suggests that this is not a byproduct of the training intervention, but rather a reflection of the demands on the participants as both ROTC cadets and students.

Limitations and Strengths

The global pandemic introduced novel limitations into this study. Due to local COVID-19 mitigation measures, the in-person semester was abbreviated, limiting this intervention to 10 weeks. Three group sessions were cancelled due to COVID-19 precautions and modified sessions for asymptomatic participants were conducted remotely, often with little to no equipment. Several training sessions were modified on account of cold weather, and 2 training sessions were cancelled due to inclement weather that caused university closures.

The study had several notable strengths including real-time implementation within CSU's Army ROTC program, expert oversight of every training session, assessment of multiple

relevant fitness components, and strong applicability to important soldiering tasks. To our knowledge, this is the first study to investigate the effect of an HIFT intervention in this population and provides a starting point for further investigations into a critical problem.

CONCLUSION

We found that three 60-minute sessions per week of moderate-high intensity training elicited improvements in ACFT scores, with no statistically significant differences between training programs. For this population of ROTC cadets, implementing a structured training program with expert oversight appears to be effective. Based on the successes and unanticipated challenges encountered in this study, training programs that emphasize intensity, train a wide variety of movements, maximize adherence, and are adaptable to a variety of situations are likely to be successful at improving ACFT scores.

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CHAPTER 3 – FROM PHYSICAL TO MENTAL READINESS

INTRODUCTION

There is no question that physical capacity is of utmost importance for military readiness and combat performance. Developing effective physical training paradigms is crucial for continued physical readiness, especially in time- and resource-constrained programs such as the Reserve Officer Training Corps (ROTC). However, it is also imperative to consider the other components that contribute to sustained physical excellence, including recovery practices, sleep, nutrition, psychological factors, and stress management.

Over the last several decades, a substantial body of literature points to the important role of psychological and affective processes in athletic performance [1, 2]. Emotions, mood states, and cognitive factors impact a multitude of performance factors, including motivation, focus, and effort level. For example, high levels of anxiety or fear may negatively impact performance, impair attentional control and focus, and reduce confidence, motivation, and ability to execute skills [3]. Further, these affective processes can impact physiological responses, including heart rate, muscle tension, and breathing, which may further impact performance [2].

While professional athletes generally have a predictable environment in which to perform, soldiers must be able to perform at a high level under a wide range of unpredictable physical demands, often with little advance notice [4]. The modern operational environment is rife with physical, psychological, and emotional stressors, and even the most physically fit soldier will not perform well if they are overwhelmed by psychological stress and unable to cope with those stressors. To perform effectively, soldiers must have high levels of both physical and mental fortitude. The necessity of mental readiness for those in leadership positions cannot be overstated, as these individuals must make decisions with potentially catastrophic consequences under both physical and psychological duress. Given that ROTC cadets commission as officers upon their graduation and these programs produce approximately 70% of officers entering the Army every year [5], mental readiness at this level is also imperative.

The military has placed high emphasis in recent years on preparing service members with the physical and psychological capacity to perform at a high level under a variety of conditions. Many programs aimed at enhancing mental readiness have focused on the promotion of psychological and emotional resilience, with each branch of the military developing and implementing resilience-oriented programs.

CHALLENGES WITH CURRENT APPROACHES

Despite years of work and large-scale efforts to improve psychological and emotional wellbeing and overall psychological resilience, there is limited evidence to support the efficacy of these programs [6, 7]. Many programs have not conducted formal assessments of their effectiveness, recorded any objective measures of performance, or included an adequate comparison group [6, 8]. Although limited, the available evidence does suggest positive, albeit modest, effects [9-11]. However, while these programs may increase knowledge of skills related to getting through adversity, *we don't know if participants are learning how and when to use these skills.* Participants may rate themselves more favorably on the skills taught, but not use these skills when faced with adversity or in unfamiliar situations [12].

A review by Thompson and McCreary [13] discussing the enhancement of mental readiness in the military suggests that how these programs are delivered may inadvertently limit their effectiveness. The training is often delivered in a lecture format and includes content related to the general principles of stress, common stressors faced by military personnel, and information related to effective and ineffective coping mechanisms. Because this information is often provided separately from other training, it may create the perception it is less important than the "core" military curriculum. Additionally, to deliver this content, many programs employ mental health professionals, who may be seen as treating the already injured, not providing training that enhances performance. Considering the negative stigma around mental health issues in the military, this may further reduce perceived relevance and individuals may not be receptive to the messaging. Timing of training may also present a challenge, as teaching

cognitive skills during a pre-deployment period means that the target audience is tired from going through rigorous training over long days and may already be cognitively depleted [7].

Stress Inoculation Training (SIT) and Stress Exposure Training (SET) have been used to reduce maladaptive behaviors under stress and to facilitate coping through teaching cognitive skills or habits that are more adaptive [13]. A meta-analysis suggests that graduated stress exposure and appropriate application of SIT/SET are effective in reducing performance anxiety and enhancing performance under stress [14]. They are effective for both high- and normal-anxious populations, with the beneficial effects appearing to increase with greater number of training sessions [10]. However, exposure to acute intensive training stress, such as survival training, can impair visuo-spatial capacity and working memory [15], which may negatively impact learning. The inconsistent results suggest that we do not know whether using SIT and SET in military contexts is effective in promoting mental readiness [13].

Further, none of this work has been conducted in non-traditional units, including ROTC programs. ROTC cadets face a unique set of challenges, as both students and soldiers. ROTC programs constrain contact time between ROTC cadets and cadre (e.g., ROTC cadre at Colorado State University have 7 total hours of contact time with the cadets) and adding additional training programs on top of already full schedules may not be feasible in this population. Therefore, it is not yet known if the currently available programs would work for this population.

MENTAL SKILLS TRAINING

A promising approach to enhancing mental readiness in the military is through mental skills training (MST) [16, 17]. MST is comprised of a variety of psychological and behavioral strategies to promote effective performance in a variety of situations, including effective goal setting, attentional control, energy management, self-talk and imagery [18], as well as self- and emotion regulation skills [17]. MST has been used broadly in sport settings and has been associated with improvements of various measures of performance across team and endurance

sports [19], and there is general agreement that successful athletes have a broader array of mental skills and are able to use these skills more effectively than their less successful peers [20]. In addition to performance, mental skills are also positively associated with a variety of cognitive, affective, and behavioral outcomes, including some components of general wellbeing [21]. Further, the addition of MST has been shown to help limit the body's dysfunctional physiological response to stress and thus may provide important protective physical effects [22]. Mental skills have demonstrated success within military populations [16, 17]. The translation to the military makes sense, as there are clear parallels between sport and military operations, including [11, 20, 23]:

- Operation in dynamic and complex environments
- They require effective utilization of perceptual, cognitive, and motor skills
- They necessitate performance under stressful situations
- They both seek tactical advantages over opponents
- Acting upon partial or incomplete information evolving over time
- Working both independently and as a team in an effective manner

Finally, in both arenas, there must be an acceptance of cognitive and somatic anxiety symptoms in the face of stressors as commonplace in their respective environments, as well as the development of strategies to cope with the stressors and the symptoms [24].

Soldiers who score highly on assessments of mental skills knowledge and use have more favorable psychosocial health profiles, including higher self-esteem and lower hopelessness, loneliness, depression, anxiety, stress, and anger scores, as compared to those who do not score as highly [18]. Psychosocial health, in turn, may serve as a psychological buffer under high-stress situations [18].

The implementation of MST in the military has enhanced performance on military tasks [9, 11] and physical fitness assessments [20], improved self-regulatory behaviors and use of

mental skills, and decreased anxiety [19]. MST also shows promise for the attenuation of stress-induced declines in cognition in Marines [22] and improving confidence during basic training [9] and Survival, Evasion, Resistance, and Escape training [10]. Importantly, in both sport [25] and military [26] mental skills research, participants recognize that the skills taught in sport can transfer to other aspects of life.

A specific type of MST, mindfulness training (MT), has also shown promise for improved performance under stress. MT may attenuate the strength of the dysfunctional physiological stress response, limit cognitive decline in the face of a stressor, and reduce the amount of perceived stress in a given situation [22, 27]. Across various protocols, MT was associated with improved cognitive function (attenuated decline), including working memory and attention [28-30], even in the high stress pre-deployment phase, with benefits correlating with increases in practice time [30-32]. A group of soldiers that underwent MT also demonstrated a 20% improvement in marksmanship under physical stress as compared with those who did not practice any mindfulness [31]. There is further evidence that MT promotes overall psychological wellbeing [31-33]and may contribute to improved group functioning [32].

LEVERAGING PHYSICAL TRAINING FOR MENTAL SKILLS AND MENTAL READINESS TRAINING

Leveraging physical training for the teaching of mental skills and mental readiness concepts may be especially advantageous for ROTC cadets since they typically have limited structured time available for both physical training and training in military operations. While they do not have the same practice and competition structure as traditional sport athletes, they are generally required to participate in group physical training sessions every week. As cadets spend 2-4 years within the program, teaching them mental skills during their time in ROTC affords them the opportunity to learn and practice these skills across a range of situations, with the hope that they will overlearn these skills to the point where they are reflexive long before they need them in a high-stakes, higher-stress environment.

Fletcher and Sarkar [34] suggest that resilience interventions should take place in an environment that provides both adequate challenge and support, where individuals can learn and practice coping skills in the face of real difficulties. While mental skills training is not a resilience intervention per se, the presence of challenge and support are also necessary for the learning and refinement of mental skills. Physical training may be an advantageous platform for this process, as it can present acute and long-term challenge, both organically and/or added intentionally into training sessions. It is possible to create an unknown, challenging, and/or competitive environment within these sessions that can be intensified or eased to facilitate learning. In this way, individuals can be presented with opportunities to practice mental skills under various degrees of stress with the support of their peers, cadre, and coaches. Building this training into what is already occurring provides the opportunity for continuous, regular practice, and allows individuals to practice their mental skills under a variety of conditions, with the hope that the skills eventually become second nature and may be utilized with little to no higher order cognition, as both attentional impairment and executive dysfunction occur in high-stress situations [24].

Physical training can help build self-awareness, understanding of emotion, and some awareness of how mental and emotional states manifest physically, which are necessary for effectively using mental skills to impact cognitive and emotional states. For high performance, it is generally assumed that each individual has an optimal state of arousal, defined as the cognitive and somatic reaction to an internal or external stimulus [35]. This state is dependent on both situational and individual factors, as well as task demands. Athletes must know what that optimal state is, what it feels like, and how to get there from suboptimal arousal states, which requires a great deal of self-awareness. In the training environment, individuals can learn to connect their own various emotional states with performance outcomes and practice increasing or decreasing their arousal level to align more closely with their preferred state for performance.

Physical training is also a great opportunity to promote the development of self-efficacy, or an individual's belief in their ability to complete a task or achieve a goal [36]. Self-efficacy has been described as "a mediator of coping skills, involving not only the individual's ability to handle a stressful situation but also their belief in that ability as well" [37]. Individuals with strong self-efficacy beliefs are more likely to engage in resilient coping efforts, and recent research has identified self-efficacy as a mechanism influencing the effects of stress on mental health [36]. While strong self-efficacy beliefs do not automatically transfer from one area to another, there is evidence supporting domain transfer, especially when domains share similar sub-skills or exhibit clear interconnections. This transfer is more likely when higher-order self-regulatory and general coping skills are engaged, and when a mastery experience leads to a transformation of efficacy beliefs [38]. Strong personal triumphs can lead to self-efficacy across highly disparate domains [38]; successfully mastering one difficult task can increase the individual's belief that other tasks with equal or greater difficulty can be overcome in the same way.

Finally, teaching mental skills and mental readiness through physical training may be an effective way to learn about these concepts. Physical training is foundational to military culture, and this approach reinforces the idea that mental readiness can be developed using the same training principles as physical readiness, including education, repeated practice, feedback mechanisms, and sufficient challenge to progress capacity continually and gradually. In light of cultural stigma, this also may be a more approachable way to discuss topics that may be more polarizing, including understanding emotions and self-compassion. Demonstrating how these concepts contribute to improved performance may help individuals feel more receptive to hearing about them. Pairing mental skills with physical training may help provide concrete, tangible examples of applications of mental skills, improving their perceived applicability to real life. While the conceptual knowledge taught in a classroom or lecture setting is certainly important, we know that conceptual knowledge alone is not enough, and it is important that individuals are exposed to examples that illustrate how this knowledge translates to real life as

well as opportunities to practice the application of that knowledge [39]. Further, this format allows basic stress management skills to be seen as part of normal operations – not distinct or only to be used after events or symptom occurrence [13].

CONCLUSION

Military personnel experience significant, sustained, and multifaceted stress in both training and combat environments. As failure to meet occupational demands can have catastrophic consequences, service members must possess high levels of physical and mental readiness. While there have been recent large-scale efforts to foster these qualities, there is limited evidence to support the efficacy of current mental readiness programs. It is not yet known if these programs are effective for ROTC cadets or if it is feasible to deliver these programs within the time and resources constraints of ROTC programs.

Mental skills training is a promising approach for enhancing mental readiness in military populations. Physical training may be an advantageous platform to teach mental skills and mental readiness, as it may increase perceived relevance to day-to-day operations. Further, physical training allows the opportunity for consistent practice in a supportive but challenging environment that is less stigmatized than overtly discussing mental readiness issues, including mental health and stress management. Finally, building mental readiness into regular operations may be a time-effective solution for ROTC programs who need to maximize limited training time.

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CHAPTER 4 – THE EFFECT OF MENTAL SKILLS TRAINING ON KNOWLEDGE, USE, AND PERFORMANCE IN ARMY ROTC CADETS

INTRODUCTION

Military personnel face myriad stressors in both the combat and training environments, including the singular and combined effects of physical exertion, cognitive overload, sleep restriction, energy insufficiency, uncertain operational environments, leading to emotional and psychological stress [1, 2] These stressors can reduce the mental resources needed to function effectively in these environments [3], leading to attentional lapses, short-term memory impairment, and impaired information processing. These may lead to errors in judgment, performance, and overall operational effectiveness [4, 5] with consequences including loss of life and mission failure. While technological advances have shifted the demands of modern military operations, humans remain the central element [4]. To be successful in modern operating environments, high levels of mental readiness and resilience are required [1].

To bolster mental readiness and improve warfighter health and performance in four additional domains (sleep, nutritional, spiritual, and physical readiness), the Army introduced the Holistic Health and Fitness (H2F) system. Due to limited space, time, equipment, and access to expertise, non-Active-Duty components, such as the Reserve Officer Training Corps (ROTC), may have significant barriers to implementing the system. Importantly, ROTC programs produce approximately 70% of the officers entering the Army each year [6] and their preparedness, or lack thereof, has substantial impact on the force. As officers, ROTC cadets will serve in leadership roles and will need to have a high capacity to tolerate stress and the mental repertoire to make good decisions in extreme circumstances. However, to date, there is no published research on best practices to enhance mental readiness in ROTC cadets.

Mental Skills Training

A promising approach to developing mental readiness in the military is through mental skills training [7, 8]. Mental skills training (MST) is comprised of a variety of psychological and behavioral strategies to promote effective performance in a variety of situations, including effective goal setting, attentional control, energy management, self-talk and imagery [9], as well as self- and emotion regulation skills [8]. MST has been used broadly in sport settings and is associated with improvements of several measures of performance across team and endurance sports [10]. There is general agreement that successful athletes have a broader array of mental skills and are able to use these skills more effectively than their less successful peers [11]. In addition to performance, mental skills are also positively associated with a variety of cognitive, affective, and behavioral outcomes, including components of general wellbeing [12]. Further, the addition of MST can help limit the body's dysfunctional physiological response to stress and thus may provide important protective physical effects [13].

Previous studies demonstrate that MST in military personnel promotes enhanced performance on military tasks [2, 14] and physical fitness assessments [11], improves self-regulatory behaviors and use of mental skills, and decreases anxiety [10]. MST also shows promise for the attenuation of stress-induced cognitive declines in cognition in Marines [13] and to improve confidence during basic training [2] and Survival, Evasion, Resistance, and Escape training [15]. Further, participants acknowledge that these skills may be applicable to other aspects of military life [16]. While these interventions have been successful in full-time military personnel, there is no research regarding the impact of MST within the ROTC population. Therefore, the purpose of the current study is to investigate the impact of a mental skills training program among ROTC cadets.

Aims and Hypotheses

The aims of this study are to compare a mental skills training program to an active control condition on 1) attainment of mental skills knowledge and use among ROTC cadets and 2) assessments of physical, psychological, and psychometric performance in the same cohort.

We hypothesize that the mental skills training program will be more effective than the active control condition in 1) increasing mental skills knowledge and 2) will elicit greater improvements in physical, psychological, and cognitive performance.

MATERIALS AND METHODS

General Overview of the Study

This study was approved by the Institutional Review Board at Colorado State University (CSU). Participants were recruited from CSU's Army ROTC program. At the beginning and end of the semester, participants completed a series of surveys, the Army Combat Fitness Test, and an assessment of psychometric performance during physical exertion that was developed for this study. Participants received either 8 weeks of mental skills training (MST) or 8 weeks of exercise programming instruction (EP) as part of their regular classroom sessions. Participants completed up to 2 journal reflections per week related to their physical training sessions and the concepts covered in class over the 8-week instruction period. A study timeline is depicted in Figure 3.

Figure 3*. Mental Skills Training Study Timeline*

Participants

Thirty-four participants (22 men, 12 women) volunteered for this study. All participants gave informed consent to participate in this study online, using REDcap electronic data capture tools [17, 18]. The training intervention was integrated into the regular curriculum and classrooms were randomly assigned to either the MST intervention or EP. Two classrooms received MST, and 2 received EP. While all members of the class received the information, participation in the research was voluntary. Twenty-two participants in the classrooms receiving mental skills training volunteered to participate in the research, while 12 participants in the classrooms receiving the exercise programming training volunteered to participate.

Questionnaires

Upon enrollment in the study, participants completed a 130-question survey battery inquiring about psychosocial factors and use/knowledge of mental skills. This questionnaire consists of 5 validated assessments: the Coping Self Efficacy questionnaire [19], General Self Efficacy questionnaire [20], the Short Hardiness Scale [21], the Mental Toughness Index [22], and the condensed Ottawa Mental Skills Assessment Tool 3 [23]. Some of the language on the OMSAT3 was slightly modified to reference military and physical training activities instead of sport. All questionnaires were completed online, using REDcap electronic data capture tools [17, 18].

Physical Performance

Physical performance was documented at the beginning and end of the semester using the Army Combat Fitness Test (ACFT). Briefly, the ACFT consists of 6 events: a 3-repetition maximum deadlift, standing power throw with a 10-lb medicine ball, maximum hand-release pushups in 2 minutes, a 250-meter shuttle involving sprinting, dragging a weighted sled, and a farmers carry, a maximum duration plank, and a 2-mile run for time. Each event is scored out of 100 points; the maximum total score on the test is 600 points. All cadets who are enrolled in the

ROTC program are required to participate in the assessment, and scores for participants were provided by CSU's Department of Military Science.

Psychometric Performance Under Physical Stress

Participants were assessed on psychometric performance during physical exertion. This assessment consisted of 3 physical tasks and 3 written psychometric tests: a 200yd shuttle run, a 15-question numerical estimation test, a 50yd sled drag (135lbs), a 9-question spatial awareness test, a 50yd plate carry (1x25lb plate per hand), and a 14-question data checking test. Participants had a maximum of 2 minutes to complete each written test, and participants were scored on the number of correct answers provided within the 2-minute time limit.

Training Intervention

The 7-module Mental Skills Training program was delivered over the course of 8 weeks. Each module consisted of a content-based lecture and a group discussion. The topics were primarily discussed in the context of physical training in order to provide concrete, tangible examples of mental skills and improve their perceived applicability to military operations, as well as to reinforce the idea that mental skills can be developed using the same training principles as physical fitness [24]. However, participants were encouraged to practice what they learned in whichever context they chose. Modules 1-4 focused on teaching the importance of mental readiness in the military environment and covered foundational sports psychology skills that were to be used throughout the entire training period. These skills include self-talk, goal setting, imagery, energy management, and attentional skills. Modules 5-6 focused on mental toughness and the application of mental skills, such as using energy management techniques to facilitate decision making in a high-stress situation or using self-talk to persevere through a difficult moment. Module 7 discussed self-compassion and coping with failure. Over the course of the training intervention, participants responded to 15 reflection prompts about the topics covered in class. The initial and penultimate prompts inquired about definitions of mental skills and mental toughness and any change in those understandings over the course of the program, and the

final reflection inquired about their use of mental skills during the ACFT. The other prompts inquired about the content covered in the class sessions and asked participants to reflect on their practice/application of this content.

The active control condition received 8 weeks of exercise programming instruction, also consisting of a content-based lecture and a group discussion. The program was focused on general programming principles, as well as programming for specific fitness goals, applicable to both individuals and larger groups. Participants in the control condition also responded to 15 reflection prompts about the topics covered in their class and worked through the exercise program design process over the course of these reflections.

Statistical Analysis

Descriptive statistics (means and standard deviations) were calculated at baseline and follow-up for all variables for the study population. Baseline characteristics were compared using Student's T-Test to assess pre-intervention differences between groups. For survey and performance measures, differences between conditions were examined using two-way ANOVA (time x group) with repeated measures. The significance level alpha, i.e., the probability of rejecting the null hypothesis when it is true, was set at $p<0.05$. Calculations were performed using R Statistical Software (version 4.3.2; R Foundation for Statistical Computing, Vienna Austria).

Qualitative analysis was also used to analyze program impact through a thematic analysis of journal reflections. These reflections were coded line-by-line using an inductive coding approach to identify changes in understandings of mental skills and/or mental toughness, changes in use of mental skills, and to determine if participants were able to identify skills, strategies, and/or tendencies that facilitated or hindered performance. Ninety-three unique codes emerged during the initial coding process; these codes were aggregated into larger categories, and subsequently into 3 major themes summarizing the outcomes of the training

program. The categories and themes were initially developed by the primary author and reviewed by the other authors and discussed until agreement was reached.

RESULTS

Mental Skills Knowledge and Use

Journal Reflections:

We observed three primary responses to the training program: 1) Increased confidence in, and expanded understanding of, mental skills and strategies, including adding new skills and shifts in definitions of mental skills, 2) improved application of their skills/strategies, including more intentional, effective, and versatile use, and 3) expanded understanding of mental toughness.

Of the 22 participants, 18 noted a positive impact of the class, mentioning the above themes as well as stating that the classroom discussions were helpful. One participant stated no real impact and 3 participants did not respond to that prompt.

Theme 1: Increased confidence in and expanded understanding of mental skills and strategies, including shifts in definitions and understandings of mental skills

Several participants noted changes in their definitions of mental skills and strategies, ranging from slight shifts to considerable effects. Other participants mentioned that their baseline definitions did not change per se, but that their understanding of these concepts expanded in a meaningful way. One participant mentioned: *"My idea of mental skills has expanded to include the self-care techniques that we were taught and is now a group of skills that I can define instead of a vague idea of what it might mean"*. Another wrote, *"I originally used the metaphor that I imagined that mental skills were like a toolbox and all the tools inside were different mental skills, now I feel that I have more skills in my toolbox".*

Many participants noted that they felt more confident in their understandings and definitions of mental skills and mental toughness, as well as more confident in their ability to use

their skills. One participant noted, "*I think our conversations helped me to feel more confident about my definition and understanding",* while another stated "*It also definitely solidified my own strategies and made me more confident in them because now I could confirm I was doing the right thing"*.

Theme 2: Improved application of their skills and strategies, including more intentional, effective, and versatile use

Throughout the course of the intervention, all participants were able to identify skills and strategies that facilitated performance and ways to make those skills and strategies more effective in the future. Participants mentioned using skills in new ways or applying new skills that they learned in class. One participant noted that the class discussions "*have also helped me to think of other situations in which I could implement these mental skills and techniques to go about implementing said skills".* Another stated, "*Before this class I did not value the importance of imagery and thought of it as a meaningless buzzword. Now, I have incorporated some more imagery into my life and its importance has definitely come into fruition"*.

Participants were also able to identify factors that helped or could potentially hinder performance, both physically and academically (such as personality traits and tendencies, sleep, nutrition, and time-management). For example, when reflecting on the module related to attention management, one participant noted, *"Maybe in the future I'll just avoid music altogether when trying to concentrate because it still impacts my thoughts/ feelings".* Another stated, "*I think that the mental skills that I have found most helpful have been mental imagery and quieting techniques. This is because I can use both to lower my heart rate, and although I don't tend to freak out or panic, these techniques often help me to be able to focus more, thereby allowing me to do the things that I do better and with more efficiency and efficacy"*.

Further, many participants demonstrated self-awareness around their internal narratives and ways of relating to themselves and were able to discern whether or not these were facilitative of success. One participant wrote,

"The negative self-talk would quickly spiral until I had an entire false representation of my character as a whole. All of this only accumulated a lot of anxiety for me because I was so scared of messing up as I knew I would feel horribly for days after. I think that that only proliferated the likeliness of errors because anxiety does not help anyone think straight. I think that learning to have self-compassion allowed me to have a better relationship with myself when faced with simple mistakes. Instead of beating myself up, wishing I were different, I take the time to ask myself, 'well why did this go wrong? Am I tired? Was I not prepared enough?' Then taking that and fixing the problem or accommodating to my needs."

Theme 3: Shifts in Understanding of Mental Toughness

Following the program, many participants noted changes in their understanding of mental toughness. Many participants included grit, tenacity, and pushing through no matter what in their initial definition of mental toughness; in their follow-up definition, several participants noted that mental toughness was more multi-faceted than they first believed, and also mentioned qualities such as staying calm and being able to adapt. One participant noted,

"When I first heard about mental skills and toughness, I thought it was just your ability to trick yourself into doing something hard – now I understand that mental toughness is not just gaslighting yourself into thinking that things are easy…. Mental skills and toughness to me is your ability to prepare yourself for something hard, and then while you are doing the hard activity, have strategies to help cope with the hard times."

Another participant wrote:

"I think that before this class I defined mental toughness as being able to cope with adverse times. Having grit and being able to push through is what I emphasized the most. Now I think that mental toughness has more of a soft side. It is being able to take your ego out of the picture and think things like, 'I might not do as much of this workout as I planned but is that better than pulling a muscle? Yes'. It is being able to have self-

compassion for yourself. it is being able to use metacognition to understand and maybe change unhealthy thinking patterns to cultivate better habits. It is being comfortable with challenging your way of thinking, so you are constantly growing."

Other participants noted that their core definition did not change, but they had increased confidence in their definition and understanding of mental toughness: *"[The conversations in class] have given me a much stronger argument for the definition of mental toughness and the different methods to reinforce mental toughness."* A few participants noted that they felt that they had increased their mental toughness. One participant specifically mentioned that they noted an improvement *"in the way I react to certain scenarios like pile up of schoolwork or the way I prepare for exams"*. Another participant noted that they felt that the classroom discussions gave them an array of strategies to use to become more mentally tough.

Survey Responses

Survey responses are presented in Table 3. Only 13 participants (n=10 MST, n=3 EP) completed the baseline and post-intervention surveys; all others were excluded from analysis. Only 6 participants in the MST group completed the OMSAT3 in its entirety before and after the intervention; all others were excluded from analysis. There were no significant differences following the intervention within either group, and no significant differences between groups, $p>0.1$ for all comparisons.

Table 3*. Pre- and Post-Intervention Survey Responses. MST = Mental Skills Training, EXP = Exercise Programming/Control Condition, CSE = Coping Self-Efficacy, GSE = General Self-Efficacy, SHS = Short Hardiness Scale, MTI = Mental Toughness Inventory, OMSAT3 = Ottawa Mental Skills Assessment Tool. Data are presented as mean (SD).*

		CSE	GSE	SHS	MTI	OMSAT3 (n=6/3)
MST (n=10)	Pre	173.6 (42.2)	32.5 (4.5)	33.1 (5.9)	45.3 (4.7)	233 (23.1)
	Post	192.9 (42.8)	33.0 (6.3)	30.6 (8.8)	44.4 (12.0)	244.7 (19.6)
EXP (n=3)	Pre	173 (58.1)	32.7 (6.1)	29.0 (8.7)	45.3 (7.7)	220.7 (37.1)
	Post	154.3 (32.7)	35.7 (2.9)	29.0 (8.0)	44.0 (3.6)	228.7 (19.9)

Army Combat Fitness Test (ACFT)

ACFT results are presented in Table 4. At the post-test, there was a statistically significant increase in the 3-repetition maximum deadlift (MDL) for the EP group. There were no other significant differences following the intervention or between groups, $p>0.1$ for all.

***Table 4**. Pre- and Post-Intervention ACFT Results. MDL = 3 repetition maximum deadlift, SPT = standing power throw, HRP = hand-release pushups, SDC = sprint-drag-carry, PLK = plank, run = 2 mile run for time. All data are presented as mean (SD). *p<0.05 for group (post).*

		Total Score	**MDL Score**	**SPT Score**	**HRP Score**	**SDC Score**	**PLK Score**	**Run Score**
MST (n=15)	Pre	498.2 (44.4)	85.5 (10.5)	77.3 (13.3)	84.2 (12.3)	90.3 (8.6)	77.5 (15.0)	83.2 (11.7)
	Post	501.7 (44.4)	85.1 (11.4)	83.7 (10.1)	82.3 (11.0)	89.1 (7.7)	78.7 (16.3)	82.7 (13.1)
EP (n=7)	Pre	507.3 (50.9)	89.1 (11.7)	82.7 (13.1)	83.6 (10.1)	86.6 (16.2)	85.6 (15.6)	82 (16.9)
	Post	527.3 (44.8)	95.9 (8.4) *	86.7 (10.4)	87.6 (9.1)	87.3 (13.3)	89.1 (11.6)	81 (14.2)

Psychometric Performance During Physical Exertion

Data for this assessment are presented in Table 5. Following the intervention, we found a significant decrease in Total Score for the MST group, as well as scores on the numerical estimation and spatial awareness tests for both groups. Additionally, at the post-test, the EP group had a significantly lower score than the MST group for the numerical estimation test. We found a statistically significant decrease in time to complete the sled drag at the follow-up assessment, with no difference between groups. Finally, the EP completed the data checking assessment faster than the MST group at the follow-up assessment.

Table 5*. Pre- and Post-Intervention Psychometric Performance. NE = numerical estimation, SA = spatial awareness, DC = data checking; *p<0.05, **p<0.001 for event, τp<0.05 for group*

	MST (N=17)		EP (N=8)	
	Pre	Post	Pre	Post
TOTAL SCORE	20.1 (4.1)	15.6 (2.7)*	17.8 (4.4)	17.1 (3.7)
TOTAL TIME (SEC)	460.9 (17.2)	472.1 (39.2)	462.8 (18.9)	477.9 (37.0)
RUN TIME (SEC)	51.4 (4.2)	50.5 (6.9)	51.9 (4.1)	52.4 (8.1)
NE TIME (SEC)	119.3 (2.1)	113.5 (15.8)	117.3 (7.8)	119.3 (1.4)
NE SCORE	6.7 (2.8)	3.7 (1.8)**	5.6 (2.0)	4.1 (2.5)**
SLED TIME (SEC)	35.9 (7.1)	53.3 (12.7)**	36.4 (7.5)	53.3 (11.7)**
SA TIME (SEC)	113.6 (11.5)	115.5 (14.8)	119.1 (8.5)	118.9 (2.0)
SA SCORE	5.2 (1.5)	4.1 (1.6)*	4.1 (1.4)	3.3 (1.5)*τ
CARRY TIME (SEC)	20.3 (3.3)	20.4 (3.3)	20.0 (5.1)	20.8 (7.0)
DC TIME (SEC)	119.8 (0.5)	119.0 (3.2)	116.9 (6.4)	113.4 (14.2)τ
DC SCORE	8.1 (2.1)	7.8 (2.6)	8.0 (3.5)	9.8 (1.6)

DISCUSSION

The primary aim of this study was to compare a mental skills training program to an active control condition on attainment of mental skills knowledge and use among ROTC cadets. Upon completion of the intervention, participants noted increased confidence in their mental skills use, expansion of their understanding of mental skills, and improved application of these skills and strategies in both physical and academic settings. The majority of participants stated that the class had a positive impact on them, and several specifically noted that the conversations in class were helpful.

Several participants noted that their understanding of mental toughness changed over the course of the intervention. These participants stated that they generally tend to push themselves too far and too hard; over the course of the intervention, all of these individuals learned that checking in with themselves and taking a long-term perspective on health performance was also important. While mental toughness has been associated with success in both sport [25] and military performance [7], rigid and inflexible perseverance is not always the optimal response

[26], as these individuals are more likely to get injured and continue to exercise despite injury [27]. Very high levels of psychological hardiness and grit are directly associated with injury risk in the basic training environment . Therefore, it may be important to take a nuanced approach to find the optimal balance of “enough but not too much” in discussions of mental toughness and related constructs within the military population.

Surprisingly, these qualitative improvements were not reflected in any of the quantitative survey measures. However, the emphasis of the training program was heavily focused on application and practice of skills and helping participants understand what was beneficial for them individually. Because the focus was not on increasing conceptual knowledge, the MST may not directly translate to the survey outcome measures. Though it did not reach statistical significance, we did see an improvement in coping self-efficacy, or one’s belief in their ability to endure adversity. This may be reflective of the participants’ increased confidence in their ability to use mental skills in their lives.

A second aim was to compare a mental skills training program to an active control condition on the ACFT and psychometric performance during physical exertion. Contrary to our hypothesis, MST did not elicit greater improvement in either of these measures as compared to the control condition. This finding is surprising given that mental skills training has previously been shown to improve performance on military physical fitness assessments and tasks [2, 7, 11]. Interestingly, however, our findings are similar to Adler et al., [2] who conducted a large mental skills training program with basic trainees and found that, while participants who received mental skills training reported more confidence and greater use of a variety of mental skills, there was no significant impact on physical performance measures. They did note a significant interaction between previous experience and training group on physical fitness measures, where soldiers with previous competitive sport experience benefitted more from the mental skills training. The authors suggest that new soldiers may have been more focused on acquiring fundamental skills than refining performance, and those who were already comfortable

with physical performance testing and/or use of mental skills may have had greater success in applying them with their application to performance. As our population included a number of first-semester college students, they may similarly have been more focused on habituating to a new set of demands and expectations as both college students and ROTC cadets.

The intention of the MST was to discuss these concepts in the context of physical training, as a tangible, practical, and approachable learning platform. Most participants discussed their mental skills use in the context of ROTC physical training sessions or their personal workouts, but many also discussed mental skills use in the context of academics, hobbies, and other sport or physical activities. These findings are in line with Sharp et al. [28], who found that youth rugby players who learned about mental skills in the context of sport were able to apply their skills in other areas of their lives.

The results of this study provide support for the integration of mental skills training into the classroom and other training activities. While traditional athletes have practice sessions and competition in which to practice their mental skills, ROTC cadets have classroom sessions, physical training sessions, laboratory activities, and field training events that could be leveraged to teach mental skills. Further, teaching and practicing these skills in dynamic training environments may better highlight their applicability to operationally relevant contexts. Building this training into what is already occurring provides the opportunity for continuous, regular practice, with the hope that the skills become second nature and may be utilized with little to no higher order cognition, as both attentional impairment and executive dysfunction occur in high-stress situations [29]. Additionally, incorporating this education early into a military career (e.g., in the Army ROTC training curriculum) may have a significant positive impact on the service members' mental and physical wellbeing over the course of their military service.

Strengths and Limitations

This study had several strengths, including real-time implementation within the Army ROTC program and allowing the participants to practice and reflect on their skills during a broad

range of realistic scenarios. Also, mental skills training was taught alongside more traditional operational curriculum, which may increase the perceived applicability to day-to-day operations. Participants demonstrated high compliance with journal responses, completing an average of 13 out of 15 responses. While the modest sample size limits the statistical power and generalizability of the quantitative analysis, the wealth of qualitative data allows for a more comprehensive understanding of the impact of the program.

Due to operational demands within the Army ROTC program, the study cohort was limited to freshman and sophomore cadets, which may not be fully representative of the larger cadet population. Additionally, due to unforeseen circumstances, the follow-up psychometric performance assessment was completed on a different surface than the pre-test, increasing the difficulty of the sled drag, and subsequently resulted in a statistically significant slower sled drag time and a slower overall time for the post-test. It is unclear whether this increased physical demand also influenced performance on the written tests, but it would presumably have been a similar added challenge for both groups.

CONCLUSION

The results from the present study suggest that 8 weeks of mental skills training leads to qualitative improvements in the understanding and application of mental skills. Additionally, this study shows it is feasible to integrate mental readiness and mental skills training into classroom curriculum and other training activities. As ROTC programs typically have limited structured training time, integrating these concepts into regular operations may be a time-effective solution for development of mental readiness.

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CHAPTER 5 – A QUALITATIVE EXPLORATION OF ARMY ROTC CADETS' USE OF MENTAL SKILLS

INTRODUCTION

The US Army defines mental readiness as "the capacity to adapt successfully in the presence of risk and adversity", and "includes the ability to integrate cognitive, emotional, and interpersonal capabilities" [1]. Mental readiness is critical for military personnel, who face a multitude of stressors in both combat and training environments, including physical exertion, sleep deprivation, cognitive overload, and psychological stress. If service members are unable to successfully cope with these stressors, they may be more prone to errors in judgement and decision-making, reduced performance, and decreased effectiveness. These errors may have catastrophic consequences, including loss of life and mission failure.

The Army's Holistic Health and Fitness (H2F) system aims to bolster soldiers' overall readiness, which includes mental readiness. Early results are promising, and the Army has begun a lengthy rollout of H2F across the force [2]. However, it is not clear when and how these resources will become available to Reserve Officer Training Corps (ROTC) cadets. Due to limited access to space, equipment, time, and necessary personnel, ROTC programs may face challenges implementing readiness training designed for an active-duty population. Unlike the comprehensive guidance provided for physical training in the H2F Field Manual [1], there are no structured training programs for mental readiness development. Further, as both students and soldiers, ROTC cadets face different challenges than their active-duty counterparts and would benefit from a program specifically tailored to their needs. As the majority of officers entering the Army each year come from ROTC programs [3], understanding how to promote mental readiness among these future leaders is imperative.

A promising approach to developing mental readiness in the military is through mental skills training (MST) [4, 5]. MST has been used broadly in sport settings and has been associated

with improvements of various measures of performance across team and endurance sports [6]. In addition to performance, mental skills are also positively associated with a variety of cognitive, affective, and behavioral outcomes, including some components of general wellbeing [7]. Previous studies demonstrate that MST in military personnel promotes enhanced performance on military task, physical fitness assessments, improve self-regulatory behaviors and use of mental skills [8-11]. However, it is not yet known if these approaches are similarly effective with ROTC cadets as there is limited research on mental skills training and use of mental skills in this population. Therefore, the purpose of this study is to explore mental skills use among Army ROTC cadets, with the goal of providing a foundation upon which to build ROTC-specific mental readiness programs. This study is intended to be more descriptive than mechanistic; our aim is to explore how cadets use foundational sport psychology tools and identify other strategies they use to navigate challenges they face.

MATERIALS AND METHODS

General Overview of the Study

This project was part of a larger study investigating the impact of an 8-week mental skills training program among Army ROTC cadets (Newman et al., in prep). Briefly, this study was approved by the Institutional Review Board at Colorado State University (CSU) and participants were recruited from CSU's Army ROTC program. Participants received either 8 weeks of mental skills training or 8 weeks of exercise programming instruction during their regularly scheduled class time. Participants completed up to 2 weekly journal reflections related to their physical training sessions and the concepts covered in class over the 8-week instruction period.

Participants

Thirty-four participants (22 men, 12 women) volunteered for the larger study. All participants gave informed consent to participate in this study online, using REDcap electronic data capture tool [12, 13]. Participants were randomly assigned at the classroom level to either MST or the exercise programming condition. The training intervention was integrated into the

regular curriculum and classrooms were randomly assigned to either the MST intervention or the exercise programming intervention. Two classrooms received MST, and 2 received exercise programming instruction. While all members of the class received the information, participation in the research was voluntary. Twenty-two participants in the classrooms receiving mental skills training volunteered to participate in the research, while 12 participants in the classrooms receiving the exercise programming training volunteered to participate.

Training Intervention

The 7-module Mental Skills Training program was delivered weekly over the course of 8 weeks. Each module consisted of a content-based lecture and a group discussion. The participants were asked to practice what they learn in the classroom setting during that week's physical training sessions. Modules 1-4 focused on teaching the importance of mental readiness in the military environment and covered foundational sports psychology skills that were to be used throughout the entire training period. These skills include self-talk, goal setting, imagery, energy management, and attentional skills. Modules 5-6 focused on mental toughness and the application of mental skills, such as using energy management techniques to facilitate decision making in a high-stress situation or using self-talk to persevere through a difficult moment. Module 7 discussed self-compassion and coping with failure.

Over the course of the intervention period, MST participants responded to 15 reflection prompts about the topics covered in class. The initial and penultimate prompts inquired about definitions of mental skills and mental toughness and any change in those understandings over the course of the program, and the final reflection inquired about mental skills use during the Army Combat Fitness Test (ACFT). The other prompts inquired about the content covered in the class sessions and asked participants to reflect on their practice/application of this content.

The active control condition also received 8 weeks of instruction, focused on exercise programming, consisting of a content-based lecture and a group discussion. Participants in this group also responded to 15 reflection prompts about the exercise programming topics covered

in their class and went through the process of developing a physical training program over the course of these reflections.

Data Analysis

For the present study, only responses from the 22 participants who received MST were included in the analysis. By design, participants in the exercise programming group did not respond to any prompts discussing mental skills use. Journal reflections were analyzed qualitatively using thematic analysis to identify patterns and themes in cadets' use of mental skills over the course of the training program. Participants completed an average of 13/15 reflections, for a total of 286 written reflections submitted over the course of the study and all were used for data analysis.

Each written reflection was uploaded to NVivo 14, a qualitative data management and coding software. With a focus on description, these reflections were repeatedly reviewed, analyzed, and open-coded using an inductive coding approach, where codes and themes are driven by the data [14]. The overarching research questions were: 1) "For which purposes do participants use the mental skills taught in class?", 2) "in which contexts/settings do participants use the mental skills taught in class?", and 3) "what other strategies do they use to get through difficult moments?". To inquire about the use of each specific mental skill, codes were organized by mental skill and themes within each skill were identified (purpose for use and setting for use). Analytic memos were kept during the coding and data analysis processes. The categories and themes were initially developed by the primary author and reviewed by the other authors and discussed until agreement was reached.

RESULTS

During the intervention, use of mental skills was primarily discussed in the context of physical training; however, participants were encouraged to use and reflect on their mental skills in whichever contexts they wished. The primary areas of use included physical training, in academic settings such as completing homework, as well as a variety of ROTC-related

activities. These activities included the weekend-long field training exercise (FTX) that the cadets complete every semester and the Ranger Challenge Competition, a national ROTC competition involving a variety of soldiering tasks.

Use of Mental Skills Taught in the Training Intervention

Self-Talk

During the intervention, self-talk was defined as *the steady stream of thoughts and internal dialogue in our minds*. One reflection prompt specifically asked participants to pay attention to and reflect on their self-talk during a workout of their choice. This prompt inquired about their internal dialogue, whether they felt that their internal narrative was helpful, and reflect on why it helped or hindered their performance during that workout. Later reflection prompts inquired more generally about the strategies they were using to navigate various challenges, and many noted using self-talk as their primary strategy. Over the course of the training intervention, self-talk was primarily used to keep composure and stay focused, to motivate, and to keep perspective.

<u>To Keep Composure</u>

Participants mentioned that self-talk helped them accept situations and to stay composed during challenging moments, primarily in physical training and ROTC events. During one challenging morning, one participant noted that *“my self-talk pivot was when I told myself ‘This is what is happening regardless of if I'm happy about it or not, might as well have fun’”.* Another mentioned that during their Ranger Challenge competition, he leaned into his mantra of *“control the controllables and forget about the rest”.* During a shooting exercise, one participant experienced a weapons malfunction and stated that *“talking myself through the fundamentals also helped me focus as my gun jammed and I was able to lock in on my target”.*

Another participant wrote,

> *I have been using the mantra “I am calm” a lot. This helps me believe I have less anxiety than I do. It is a very simple one, but I think it helps. I use it if I have to do something*

unfamiliar or something I am not comfortable with. This week I used it during land navigation because I was so far away from everyone and hadn't seen any other people for 20 minutes and was getting scared. I said "I am calm. I am brave". This definitely helped. Even if I didn't feel like it was true, it was easier to embrace the very small part of me that did feel that way."

To Motivate

Participants used self-talk to motivate themselves during physical training (including personal workouts, ROTC PT, and Ranger Challenge PT) and in academic settings. During physical training, participants stated that "*self-talk helps me keep going*", "*I tell myself that this is something you can do and quitting now when you're this far would be for nothing*", and "*by motivating myself with self-talk I saw myself push myself more towards the end when I was feeling tired*".

In academic settings, participants used self-talk to remind themselves to keep working hard to achieve their goals: "*Whenever I am unmotivated, I use self-talk by telling myself reminders of where I will be if I work hard and what hard work has done for me in the past*" and "*The self-talk I had was reminding myself to work hard and be successful for that week because it will pay off and the following week would be easier*."

However, one participant noted that his ability to push himself using self-talk was not always helpful: *"I used most of the same self-talk and pushed through [fatigue and difficulty] but also to the point where I hurt my knee a little."*

For Perspective

Participants used self-talk to keep perspective when dealing with illness and injury, such as *"I used self-talk to tell myself it's better not to make it worse than try to run"* and another stated that "*something that helped me during my struggles was reminding myself that it was okay to not have a perfect ACFT score under the conditions*". One participant relied on self-talk during a challenging field training exercise (FTX), noting,

"… as FTX continued my mental talk continued to become more negative. I kept telling myself it was all in my head and that I was babying out of FTX. I had to be very deliberate to remind myself that I was justified to listen to my body and having blood in my urination was good evidence that I was not babying out just to baby out. I think being more deliberate with my self-talk helped me be more realistic with my expectations of myself and give myself grace. The only mantra I used was breaking the time up, so things like 'only five more minutes' or 'I already made it 20 minutes, I can make it three more'."

Attention Management

During the training intervention, attention management was defined as the capacity to purposefully direct attention inward (on thoughts, feelings, emotions), on the present moment, and/or externally (to dissociate or distract from the present moment or thoughts, feelings, and emotions). We discussed a number of attention management skills and strategies, including cues or triggers, ways to "release" negative thoughts, grounding techniques, and mindfulness.

Directing Focus Inward for Performance

Several participants mentioned directing focus on their form during a workout as a way to improve performance. One participant mentioned that:

"During the run, I was simply trying to keep a forward mindset so that I could ignore the pain of running and just focus on my form. I think in the future, I would focus on my form for the whole time as opposed to just when it became painful, and this would allow me to have better performance for the whole event as opposed to just the challenging part."

Another noted that he used the direction of focus (facilitated through self-talk) as a way to help with performance and avoid building bad training habits:

"During my workouts, the main self-talk that I use is just reinforcing my training in the back of my head, rather than using motivational speech. When I am tired, if I can think about the correct form, it helps me maintain my intensity/ speed depending on the workout I am doing. It often helps my performance because it keeps me from creating

bad habits that I might do when I am not tired. My self-talk often does switch throughout the workout. At the beginning, I will be trying to motivate myself, especially with having to wake up early for PT. However, as the workout goes on, I move away from the motivational side and focus on my form and rely on my prior training. The main cue I use is head up, once I start putting my head down and let my breathing get out of control, that is when the quality of the workout starts to decrease."

Directing Focus on the Present Moment to Reduce Stress

Other participants used the attention management skills and strategies to stay present to reduce stress, noting "*when I'm freaking out not only do I try to consciously try to breathe, but I pay attention to my breath on the physical world watching it move things*." Others stayed present through trying to focus on the task at hand: *"I just kept telling myself to get through each event one at a time. Once I got to an event, my focus was only on that event, and I zoned everything out. I did not worry about what happened before or what event was next. I feel like that also helped me be able to focus in and do my best on each event".*

Another mentioned that being present was helpful for both accomplishing tasks as well as reducing stress,

"I made myself be entirely present in the moment, and ignored any thoughts that weren't relating to the task. At first, I found it difficult to force my thoughts to the task, but once I did that, my emotions leveled out into neutral while I was working even if I was stressed that day. I was amazed how just focusing on the task took away that stress for an hour or so".

Distraction or Dissociation from Experience to Cope

Participants also noted that they purposefully directed their attention away from their experience as a means to cope with discomfort, including mental rehearsal of skills they needed to perform in the Ranger Challenge competition or other mental games, "*I will also run through all the skills in my head while I'm rucking*", or "*I was running through various Army acronyms during my running interval workout on Tuesday*".

Several mentioned that they thought about something besides what they were doing, such as "*During the mile run the "loudest" feeling was pain in my side from running. Feeling those things didn't incite specific changes in thought, but more so produced emotions of anxiety and dread. I worked through those emotions by thinking about what I would do when I got home*", and another noted "*some thoughts that came were just keeping me busy like noticing the owl hoooing, the crickets, take notice of building to keep my mind off the ruck itself*".

Other participants stated that they simply just ignored the feelings, without mentioning any specific strategy that they used to do so, such as "*I also simply ignored the thoughts of slowing down and stopped thinking about the pain",* or *in order to finish the workout I put my thoughts and feelings aside as much as possible and just pushed through*".

Imagery

During the training intervention, imagery was defined as a technique that involves imagining oneself in a situation or environment, using all of your senses, and performing a specific activity within that context.

Motivation

Imagery was predominantly used as motivation in academic settings. Participants stated that they used imagery to help motivate themselves to study for tests by envisioning the outcome of their hard work:

> *"This week I used imagery to study for a test. I pictured myself three years from now graduating and being able to commission. Starting a new and exciting chapter in my life. I knew that in order to be able to reach that point I would have to get good grades which meant I would have to do well in tests which ultimately meant I would have to study.*

A few individuals mentioned using imagery for motivation, including during group physical training, "*Another time I used imagery was at PT. I had to imagine myself doing the workout and finishing it so that I could actually do it*", and during rucking as part of training for Ranger Challenge:

"I used imagery in a motivational way during my ruck. I imagined being one of the people behind me going at my pace and wanting to be able to increase the speed a little. This motivated me because I wanted to perform the best I could so the people behind me felt like they were getting a good workout in as well. I think I might need to try and just find better ways to use imagery in general because it is not my strong suit."

Rehearsal and Planning

During physical training, participants primarily used imagery to mentally rehearse movements before they attempted them, including heavy lifts and movements that they are still learning.

"I also really used it for my deadlift, I don't really lift weights so for the past day or two just imagining through a [point-of-view] sort of perspective how I would hold my back and shoulders and posture, where my eyes would go, how my feet would be planted, and then the holding of my shoulders to prevent them from rounding as much as possible."

Others used imagery for rehearsal and planning during shooting training:

"I did a fair amount of shooting this weekend and tried to use imagery to help with my groupings. On my way to the range, I visualized my red dot and corrections I would make if I was pulling shots. One thing I've found that helps with that especially is imagining that I am shooting through a very small hole in front of me, so I can't flinch or anticipate my shots."

Others used it for ROTC-related training, such as the tactical movements they perform during their field training: *"During FTX I decided to rehearse what I was going to be doing before each lane because I knew it would be harder to remember things while it was happening and that definitely helped."*

Goal Setting

During the training intervention, we discussed process, performance, and outcome goals as they relate to performance. The discussion of goal setting also included the process of segmenting, or breaking down larger tasks into smaller goals. Participants responded to a reflection prompt in which they were asked to set process, performance, and outcome goals for an event of their choice. All participants responded to this prompt, but interestingly, goal setting was not frequently mentioned outside of that specific reflection prompt.

Motivation

Goal setting was predominantly used for motivation in academic settings. Participants spoke about using goals to motivate and to stay on track, such as setting goals for getting grades on tests, getting homework done by a certain timeframe, or getting ahead on assignments. They noted, "*what helped me is remembering the end goal of passing my test*", and "*I need to keep reminding myself that in order to accomplish my big, long time goals, I need to continue getting homework done and build that consistency*".

Goal setting in the context of physical training was primarily in the form of competition and setting goals to beat their peers. One participant leaned into his competitive side to push through physical discomfort during training,

> *"I actually enjoyed the mile because all of [Alpha Company] ran it at the same time. That meant that I could chase people to motivate me. My competitiveness kicks in during those scenarios, and that made me run faster. By setting goals of chasing down and beating other cadets, I was able to dull the pain of the running and push through."*

Another leveraged competition to perform at her best during the ACFT:

> *"Often times I keep a mindset of doing better than the people next to me and that helps. For example, in my heat this time there was a freshman boy that I knew was able to outdo me in a couple of the events, but we were still very close in ability. My goal was to*

try and outperform him as much as I could (but silently of course because I'm not trying to make him feel bad)".

Segmenting

Participants primarily discussed using this strategy to cope with stress and to get through academic challenges:

> *"A mental skill that has helped me a lot is the analogy you used of, how do you eat an elephant, one bite at a time. I find it easy at school to get overwhelmed with the amount of work I am assigned. However, when I look at my work as I just have to do this one assignment, and the rest are a problem for future me to worry about, it helps me focus better mentally. I trick my mind into thinking I only have to do one assignment, and I just do that for multiple assignments until I have no work left. This strategy also works in PT; however, I feel that it works best for me in the academic scene."*

Participants stated that this helped reduce stress, "*segmenting every one of my days sometimes down to the hour made life much less stress full and allowed me to think more clearly"* and made their workload feel more manageable, "*the whole picture was overwhelming and taking one assignment at a time made it easier to manage*".

A few participants mentioned using this approach during physical training, stating that *"one strategy to hype myself up was breaking the workout down and celebrating a little to myself the smaller increments"*. Another used it to persevere through a challenging ruck as part of training for Ranger Challenge:

> *"Rucking is always very physically demanding and carrying that kind of weight after not doing a lot of weight training over the summer was very difficult. It was also difficult because of how early it was after a long week of school. I was able to keep a pretty consistent pace, even though my body was fatiguing because I was able to break it into manageable segments for myself.*

Energy and Emotion Management

During the intervention, we defined energy and emotion management as the ability to increase or decrease energy levels to facilitate more optimal performance in a given context. Breathing exercises and music were predominantly used to regulate energy levels in a variety of contexts, including physical training, ROTC training, and academics.

Breathing

Breathing was commonly used as a strategy to calm down or reduce stress. One participant mentioned that he used it for these reasons in a both physical training and academic contexts:

> *"For me, active breathing is very effective in that it gives me time to assess a situation before my body starts taking over. It gives me time and a clearer headspace to tackle whatever comes next. I'll use this strategy both during workouts and during schoolwork, because a clear head is always a good place to start. Specifically, when I feel stressed about school/ an assignment, or when I start to freak out during a swim because I'm running out of air, this strategy is majorly effective."*

In response to a reflection prompt inquiring about what skills and strategies participants found themselves using to stay calm during stressful moments, many participants noted that they employed breathing exercises:

> *I think that breathing is one of the most helpful ones for me. Very often, I find myself literally holding my breath for no reason which negatively affects me. It is important to breathe fully at all times. If I want to focus/reduce stress, I have found that box breathing is effective for me.*

Music

Music was also commonly used as an emotion management tool, and participants reported listening to music to increase energy levels, to maintain positive energy, as well as to calm down. Participants mentioned that "*my favorite way to hype myself up and calm myself down is by listening to different types of music" and* stated that it is an effective way to get into a

more optimal performance state: *"[music] helps me because it puts me in "my zone" and just drowns out everything else".*

Leveraging Emotion

Several participants also discussed leveraging their emotions as motivation instead of trying to regulate them. Anger and frustration were the primary emotions used for motivation, with one participant noting "*a method to increase energy levels for some work outs can be getting yourself to feel angry*", and another stated *"I turned the frustration into more energy and took out my anger on the other events. I think converting that angry energy into motivation was definitely the most useful mental skill I used to get through that".*

Another participant noted that his physical discomfort served as motivation for a PT session:

> *Leading up to the workout, specifically on the walk to PT I noticed these feelings of soreness and tiredness and turned them into positive motivation. I used it as fuel to know that nothing was going to stop me from achieving my personal goals. The soreness hit me once we started working on agility drills, and I used the pain to fuel my energy. I knew the harder I pushed, the less my mind would focus on the pain. This gave me the necessary motivation to finish the workout strong and have a successful rest of the day and successful practice that night.*

Strategies Outside of the MST

While part of the training intervention focused on providing education and structured practice of mental skills, there was also a strong emphasis on building self-awareness around which strategies the participants were already successfully using to get through difficulty. Several of the reflection prompts inquired generally about which skills and strategies they were using to navigate challenge.

Leaning into Community

Many participants stated that their ROTC peers and cadre played important roles in helping them navigate challenges in both physical training and academics. Participants wrote

that their peers helped keep them motivated. One participant noted that during a running workout "*the biggest thing that helped me reach this goal was having a group of people around me to keep me going and push me when things started to hurt*", and another stated that their squad leader (a fellow cadet) was influential in helping them persevere through a challenging workout: *"I didn't use a mantra or cue word, but rather what helped me get through the end of the workout and truly push myself instead of getting lazy, was one of my squad leaders walking alongside me, motivating me through the workout telling me to push myself. Which I found gave me the boost I needed to put in 100% of myself towards the end of the workout even though I felt tired".* During preparation for Ranger Challenge, one participant state that his plan was to "*use imagery and imagine [our cadre member] telling us Tuesday morning "just put one foot in front of the other" He told us this because he said it is going to get tough."*

Participants also noted that others played an influential role in their academic journeys, writing that "*over the last 2 weeks I've been doing research and talking to other people about school and my choice of major and more and more I'm starting to feel more comfortable with the thought of shifting my major over*". Another participant noted that his friends and cadre were among the main reasons that he chose to persist in the ROTC program, stating "*about a year ago during fall semester I wanted to drop out of college and enlist. I was set on it for a while until some friends and cadre talked me out of it and I'm glad I chose to tough it out*".

Acceptance and Mindset

Many participants noted that accepting the situation at hand was very helpful for navigating challenge. Several mentioned that some degree of self-talk was helpful for accepting what was happening, stating "*I also like to think about the saying "It is what it is," because I think if you say that about every situation, you don't spend time weeping wallowing, or dawdling, you just get going and that's crucial*". Another noted, *"once you think "I just have to do this, there's no other way" it makes working out way easier"*.

Other participants noted that they were able to come to a place of acceptance, without discussing what helped them get there. One participant noted, "*I was decently frustrated [with the situation], but I did not allow myself to get mad since there was nothing I could do about it"* and another stated "*I was able to just sit in the situation because I was able to acknowledge that there was nothing I could do to change it at that point*".

DISCUSSION

The purpose of this study was to explore how first- and second-year Army ROTC cadets use mental skills, with the intent of providing more information for future MST programs. A secondary purpose was to assess the feasibility of delivering MST in the ROTC classroom setting. By understanding how cadets use mental skills, the hope is that programs can be tailored to more specifically support them. The results suggest that cadets use a variety of psychological skills in their ROTC-related activities, academics, and physical training.

To our knowledge, there are no other research studies using rigorous qualitative methods that have investigated use of mental skills in military populations. While a direct comparison to the athlete literature is challenging since ROTC cadets do not have equivalent practice and competition settings, there are some similarities between the current findings and what has previously been found among athletes. In the present study, participants primarily used self-talk for regulation – to maintain composure, to motivate themselves, and to maintain perspective. Hardy et al. [15] report that athletes predominantly use self-talk for motivation, mental preparation, focus, relaxation, and control of nerves both in practice and competition settings. Generally, athletes reported using motivational self-talk much more frequently than cognitive or instructional self-talk [16].

Cadets in the present study used attention management techniques to facilitate performance by focusing inward, to reduce stress by staying present, and to cope with physical discomfort by distraction or dissociation. A study with runners suggests that athletes use a mix of associative and dissociative strategies during both practice and training for the same

purposes as the cadets in the present study, with experienced runners demonstrating a greater use of associative strategies during competition than they do in practice settings [17].

Cadets used imagery in the present study as motivation primarily in academic settings, with individuals imagining themselves doing well on a test or reaching their goal of graduating. A few participants reported using it in the context of physical training and ROTC-related activities, primarily for rehearsal and planning. These findings are consistent with previous work suggesting that imagery is used most frequently prior to competition rather than during competition and more frequently in competition settings than in practice [18, 19], and that athletes use imagery more for mastery purposes than any other purposes [19]. Imagery has been shown to be effective in increasing activation levels [20], and it is interesting that participants used the motivational functions more for academics than for physical training.

Cadets used emotion management skills more frequently to calm down as opposed to increasing energy levels. Intentional breathing was commonly reported as an energy management tool, with most participants stating that they used breathing exercises as a means to calm down. Music was commonly used as a tool to increase energy, maintain energy, and to calm down. The other specific techniques (grounding, releases, triggers) were not mentioned as frequently; however, because other skills such as self-talk were used to manage energy and emotions, it is possible that additional techniques weren't necessary.

In the present study, we found that goal setting was predominantly used for motivation in both physical training and academic settings. To motivate themselves to complete homework or study for tests, participants set goals for grades and reflected on larger goals, such as graduating and commissioning. During physical training, goal setting took the form of competition, with participants setting goals to beat their peers in a workout. Segmenting was used in academic settings to cope with stress and to get through academic challenges. A few individuals mentioned using this in physical training and ROTC settings, but it was more frequently mentioned in academics. Because goal setting is strongly linked with performance in

athletic settings [21]; it is surprising that goal setting was not reported more frequently by ROTC cadets.

While there are no qualitative studies examining mental skills use in military populations, there are some quantitative studies examining use of mental skills. Adler and colleagues [8] investigated a mental skills training program in basic trainees and found that, following the intervention, participants in the MST group demonstrated greater use of self-talk, relaxation skills, control of negative thinking, and automaticity than those in the control group. Interestingly, there were no significant training effects for goal setting, imagery, emotion control, and attention control, as measured by the Test of Performance Strategies questionnaire (TOPS2), which inquires about use of these skills in training and competition. Similarly, Fitzwater et al. [4] found that British soldiers reported greater use of goal setting, relaxation techniques, self-talk, and imagery/mental rehearsal as a result of a mental skills training intervention. However, use of imagery and relaxation was greater during the training events for the intervention group, but there was no difference in use of goal setting and self-talk during the training events as compared to the control group [4]. Other studies have reported use of goal setting for performance in military populations [22, 23], and future research is needed to understand goal setting as a performance strategy in this population.

The skills included in the MST program (self-talk, attention management, imagery, emotion management, and goal setting) were taught in class and participants were asked to practice them during physical training. In their reflection prompts, participants were also asked to discuss other skills and strategies that they used to navigate challenge in order to build self-awareness around strategies that they were already successfully using. Many participants noted the importance of their communities, especially their fellow cadets and their cadre. Army ROTC and the larger Army are team-oriented organizations and there is potential for very strong social bonds. Research in youth athletes, while slightly younger than the population of the present study, supports the consideration of the larger social context in which youth athletes develop

and emphasis on sport psychology tools as applicable beyond sporting contexts [24]. Interpersonal skills are a component of mental readiness in the Army; while not included in this program, future programs should consider the addition of these skills.

Many participants also mentioned that what helped them the most was being able to accept a challenging situation for what it was. A few participants mentioned that their internal dialogue was helpful for coming to this acceptance, while others did not discuss what helped them get to that place. It is possible that they simply chose not to share that information, but it is also possible that they aren't aware of the skills and strategies that helped them come to a place of acceptance. Because mindset and acceptance were reported by many participants as an important component of how they navigated difficulty, future MST interventions should consider incorporating a discussion about performance-facilitating mindsets and methods to enhance that type of mindset.

During the training intervention, these skills were predominantly taught in the context of application to physical training, and the reflection prompts primarily inquired about the practice of these skills in physical training. However, participants were always offered the opportunity to reflect on another event of their choosing. While many chose to practice and reflect on mental skills use in physical training sessions, participants also successfully applied these skills broadly across their various roles as students and ROTC cadets. This provides some support for the notion of integrating these skills into current operations, such as physical training and other ROTC activities. In a review of military mental skills programs, Rodden-Aubut and Tracey [5] suggest that while some programs were identified as potentially time-consuming, programs were generally low risk and low cost, and provided benefits to those who participated, even for those who did not receive the full intervention [25]. As ROTC programs face time and resource constraints, weaving MST into the classroom curriculum may be a time- and budget-effective solution. While physical training appears to be an effective avenue to teach and reinforce mental skills, other curriculum components could be leveraged as well. For example, participants

reported using imagery for rehearsal and planning during ROTC-related activities such as their field training and lab activities. These events may be an effective opportunity to teach and practice imagery, and imagery could be suggested as another tool for practicing and learning tactics outside of formal training opportunities.

Limitations

As this study was focused on first and second-year cadets, these results may not be representative of, or generalizable to, all ROTC cadets. As newer cadets, the participants in the present study are not yet in positions of leadership within the program, and it is unclear if and how they use mental skills to make leadership decisions. While mental skills use is strongly linked to performance in the athletic realm, it is still unclear how use of these skills relates to physical, academic, and leadership performance for ROTC cadets across the 4-year program, and longitudinal work is needed to understand these relationships.

CONCLUSION

The present results show that delivery of an MST program to ROTC cadets is feasible and, at least qualitatively, impacts their approach and strategies in the physical and academic realms. To tailor MST interventions, practitioners should consider the wide variety of contexts in which ROTC cadets use mental skills and discuss broad application of mental skills. Further, practitioners should consider integrating interpersonal skills and leveraging the communal nature of ROTC programs. Additionally, these results lend support for the translation of sport skills into other aspects of life and the use of physical training as a platform to teach and reinforce mental skills.

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CHAPTER 6 – LEVERAGING ACADEMIC PARTNERSHIPS FOR CHANGING THE CULTURE OF FITNESS IN ARMY ROTC: RECOMMENDATIONS AND LESSONS LEARNED

INTRODUCTION

With the implementation of the Holistic Health and Fitness system (H2F), the Army is moving toward a more integrated health and performance approach, seeking to improve warfighter readiness across 5 key domains – sleep, nutrition, spiritual, mental, and physical. However, it is not yet clear how this system will be implemented outside traditional Army units, such as the Reserve Officer Training Corps (ROTC). ROTC programs are often constrained by limited resources, including time, personnel, equipment, and/or space, making it difficult to implement a program designed for full-time soldiers. Additionally, ROTC cadets are a unique population, balancing both military and academic demands, and programs designed for the traditional soldier may not be as effective for this population. As each of the ROTC programs nationally likely faces a different set of constraints, there is unlikely to be a singular effective solution for implementing readiness programming across the entirety of ROTC. To ensure comprehensive readiness, leaders must introduce targeted programs addressing the specific challenges and needs of their population [1]

One possible mechanism for implementing H2F in ROTC programs is through collaboration with university partners. By developing cross-campus collaborations, ROTC programs can access necessary resources, especially fitness programing, supervision, and support, to bolster readiness and prepare cadets for success as future Officers. The collaboration between Colorado State University's Army ROTC program and the Department of Health and Exercise Science (HES) has been productive and mutually beneficial. The aim of the present discussion is to provide an overview of our partnership, as well as the challenges we have faced and the lessons that we have learned along the way.

THE COLLABORATION: RECOMMENDATIONS AND LESSONS LEARNED

The Research

The partnership between HES and Army ROTC began as a small pilot project examining training approaches to effectively prepare cadets for the Army Combat Fitness Test (ACFT). To date the partnership has resulted in two larger studies, a master's thesis project investigating the impact of sleep extension on performance, and an undergraduate honors thesis project examining trends in cortisol measures and perceived stress over the course of a semester. We will briefly summarize the larger projects here.

Our physical training study [2]) evaluated two training programs to improve performance on the ACFT. The first was an adaptation of programs from Army Training Publication 7-22: Holistic Health and Fitness (ATP 7-22) and the other was designed by HES staff. HES staff, including a Certified Strength and Conditioning Coach and undergraduate practicum students, supervised all physical training sessions alongside Army ROTC cadre. While we saw no significant differences between groups, we found a statistically significant improvement in ACFT scores in our collective study cohort. We faced several challenges over the course of the study period, including a global pandemic and severe weather that impacted and cancelled training sessions. Despite this, we showed that it is feasible to provide effective, multidimensional physical training with limited time and equipment, even in the face of unforeseen challenges.

In our mental skills training study (Newman et al., in prep), we delivered an 8-week mental skills training (MST) program to first- and second-year Army ROTC cadets. Our qualitative findings suggest that the intervention was impactful and that the participants were able to learn and apply the skills taught during the intervention in physical training and academic settings, as well as during their ROTC training. While we did not find any statistically significant performance outcomes, the results of this study demonstrate a positive impact of MST in this population and provide support for the integration of increased MST into the ROTC curriculum.

Collectively, these studies show the impact of both physical and mental readiness training interventions in ROTC cadets. Perhaps more importantly, these studies demonstrate the feasibility of conducting such programs in real time, even with limited time and resources, as well as the capacity for a partnership between ROTC and other university academic departments. We believe that this collaboration is not an isolated success but a blueprint that other universities can follow to foster similar relationships. In our specific approach, graduate students from the HES department serve as human performance subject matter experts, overseeing physical readiness programming, educating cadets and cadre, providing guidance related to performance optimization, and overseeing HES undergraduate assistant coaches. This approach replicates the 'expert-informed, soldier-led' H2F approach and serves to improve readiness throughout a cadet's time in the ROTC program, familiarizes them with the elements of H2F, introduces them to the benefit of H2F, and prepares them for working with civilian experts once they enter the Army.

RECOMMENDATIONS AND LESSONS LEARNED

While successful, this partnership has encountered some challenges, which we discuss below, as well as the components that have been crucial to success, the lessons we have learned along the way, and recommendations for other programs.

INSTITUTIONAL LEVEL OPPORTUNITIES

Key Components

Identification of Interdisciplinary Opportunities and Mutual Benefit

The success of this collaboration has been rooted in a shared commitment to a common goal – improving the performance and readiness of ROTC cadets. While this common objective served as the catalyst for collaboration, the partnership has been sustained by mutual benefit. In our case, researchers provide expertise and oversight of physical training, and the HES department provides undergraduate practicum students who assist in the supervision and execution of training sessions. The integration of HES personnel has led to significant

improvements in physical training programming. Currently, a Certified Strength and Conditioning Specialist develops training sessions that are purposeful, tailored to the cadets' needs, and scalable for a range of fitness levels. This approach has translated to consistent high performance on physical training measures, such as the ACFT, reduced training-related injuries and increased cadet and cadre knowledge of human performance optimization. For example, at Cadet Summer Training (CST), CSU Army ROTC cadets have recorded ACFT scores in the top 20% of programs nationally for the two years that the ACFT has been the Army's official fitness assessment, averaging 536 points in 2023 and 522 points in 2022. CST is the nationally centralized leadership evaluation process critical to career placement with the Army and takes place over 35 days at Fort Knox, KY. This leadership and training process is physically and mentally demanding, and since the beginning of this partnership, none of CSU's cadets suffered a serious injury at CST. This could be due, in part, to the physical durability developed in this programming.

In return, Army ROTC participates in research, including the physical and mental training studies mentioned above that formed the basis of a doctoral dissertation. The ROTC program helps facilitate data collection, contributes to the funding of graduate assistants, and serves as an internship site for HES undergraduate students, who are able to gain real-world coaching experience as part of their degree program. Further, these students gain exposure to military culture and are introduced to a potential career path in tactical strength and conditioning.

Securing of Institutional Support:

This sustained relationship would not have been possible without support from the department heads of both programs (HES and Army ROTC), as well as upper administration, specifically the offices of the Provost and the Vice President for Research. Buy-in from administration officials enabled us to acquire resources and funding to facilitate the collaboration. From a department perspective (HES and Army ROTC), the interdepartmental

collaboration highlighted co-learning at its best – ROTC and HES students learning together. At the university level, the partnership demonstrated the ability of completely different academic units to work together for shared outcomes. As a land-grant institution, collaboration, access to education, and benefit to society are key outcomes of every project. This partnership highlighted all three.

Advocacy

We have key people as strong advocates for our partnership, at multiple levels of the institution. These individuals have helped bring in funding for research and secured equipment, among many other things. At the heart of our partnership is a desire for change – change of Army fitness culture and the body of science surrounding this niche problem. Many change models [3] articulate the need for shared vision and a coalition of advocates to sustain the drive for change. On our campus, advocacy was built and sustained from Department through College, to the University Provost office. With university academic decision makers in support and advocating for this program we were able to build and then expected to maintain this relationship. The ROTC programs on our campus provided semester updates to an academic advisory board. Demonstrating research project and partnership outcomes at this venue further solidified academic support for the partnership. Further, official Army approval for our physical training study drove interest and energy from Brigade and Cadet Command levels, resulting in a donation of equipment to our program.

Buy-In from Faculty and Staff

We had support not only from the HES and Military Science department heads, but also from the staff and students directly involved in the research projects and daily operations, including Army ROTC cadre and HES staff. The presence of multiple individuals on both sides of the partnership who are invested in the success of the program has been crucial and helped to alleviate the inevitable friction that came working “across” campus. As the partnership has produced consistent positive results, gaining support has been easier. Allowing all members of

the team to voice concerns and provide input, as well as tending to points of friction in a timely manner have been crucial for continued investment for both parties. While incoming personnel have not always immediately seen the value in the collaboration, leadership has iterated that this partnership is a priority and as needed, set clear boundaries around continuation of the partnership, including delineation of roles, responsibilities, and scope of practice for incoming personnel.

Challenges

Overcoming Institutional Resistance:

Resistance from within the institution can be a significant hurdle. Traditional structures and hierarchies tend to resist interdisciplinary initiatives and collaborations because it is another time and financial investment that competes with other priorities for limited resources. Further, individual faculty and staff members may have varying levels of enthusiasm for interdisciplinary collaboration. Convincing everyone of the value of the partnership and ensuring widespread buy-in will take time and effort. Convincing stakeholders of the value of collaboration and overcoming institutional inertia may present challenges, but carries with it the reward that the partnership, when proven successful, benefits both sides. Our program has invited advocates to observe and participate in ROTC activities, offering them the chance to better understand the challenges faced by ROTC cadets. These experiences and opportunities to connect with the cadets could encourage potential collaborators' willingness to offer support.

Resource Allocation and Funding:

Collaborative projects require resources, and securing funding for interdisciplinary initiatives can be a complex process. Balancing budgetary constraints and ensuring equitable distribution of resources between departments requires negotiations and good will to alleviate potential tensions. Initially, the HES staff member assigned to Army ROTC was paid through the training study's funding. As the partnership has continued, HES covered the cost of staff hours for Army ROTC since it serves as a practicum site and as a research partner. However, the

sustained success of this partnership has been largely due to financial contributions from Army ROTC back to HES to compensate personnel, reducing the monetary cost to HES.

Measuring Success:

Determining the success of interdisciplinary collaboration can be subjective and multifaceted. Establishing clear metrics and agreed-upon indicators of success may be challenging, leading to differing expectations and potential disappointment. Collection of both short- and long-term data related to outcome metrics is crucial to demonstrate success to stakeholders, university partners, and prospective funders. Currently, our primary metrics of success in this collaboration are physical performance as measured by the ACFT, training-related medical profiles, and the cadets' performance at CST. While these outcomes are important, we recommend that other programs develop methods for assessing broader outcomes – for example, knowledge related to exercise programming, injury risk reduction, and other aspects of human performance. As our program expands, demonstrating the potential for external funding, research publications, conference presentations, and number of students gaining real-world experience will be crucial as well. Having objective and diverse data to share with stakeholders and advocates to demonstrate return on investment is imperative for continued success.

Program Evaluation and Modification

The iterative process of evaluation and modification is key to maintain effectiveness, especially as the needs of the population, the needs of the program(s), and/or the contextual demands change. However, this can be very challenging in resource-strapped environments, as this process takes time and resources, as well as agreement on evaluation metrics and processes for modification. As discussed above, our partnership predominantly relies on the cadets' performance at CST and their ACFT scores as our outcome measures, since these have a direct and significant impact on their career opportunities. However, these measures of

performance have not been consistent, with cadet ratings at CST using a forced distribution method in 2022 but not in other years, making it difficult to accurately evaluate trends in performance based on these measures alone. Our partnership employs a seasonal approach to training and evaluation, prioritizing preparation for CST in the Spring and emphasizing more general fitness in the Fall semester. In the Spring, our primary evaluation metrics are cadets' performance on shorter ruck marches, ACFT performance at the end of the semester, especially measures of aerobic capacity and muscular endurance, as well as qualitative feedback on leadership performance during ROTC activities. Because these measures are heavily driven by Army requirements, the ROTC cadre primarily drive modification to the program during the Spring semester, including reallocation of time, personnel, and resources, as well as requesting adjustments to training based on their observations. In the Fall, our primary outcome measures are the ACFT at the end of the semester, primarily the strength and power components, and coaches' qualitative observation of cadets' exercise form. Because our emphasis is general fitness, the modifications to the program are largely driven by HES staff. Importantly, HES staff still defer to ROTC leadership for the final say regarding logistics, cancellations or modifications of training sessions, and overall program operations.

Recommendations:

- Universities should actively seek interdisciplinary opportunities by identifying common goals or challenges that can be addressed collaboratively. This requires a mindset shift toward breaking down silos and promoting cross-departmental initiatives. Our recommendation is that ROTC programs seek partnerships with academic units because there is a higher potential for mutual benefit (e.g., opportunities for students to get hands-on experience and research studies).
- Opportunities may exist for external funding of this partnership. Early in our relationship, the Office of Defense Engagement in the Vice President of Research Office, provided funding for initial equipment issue. Some Army funding may be available based on the

novelty of the research endeavor – Initial Military Training Command provided ACFT lanes before ROTC programs were issued standard equipment. On our campus, this relationship found allies in multiple locations.

- Engage stakeholders and program advocates.
- Identification of outcome metrics.
- Development of an evaluation system and a plan for program modification

COLLABORATION, COMMUNICATION, AND CULTURE

Key Components

Communication

Effective communication is crucial for any successful collaboration. To ensure consistent communication and make sure all parties are on the same page, the Army ROTC program created an "HES Liaison" role, and this person serves as the point of contact for HES staff. Another option to ensure shared understanding would be to have the HES coaches attend ROTC operational synchronization meetings. However, we found this too onerous on the already busy schedule of a graduate student. The Liaison was able to provide the deliberate link to the HES staff and provide congruent communication to the cadre and staff of Army ROTC. Further, leveraging collaborative/cloud-based platforms allows for information to be easily shared with the entire team and provides a singular source of information, ideally minimizing miscommunication from having multiple versions of documents.

Team-Based Approach

Our success has depended heavily on the integration of expertise and navigating a co-leadership model, in which HES staff and graduate students co-lead physical training with ROTC cadre. At the level of the cadets, physical training is co-led by HES undergraduates and ROTC cadets. This approach has required each side to provide education to the other, understand each party's scope of authority and expertise, and keep the common goal — physical development of the cadets – as the focus of all efforts. Effective co-leadership has

required humility, patience, flexibility, and a mutual agreement on goals and priorities. It has also required clear delineation of responsibilities and deliberate accountability for all parties involved, including HES staff, cadre, cadets, and HES undergraduate students. For example, in our model, issues with the physical training programming and execution are the responsibility of the HES staff, while issues related to logistics or discipline are the responsibility of the ROTC cadre. Both parties provide input to each other about these issues but defer to the responsible party's expertise for the final decision.

Flexibility and Adaptability

Building flexibility and contingency planning into the programming provides us with the ability to navigate weather, facility, schedule, and resource issues. Having a clear understanding of our goals and being flexible with the methods employed to achieve those goals has been crucial. Finding creative solutions to problems, leveraging expertise across the team, and ongoing discussion of departmental needs allows the program to grow and evolve to maintain effectiveness. For our physical training program, we create contingency plans for weather in advance, establish guidelines for modifications of workouts, and ensure advance communication to the extent possible about any necessary changes. Additionally, aligning the physical training program with the long-range training calendar has been crucial for effective training, sufficient recovery following major ROTC events such as field training, and anticipation of disruption to regularly scheduled training.

Challenges

Communication Barriers:

Differences in language, terminology, and communication styles between the ROTC program and an academic department can lead to misunderstandings or misinterpretations. Use of academic or military jargon can further impair communication efforts. Ineffective communication and the lack of a consistent point of contact for both parties can cause frustration and ineffective program delivery. Army operations can change frequently and often

immediately prior to execution of an event and must be conscious of the impacts of last-minute changes. Academic culture can seem rigid and inflexible but must understand the dynamic environment of leader development stuck between higher education and federal bureaucracies. In our training study, last-minute changes to training sessions were a point of friction between HES staff and Army ROTC, and inconsistent communication has been a challenge for the partnership. Establishing the HES Liaison role as a dedicated point of contact for HES has ensured consistent and clear communication. The liaison is also able to provide education to HES about the ROTC environment and the rationale for any changes.

Balancing Academic and Military Objectives:

Striking a balance between academic objectives and military training goals is a delicate task. Ensuring that both the ROTC program's mission and the research pursuits of an academic department are addressed equally can be challenging, requiring ongoing negotiation and compromise. Briefing the research plan and goals to ROTC cadre should be seen as a priority to help all players to understand the gravity of even small-scale changes to scientific research. Aligning the goals of the research with the goals and constraints of the ROTC program can facilitate study implementation efforts and cooperation from ROTC cadre. As the civil – military divide continues to widen with fewer Americans knowledgeable of the military culture [4], ROTC programs must deliberately onboard academic partners to understand the culture and training requirements of commissioning programs. Increasing researchers' knowledge of daily operations can facilitate development of minimally disruptive study protocols. For example, in our MST intervention, we utilized performance measures that were already part of regular physical training or could be completed during regular physical training sessions to minimize time burden on participants and cadre.

Integration of Leadership

As noted above, our program involves co-leadership, which has taken time, patience, and humility to do well. Misunderstanding roles and responsibilities can create conflict and

unproductive power struggles. The introduction of civilian experts can create confusion for cadets if they do not understand where this person fits in the organizational structure or chain of command. Further, failure to introduce academic partners to the usage of the chain of command structure may lead to miscommunication and unnecessary confusion. In the Army culture specifically, titles carry meaning and often authority. Deliberately calling the HES staff "coach" and introducing them each semester as "cadre" of the ROTC program helped to establish power base for our academic partners. While our relationship is now mature enough that HES staff know the structure of military rank, a deliberate process will be required with new additions from the academic community.

An additional challenge is the frequent personnel changes on both academic and ROTC sides. Graduate students may only be involved in the program for 2-4 years and ROTC cadre are typically only assigned to the program for 3 years. New personalities may not mesh as well into the existing relationships and may require re-negotiation of roles and responsibilities across the collective team. Additionally, incoming leadership on both sides may be less enthusiastic about the collaboration and/or see it as a lower priority than other initiatives and programs.

Program Execution and Supervision:

Supervising and planning physical education and preparation in the Army is delegated to the non-commissioned officers in most cases, and ROTC programs likely operate in a similar manner. These professional soldiers are tasked with small team and individual development but often lack the technical skills necessary to effectively program and supervise complex physical training methods – especially with the recent changes around H2F. Without deliberate delegation of responsibilities, we found friction between the strength and conditioning teams from HES and the Army Cadre at times. Implementing boundaries and clear delineation of responsibilities has been crucial for our continued success. In our program, Army ROTC Cadre are responsible for the proper resourcing of a workout and the discipline of cadets. HES strength and conditioning coaches are responsible for the proper execution of individual movements with focus on safety.

Cultural Barriers

Academic departments often have distinct cultures, methodologies, and priorities. Interdisciplinary collaboration requires both sides to be open to new ideas and to shed "the way we've always done it" should a better approach present itself. An area of challenge for our partnership was specific to the culture and messaging around physical training in the Army, as well as reliance on outdated physical training paradigms. This challenge is not unique to our program, but a challenge faced by H2F programs nationally. However, our program may help to solve the largest of the H2F program problems – cultural change around fitness for the Army. Integration of scientific process and research informed training methodologies with aspiring officers can help to cleanse the Army of decades of poor fitness practices. HES staff has provided both informal and formal education to ROTC cadets and cadre through weekly physical training meetings, 'coach's notes' sent out along with every workout, discussions during training sessions, and guest lectures about physical performance optimization in the military science classes.

Recommendations:

- Cross-departmental education, including on-boarding for academic partners, educating cadre on fundamentals of research and whatever readiness programming you are implementing.
- Sensitivity to use of academic jargon and 'MILSPEAK'; developing a list of common terms and/or an acronym dictionary.
- Establishment of clear communication channels and identifying individual on both sides who own communication with the other; leveraging technology that facilitates collaboration.
- Delineate roles and responsibilities ("left and right limits") for leadership positions; identify where academic partners (e.g., the PT subject matter expert) fall in the chain of command.

- A “make new mistakes” approach. We recognize that as this partnership continues to grow, we will not always get it right. A shared commitment to “making new mistakes” means that we learn from our errors and make a concerted effort to not repeat them in the future.
- Encourage a culture of flexibility and innovation. Recognize that the needs of academic departments may evolve, and a successful collaboration requires adaptability to these changes.

RESEARCH

Key Components

Consideration of Context

As our partnership has developed, the interventions have been better matched to the environment, as we very quickly learned that rigid research designs are not feasible. This approach has demanded creativity and adaptability in assessments, intervention delivery, as well as timing of interventions. The implementation of more flexible designs and efforts to integrate the research into daily operations has improved compliance with study protocols and has been better supported by ROTC Cadre. For example, in our physical training study, the exercise intervention did not account for the last-minute changes that can be inherent to Army operations. While adherence is crucial for understanding the efficacy of an intervention, the inflexible approach was a point of conflict in our partnership. Evaluation of training outcomes for this project was an onerous task, as we collected VO2 max data and DEXA scans on all participants. While this was a more accurate way to collect these data than a field assessment, the fact that we were conducting this research intervention in real time during physical training necessitated a cohort start. We enrolled 44 participants in this study, meaning that HES staff conducted 44 VO2max tests and DEXA scans (~50 hours of testing) in a short period of time both before and after the training intervention, which was burdensome on a very small research team.

Conversely, in our MST intervention, we used a mixed-methods approach to provide more flexibility in program evaluation and used outcome metrics that would be minimally burdensome on HES staff and ROTC cadets and cadre. For example, we used the ACFT as our measure of physical performance, which is completed twice per semester as part of the cadets' regular physical training. Our psychometric and physical assessment was designed so that it could be completed as an alternate activity during a military science lab and/or as an alternate PT session during the ACFT. Further, while we hoped that all participants would complete all assessments, we anticipated that we would only be able to collect complete data on a subset of participants and accepted that as a limitation of this project. While not all participants completed the pre- and post-intervention assessments, the mixed-methods approach allowed us to collect usable data from all participants and did not have to disenroll anyone from the study.

Cadre Engagement

Engaging ROTC cadre in the research process is crucial. Providing education on the purpose and value of the research, the assessment processes, and identifying the 'no-fail' elements of the project enables buy-in and support throughout the research process. The ROTC cadre are the experts on the contextual demands of the ROTC environment, the training objectives, and the demands of military service; leveraging their expertise in the design of the intervention will improve the research process. Allowing them to provide input on the timing and delivery of the research intervention can further increase buy-in and support. In our MST study, for example, our research team worked in collaboration with ROTC cadre to design and execute the training and assessments, which increased buy-in from the ROTC program and facilitated higher quality intervention delivery and data collection.

Challenges

Time and Resources

ROTC programs may have many demands on their time and resources, including involvement with athletic events, field training, extracurricular programs, and special events.

Additional time and resource commitment to research may be difficult or even impossible, and the ideal time for a research intervention may not be a feasible time to implement the intervention. Research efforts may further be constrained by the academic calendar and interventions may need to be shorter than what may be considered ideal. For example, in our training study, we were limited to 27 sessions over the course of 10 weeks due to an abbreviated in-person semester on account of COVID-19 precautions in Spring 2021. However, even in a more routine spring semester, we have ~30 sessions over the course of 12 weeks in consideration of Army ROTC's training and testing schedule.

Collaborative Science

Engagement of stakeholders within the ROTC program may be challenging, especially if those individuals are unfamiliar with the process of doing human research or do not believe that integrating research into the program is necessary. Program staff who do not support the research may not be compliant with study protocols, which may lead to incomplete data, low participant compliance, and/or difficulties recruiting participants. In the pilot phase of the training study, we struggled with collecting our weekly training data largely because we assigned this to ROTC cadre, who were not adequately briefed on the importance of recording training metrics. When we conducted the actual intervention, we provided more information to the cadre about the needed measurements and their importance, and assigned data collection to undergraduate research assistants. This enhanced the quality of data collected and reduced additional burden on ROTC cadre.

Limited Internal Validity

The studies that we have completed in collaboration with the ROTC program have been conducted in real time with the program, which is a strength in terms of sustainability, feasibility, and external validity. However, the highly realistic approach is a significant limitation in terms of internal validity, as there were many factors that we simply could not control for in our study design. For example, in our training study, we asked participants to participate in no more than

90 minutes of moderate-intensity activity outside of the training intervention/group physical fitness sessions. We attempted to record this using self-report data but had no practical method to ensure participants were limiting their additional training. Similarly, we asked participants to make no other significant changes to their dietary intake, including supplements, or other habits that could impact performance, but we could not feasibly enforce this.

Sharing of Knowledge

While there are anecdotal reports of other ROTC programs collaborating across their respective campuses, there is little published research. This lack of collective knowledge means that programs may be unnecessarily starting from scratch, making avoidable errors, and knowledge of best practices does not get shared across programs. This, in turn, slows down the process of understanding how best to prepare cadets for their military service in every domain of readiness. Reporting of research results and showcasing partnerships through academic publications, white papers, and conference presentations can help ROTC programs connect with others who are implementing similar programs.

Recommendations

- We recommend that researchers seeking to work with ROTC program adopt an implementation research (IR) approach, or at least be informed by IR. The goal of IR is to understand and work within real world conditions [5], not necessarily acquiring new knowledge but rather determining how to transfer knowledge into the real world [6]. Further, IR places an emphasis on research-practice partnerships, or “team science”, which leverage expertise from multiple backgrounds to solve complex problems [7].
- While randomized controlled trials are valuable, they are unlikely to be the best fit for an ROTC program. Flexible research approaches, including mixed methods or qualitative research, can help determine feasibility and effectiveness of interventions in these settings.

- Successful research necessitates the design of an intervention that fits within the environment. This may require a high degree of flexibility, creative problem-solving approaches, the development of contingency plans, and a very clear understanding of which outcomes are essential and which ones are less importance.
- Facilitation of communication with other universities and sharing of best practices and lessons learned on both the ROTC and academic sides.
- Universities should actively showcase successful interdisciplinary collaborations as case studies. These success stories can inspire other departments and universities to explore similar partnerships.

FUTURE WORK

To date, our work has investigated the integration of physical and mental readiness program into ROTC, and future work is needed to refine delivery of these programs, evaluate the integration of other readiness programs, and assess long-term outcomes of these interventions. Additionally, more research is needed to understand if partnering with academia is an effective model for Army Reserve and National Guard units, who face similar time and resource challenges as ROTC programs. The first Morrill Act mandated that land-grant institutions, such as CSU, include practical education in military tactics in order to prepare students for potential military service and contribute to national defense efforts. Although the focus on military tactics at these universities has shifted over time, extending our collaboration beyond academic boundaries is well-aligned with the land-grant mission of CSU's heritage and our ongoing commitment to extend research-based knowledge and resources to the broader community.

CONCLUSION

The implementation of the H2F system within ROTC programs will be a challenge for universities across the country. Partnerships between ROTC programs and academic units may be an effective way to navigate many of the difficulties faced in delivering comprehensive

readiness programming to this population. These partnerships are not without difficulty, and successful collaboration requires flexibility, persistence, effective communication, and a shared commitment to the overarching goals of the partnership. By sharing our success and the lessons we have learned along the way, we hope that we have provided a framework for other programs to replicate our success and positively impact the lives of our future military leaders.

***Table 6**. Recommendations for ROTC-Academic Partnerships*

Institutional Support	• Identify mutual benefit opportunities. • Identify advocates. • Share stories. • Be creative in the funding search. • Align with university mission to effect real-world change that benefits society. • Clearly identify outcome metrics.
Communication, Culture, and Collaboration	• Create effective communication channels. • Leverage technology for collaboration. • Clear delineation of roles and responsibilities • Cross-departmental education and on-boarding.
Research	• Use IR-informed research approaches. • Engage ROTC cadre in the research design and implementation process. • Use a variety of data collection tools, including mixed methods and qualitative approaches. • Establish collaborations with other universities. • Seek to share success stories outside of formal academic publications.

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APPENDIX A – ARMY COMBAT FITNESS TEST PROTOCOL

You will complete the warm-up and ACFT in accordance with US Army Field Manual 7-22 and the ACFT Field Testing Manual. The total time of the test is approximately less than 1 hour, not including the prescribed warmup (~20 minutes).

The ACFT is a six-event physical fitness test; the test events are administered in the following order: 3 Repetition Maximum Deadlift (MDL), Standing Power Throw (SPT), Hand-Release Push-up (HRP), Sprint- Drag-Carry (SDC), Leg Tuck (LTK), and 2 Mile Run (2MR). If you fail to complete the LTK, you may attempt a 2-minute plank to earn a passing score on that event. There are no exceptions to the ACFT testing sequence and currently no alternative tests or test events. All six events must be completed in order to qualify as a valid test.

Prior to the start of the first test event, you will warm-up using the FM 7-22 Preparation Drill (approximately 10 minutes) and 3 Repetition Maximum Deadlift warm-up (approximately 10 minutes). Following the 10-minute Preparation Drill and 10-minute 3 Repetition Maximum Deadlift warm-up, you will begin the MDL test event.

Event 1: MDL

You will execute 3 continuous repetitions at the same weight. If you fail to complete 3 continuous repetitions under control, you are permitted one retest at a lower weight after a rest of up to 2 minutes. If you successfully complete the first attempt, you may take an additional attempt after a rest of up to 2 minutes. The maximum number of attempts is 2 and you will be given 5 minutes to complete this event. Upon completion of this event, you will be given 2 minutes of rest.

Event 2: Standing Power Throw

You will throw a 10 lb. medicine ball backwards as far as possible. You will be given a practice throw to warm up and familiarize yourself with the exercise. After the practice throw,

you will be given 2 attempts to throw the ball as far as you can. You will have 3 minutes to complete this event and you will be given 3 minutes of rest upon completion.

Event 3: Hand Release Pushup

You will have 2 minutes to complete as many continuous repetitions as possible. In this version of the pushup, once your chest, hips, and thighs touch the ground, you will extend your hands out from your body until your arms are fully extended. You will then return your hands to their starting position and push yourself back up. Upon completion of this event, you will be given 3 minutes of rest.

Event 4: Sprint-Drag-Carry

You will be asked to complete a 250-meter shuttle event that involves running, dragging a sled, moving sideways, and carrying weights. You will start this event laying down on your stomach with the top of your head behind the start line. When you are instructed to go, you will sprint 25 meters to the turn line, touch it with your hand and foot, and sprint back to the start. You will then grab a 90 lb sled and pull it to turn line and back to the start. After the sled crosses the start line, you will shuffle sideways to the turn line and back. You will then grab the handles of two 40 lb weighted implements and carry them to the start line and back. Once you have placed the implements on the ground behind the start line, you will again sprint to the turn line and back. You will have 4 minutes to complete this event and upon its completion, you will be given 4 minutes of rest.

Event 5: Leg Tuck

You will complete as many continuous repetitions as possible in 2 minutes. To start this exercise, you will hang from a pullup bar with your arms straight and feet off the ground. Then, you will flex at the elbows, knees, hips and waist to lift your knees up. To successfully complete a repetition, your knees must touch your elbows. You will then return to the start position. If you drop from the bar before time expires, the event is over. After this event, you will be given 5 minutes of rest.

Event 6: 2-mile run

You will complete a 2-mile run as quickly as you can on a clearly marked course. In case of inclement weather, this test may be held indoors at the discretion of study staff.

APPENDIX B – CHAPTER 2 SUPPLEMENTAL FIGURES

***Table 7**. Pre-intervention correlations (Pearson's r) between Body Mass, Lean Mass, ACFT Events, Total ACFT Score, Benchmark Time, and 1600m Ruck Time. MDL = 3 rep max deadlift, SPT = standing power throw, HRP = hand release pushups, SDC = sprint-drag-carry, LTK = leg tuck, 2MR = 2 mile run, Benchmark Time = time to complete 8-event obstacle course. ** denotes p<0.01, * denotes p<0.05*

	Body Mass	**Lean Mass**	**MDL**	**SPT**	**HRP**	**SDC**	**LTK**	**2MR**	**ACFT Total**	**Benchmark Time**
Body Mass	1									
Lean Mass	0.58**	1								
MDL	0.30	0.75**	1							
SPT	0.31	0.76**	0.74**	1						
HRP	-0.01	0.26	0.52**	0.33	1					
SDC	-0.22	-0.66**	-0.72**	-0.79**	-0.47**	1				
LTK	-0.07	0.30	0.56**	0.41*	0.7**	-0.62**	1			
2MR	0.2	-0.27	-0.52**	-0.38*	-0.46**	0.64**	-0.56**	1		
ACFT Total	0.02	0.54**	0.79**	0.69**	0.67**	-0.84**	0.78	-0.84**	1	
Benchmark Time	-0.25	-0.44**	-0.65**	-0.48**	-0.31	0.64**	-0.67**	0.44**	-0.83**	1
1600m Ruck Time	0.11	-0.31	-0.64**	-0.39*	-0.47**	0.68**	-0.64**	0.87	-0.55**	0.65**

***Table 8**. Pre- and post-intervention correlations (Pearson's r) between Body Mass, Lean Mass, ACFT Events, Total ACFT Score, Benchmark Time, and 1600m Ruck Time. MDL = 3 rep max deadlift, SPT = standing power throw, HRP = hand release pushups, SDC = sprint-drag-carry, LTK = leg tuck, 2MR = 2-mile run, Benchmark Time = time to complete 8-event obstacle course. ** denotes p<0.01, * denotes p<0.05*

	Body Mass	**Lean Mass**	**MDL**	**SPT**	**HRP**	**SDC**	**LTK**	**2MR**	**ACFT Total**	**Benchmark Time**
Pre Body Mass	1									
Post Body Mass	1									
Post Body Mass	1									
Pre Lean Mass	0.58**	1								
Post Lean Mass	0.86**	1								
Pre MDL	0.30	0.75**	1							
Post MDL	0.46**	0.75**	1							
Pre SPT	0.31	0.76**	0.74**	1						
Post SPT	0.57**	0.76**	0.70**	1						
Pre HRP	-0.002	0.26	0.52**	0.33	1					
Post HRP	-0.02	0.36**	0.64**	0.38*	1					
Pre SDC	-0.22	-0.66**	-0.72**	-0.80**	-0.47**	1				
Post SDC	-0.38*	-0.68**	-0.76**	-0.80**	-0.56**	1				
Pre LTK	-0.07	0.30	0.56**	0.41*	0.70**	-0.62**	1			
Post LTK	0.12	0.47**	0.69**	0.49**	0.77**	-0.65**	1			
Pre 2MR	0.2	-0.27	-0.52**	-0.38*	-0.46**	0.64**	-0.56**	1		

Post 2MR	-0.45**	-0.33	-0.11	-0.29	-0.05	0.31	-0.22	1		
Pre ACFT Total	0.02	0.54**	0.79**	0.69**	0.67**	-0.84**	0.78	-0.84**	1	
Post ACFT Total	0.10	0.53**	0.80**	0.66**	0.72**	-0.86**	0.82**	-0.11	1	
Pre Benchmark Time	-0.25	-0.44**	-0.65**	-0.48**	-0.31	0.64**	-0.67**	0.44**	-0.83**	1
Post Benchmark Time	-0.69**	-0.81**	-0.84**	-0.82**	-0.54**	0.78**	-0.61**	0.37*	-0.78**	1
Pre Ruck Time	0.11	-0.31	-0.64**	-0.39*	-0.47**	0.68**	-0.64**	0.88	-0.54**	0.65**
Post Ruck Time	-0.32	-0.57**	-0.63**	-0.54**	-0.67**	0.69**	-0.71**	0.77*	-0.85**	0.61**