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Master of Military Studies Requirements for the Degree

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MASTER OF MILITARY STUDIES

TITLE:

Enhancing Human Potential

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MASTER OF MILITARY STUDIES

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Master of Military Studies Requirements for the Degree

Executive Summary

Title: Enhancing Human Potential

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Thesis: Have advances in technology exceeded human capability? This paper will investigate whether it is possible to safely boost cognitive and physical ability with performance-enhancing substances to bridge the gap between human capability and technology to win the fight tomorrow? Increased human performance could lead to lowered injury rates, stronger mental health, higher states in readiness, and less of a burden on the Veterans Affairs (VA).

Discussion: Technology has increased significantly since the beginning of warfare. From stick and stones to the nuclear age. There has been no increase in the human performance outside of advancements in training to match technology or the physical and cognitive demand on the operator. History and advances proved in the sports arena demonstrate there may be physical and cognitive enhancers capable of safely increasing human performance.

Conclusion: Through advances in performance-enhancing substances we can increase the capability of the human element in warfare.

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Preface

Performance enhancing substances carry a general sense of disapproval. Research mostly focused on sports and select communities prove there are safe practical uses of performance enhancing substances. The topic of human performance-enhancement has been the centerfold of comic books, movies, and television series but a practical application exists. A seemingly impossible task faces warriors every day and bringing everyone home carries a heavyweight. Military service members need the tools offering the highest opportunity to return home and live full lives.

I want to give thanks to God for the patience to work through a long project. To Dr. Jonathan Phillips thank you for your guidance on this project. To the Leadership Communication Skills Center for their assistance in presenting the information in an understandable format. Finally, to classmates, friends, and family who helped by reading, asking questions, and supporting me along the way.

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A. Introduction

Saturday night sports fans stood in awe as professional baseball player Jose Canseco hit yet another home run. He would eventually be ranked fifth in history for his ability to play baseball. Fans were in shock when he admitted to using performance-enhancing substances (PES) in a tell-all book. Americans cheered Lance Armstrong as he brought home his seventh consecutive Tour de France victory. Months later, his victories carried an asterisk because he used PES to win. Major athletic icons search for anything to give them a competitive edge in the ring, on the field, or on the court. Professional athletes have a lot on the line: lucrative endorsement deals, significant contracts, and ultimately their reputation. They earned their opportunity to compete with years of blood, sweat, and tears— anything to win. These athletes did everything and anything to win, including PES.

Athletes have used PES to increase human performance since the beginning of competition. Gladiators would use a hallucinogenic to mask pain and fatigue.¹ Jose Canseco said, “I do not recommend steroids for everyone...but for certain individuals, I truly believe, because I have experimented with it for so many years, that it can make an average athlete a super athlete. It can make a super athlete incredible.”² A pitcher once challenged Jose Canseco with a variety of different pitches in relatively unchanging environment and he consistently hit it out of the park. Now imagine the pitcher, instead of bringing a baseball, brought an arsenal of weapons and the diamond was covered in lethal obstacles; Jose Canseco has to carry 50 pounds of extra weight, restricting his natural movement. Combined with the shock of operating in a new environment with extra gear and the knowledge that if he does not hit a grand slam the penalty is death for not just himself, but his teammates, Jose Canseco must use every tool

necessary to succeed. Jose Conseco, the baseball player, used PES to gain an unfair edge in a baseball game. Jose Conseco's, the warrior, use of PES is more complicated. The difference between the warrior and baseball player is life and death. The challenges of the 21st century demand a change in the cognitive and physical fitness.

Athletes are not alone in their quest to increase human performance. Militaries research how to increase soldiers' performance on the battlefield. In World War II, the Allied Forces experimented with amphetamines to reduce fatigue during combat.³ The experiment was canceled quickly because of adverse side effects experienced by soldiers such as addiction. The Marine operational concept for the future fight looks to technology for an edge to win. However, the military leaves potential on the table by not exploring how PES increases human performance. The future conflict will be competitive — against a peer competitor in a lethal, information-saturated environment. Tomorrow's service members will have more weight on their backs and higher volumes of information to process. Military vehicles, planes, and ships are continually evolving to become stronger, faster, lighter, and complex. Military research focuses on gear and pays little attention to increasing the ability of service members to utilize and maximize their new capabilities. Athletes not only improve their gear with lighter bikes, better bats, and stronger helmets, but also look to improve their own human performance in order to become "incredible athletes." [The military currently does this today in aviation. Aviators use PES in order to accomplish their mission despite a demanding environment.]. Developments in technology can be coupled with increases in human performance in order to enhance lethality on the battlefield. It is possible to safely boost cognitive and physical ability with PES to maximize advanced technology. Increased human performance can lower injury rates, improve mental health, increase readiness and reduce the burden on the Veterans Affairs (VA).

By examining the historical evidence of PES and the current policies regarding their use, I will argue PES can be safely administered and tested today. Safety being paramount is a broad expression, which focuses on the short-term and long-term health of the service member, the types of substances considered and will address the cases against using PES. Warriors like athletes have been around for a long time and history offers numerous military examples of using PES to increase the performance on the battlefield.

B. Defining Enhancement

Enhancement has a wide array of meaning and effects. While Jose Conesco enhanced his athletic performance, this thesis highlights enhancement as a tool for the military, illustrates the distinction between cognitive and performance enhancement, and emphasizes consideration for the use of PES as a military application. In order to understand human enhancement and the effects of PES, it is necessary to look at the definitions of PES and enhancement as defined by ethics and medical experts. Patrick Lin, an ethics professor at California Polytechnic State University at San Luis Obispo, defines PES as "the process of endowing an individual with an ability that goes beyond the typical level or statistically normal range of functioning for humans generally (or the personal unenhanced capabilities of a particular individual), where the ability is either integrated into the body or is so closely worn or connected that it confers an advantage similar to an internal or organic enhancement that transforms the person."⁴ Furthermore, Eric Jungst, the Director for Bioethics at University of North Carolina at Chapel Hill, defines human enhancement as "any medical or biological intervention that aims to temporarily or permanently improve current performance, appearance, or capabilities besides what is necessary to achieve, sustain, or restore health."⁵ Using these two definitions, there are three crucial aspects that the military should use to define enhancement accurately: medical or biological intervention,

“beyond typical range,” and increased quality. The medical or biological intervention involves using the advances in medical sciences to intervene at the point where training or knowledge fails to fill the gap created by new technology. “Beyond typical range” involves looking past what average human capability provides to meet the unique conditions on the battlefield. Increased quality does not just mean more, but better.

Enhancement, for the purposes of this paper, is neither a new basic training regimen with updated training and readiness standards, nor is it more education on how to properly use new technology. It is the addition of a medicine or chemical compound to speed up the body’s natural ability to recover after long and severe training. It is a chemical to intensify the ability to focus the mind. It is cyber genetics integrated into a system which fuses human biology with the latest technology. Simply stated, this paper defines PES as using scientific and technological advances to increase the level of human ability beyond what naturally occurs in the average service member. Understanding the meaning of PES is only the first step. The next step is to understand the areas of focus: the physical and cognitive domains.

Often the focus of enhancement resides in the physical domain. In sports, the conversation naturally steers towards how to be bigger, stronger, and faster. This emphasis on the human body is the same for the military. Are service members able to increase strength, build endurance, and recover more efficiently than organically possible? Back-to-back and extended deployments, time-intensive work-ups, and everyday training all play a part in the physical breakdown of service members. Increasingly heavy gear and austere living and working conditions aggravate physical conditioning. Due to the extreme physical demands associated with military service, today’s service members leave the service with more injuries than necessary. With PES, servicemembers can enhance their physical ability and potentially offset injuries. There are a

wide variety of physical PES available today, legal and illegal. It is important to note that most current research on physical PES is done within the context of sports and has a negative bias due to the viewpoint that PES is a form of cheating. The military is not looking for a fair fight; the unfair advantage is not a concern in war.

Supplements, a form of PES, are found everywhere and are used widely across society. Unregulated supplements like creatine, protein, and branch chain amino acids (BCAA) offer a low-cost way for individuals to add nutrients to their diet and maximize any physical gains from training. Supplements are worth mentioning because of the positive aspects of physical enhancement and for increased service-level implementation. Creatines, non-essential amino acids, aid in muscle growth and development. Creatines can be purchased off the shelf and found in some meat products.⁶ In testing, creatine has been proven to increase muscle conditioning and shows to be a powerful brain booster.⁷ While creatine is not traditionally thought of as an enhancement, improved muscle function does translate to better performance and improved body resiliency under stress. Like creatine, protein can be purchased over-the-counter as a supplement. Protein provides essential and non-essential acids the body needs to recover, build, and grow.⁸ In a 2017 test conducted on master age triathletes (ages from 35-60), adding protein to their diet showed significant retention of muscle mass over ten weeks.⁹ This is significant given the harsh training and physical demand of a triathlon. Long periods of exertion required by a triathlon are similar to the requirements of military training. The ability to maintain muscle mass throughout training and extended deployments leads to a healthier service member in the long run. Supplements provide a solid base from which to grow and reduce injuries over time. Currently, service members in deployed settings rely on meals, ready-to-eat (MRE) to provide necessary nutrition. MRE's provide the bare essential nutrients and nothing more.

While supplements are the “tip of the iceberg” when discussing physical enhancement, gene doping modifies human DNA at an elementary level. Gene doping improves almost all attributes of physical performance like speed, endurance, strength, and ability to recover.¹⁰ There are many forms of gene doping, but three merit further discussion: insulin-like growth factor, human growth hormone (HGH), and myostatin.

Insulin-like growth factor (IGF-1) and HGH both had promising results in animal testing. More evaluation and human trials are necessary before using in military application. IGF-1 increases muscle mass absent of training. Training in conjunction with the use of IGF-1 doubles muscle mass gains.¹¹ HGH has been tested in underdeveloped children with promising gains in bone density and muscle mass.¹² Both IGF-1 and HGH work similarly and the human body naturally produces both. As we age these naturally occurring hormones decrease up to 50% within seven years post-puberty. With very limited human trials, Doctor Fred Sattler, a professor of medicine at University of Southern California, reviewed results of medical testing and literature on the subject of IGF-1 and HGH. These results showed an increase in lean body mass, cardiovascular strength, and resiliency to age-related issues with minimal adverse side effects observed.¹³ These two forms of gene doping could play an integral part in physically enhancing service members in the future.

The final form of gene doping is the blocking of a gene’s natural production, myostatin is produced naturally in the human body to monitor muscle development. Myostatin plays an essential role in protecting the body from hurting itself. Too much myostatin has the opposite effect on the body, causing the muscle to waste away and fat to replace it. In 2014, a study using a myostatin inhibitor saw active skeletal muscle growth and strength.¹⁴ Using an inhibitor for the

production of myostatin to increase muscle mass and strength may prove vital to military programs aimed at enhancing human potential.

Going beyond the physical domain, unlocking the power of the mind has become a stand-alone topic. With new technology comes more complex systems and higher quantities of information requiring the exploration of cognitive enhancement. Cognition, according to Alan Baddeley, a professor of psychology at the University of York, is “the storage and manipulation of the information necessary for such complex cognitive tasks as language comprehension, learning, and reasoning.”¹⁵ The goal of cognitive enhancement is to increase attributes such as memory, attention, and problem-solving. Stimulants and nootropics enhance cognitive abilities of service member.

Stimulants can be both pharmaceutical and natural. A stimulate is classified as a catalyst for increased cognitive function. A cognitive stimulant increases attributes such as memory, attention, or problem-solving. The most common example of a stimulant is caffeine, naturally found in coffee, tea, and chocolate and widely used across the globe to increase alertness and mental focus. In several studies, caffeine has shown to increase complex cognitive function significantly.¹⁶ This study is significant because the subjects were in an exhaustive state and prove that stimulants, in the short term, can be effective at increasing cognitive performance. A common pharmaceutical stimulant is Dextroamphetamine. Dextroamphetamine is used to treat ADHD. Dextroamphetamine shows improvement in cognitive attributes like attention and critical thinking.¹⁷ Currently, the U.S. Air Force issues pilots two forms of stimulates, modafinil and dextroamphetamine, to aid in mission effectiveness. A 2005 study illustrated how dextroamphetamine reinvigorates and maintains cognitive output during high stress.¹⁸ A second

type of stimulant is eugregorics. Modafinil, an example of eugregorics, showed fewer side effects than other cognitive enhancers.¹⁹ Stimulants show great promise in increasing the cognitive ability of service members under harsh conditions.

The second type of cognitive enhancers is nootropics. Nootropics are both synthetic and natural. Nootropics work in concert with the central nervous system to aid in absorbing information and improving short- and long-term memory. Originally nootropics were used to treat a wide range of cognitive issues such damage from a disease like a stroke, traumatic brain injury, and learning disabilities such as dyslexia. Another common name for nootropics is "smart drugs."²⁰ While "smart drugs" have synthetically been available since the 1960s, Chinese medicine has been using natural nootropics for centuries. The synthetic form of nootropics is known as Piracetam. Piracetam has undergone many studies over the years and has few adverse side effects. Two attributes of cognitive function most improved through stimulating the brain receptors are memory and learning. A bonus effect is increased blood flow and nutrients to the brain.²¹ Nootropic, in the natural form, is commonly found in nicotine and ginseng. Nicotine, widely used by service members, has many cancer-causing effects. Ginseng, a staple of traditional Chinese medicine, is a non-toxic herb aiding memory and attention with little known side effects.²²

As mentioned earlier, physical and cognitive enhancers can offer a low-risk option for military application. This is not to insinuate; that there are no risks. There is always inherent risk in warfighting operations; military leadership make decisions while understanding that benefits outweigh the risks. Below are two tables outlining the adverse side effects of PES. It is important to note that many of the side effects could be drastically lowered in probability with oversight on

the application of any PES. This oversight is built into the military architecture. The military hierarchy includes medical personnel at the platoon level. The benefits of PES go beyond immediate combat-related benefits. Nootropics and stimulants offer a low-risk option for military members to enhance cognitive function by boosting blood flow to the brain. Increased blood flow could reduce mental related injuries related to military service. Physically increasing bone density, muscle mass, and strength could lead to fewer skeletal and muscle-related injuries from prolonged overuse.

Class	Type	Effects	Unwanted effects
Stimulants Chemical agents that produce a transient increase in psychomotor activity by affecting the central nervous system, enhancing specific body functions like alertness, wakefulness, memory, and locomotion.	Eugrogerics (e.g., Modafinil, Adrafinil)	<ul style="list-style-type: none"> • Promotes alertness, wakefulness, and arousal • Reduces tiredness and drowsiness 	<ul style="list-style-type: none"> • Excitation or agitation, anxiety, insomnia, irritability, nervousness, aggressiveness, tremor, nausea, and sleep disturbance
	Amphetamines (Methylphenidate)	<ul style="list-style-type: none"> • Promotes attention, arousal, mood, and wakefulness • Reduces anxiety, rebound depression, and fatigue 	<ul style="list-style-type: none"> • Highly addictive • Insomnia, agitation, dry mouth, dizziness, tremors, restlessness, increased heart rate, loss of appetite, aggressiveness, and irritability
Nootropics Compounds that act on the CNS to facilitate learning and memory or prevent cognitive impairments induced by diseases and brain damage.	Synthetic (e.g., Piracetam, Oxiracetam)	<ul style="list-style-type: none"> • Promotes memory functions, learning, and memory restoration • Reduces stress, drug addiction, cholesterol levels, and pain 	<ul style="list-style-type: none"> • Excitation, depression, dizziness, and sleep disturbance • Psychomotor agitation, dysphoria, tiredness, memory loss, headache, and diarrhea
	Natural (e.g., nicotine, Panax ginseng)	<ul style="list-style-type: none"> • Promotes memory functions and learning • Reduces memory impairment 	<ul style="list-style-type: none"> • Unknown

Figure 1: Cognitive Enhancers

Class	Type	Effects	Unwanted effects
Supplements A product intended for ingestion that contains a dietary ingredient intended to add further nutritional value to the diet.	Creatine/ Protein/ and BCAA powders (e.g., vitamins, minerals, herbs, amino acids, metabolite).	∇ Increases lean body mass, muscle size and strength ∇ Promotes energy cycle within the cells	∇ ∇ Water retention ∇ ∇ Creatinine by-product may produce acidemia ∇ ∇ Waste by-product can stress the kidneys ∇ ∇ Gastro-intestinal discomfort ∇ ∇ Constipation
Gene Doping Gene doping aims to manipulate DNA to improve aspects of athletic performance, such as speed, power, or endurance.	Insulin-like growth factor	∇ Increase targeted muscle mass and strength	∇ Unknown
	Myostatin	∇ Lead to widespread increase in skeletal muscle mass and strength	∇ Unknown

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Figure 2: Physical Enhancement Substances

C. Current Programs and Policies

The military needs service members to succeed despite great physical and mental challenges in unknown and uneven terrain. To understand why PES have a place in today's military, we need to know how the military squeezes every bit of performance out of our service members today. How does the military optimize the force for victory on the battlefield? At every level of leadership, all services wrestle with how to best train and prepare service members to win. Although every service has its training manual, this section will specifically analyze how the United State Marine Corps currently prepares its forces for the rigors of combat.

The Marine Corps philosophy of training is "to provide combat-ready units to the nation ... so Marines can survive and succeed in combat."²⁵ To standardize training, the Marine Corps produces a Training and Readiness (T&R) manual that sets standards for the service as a whole, and military occupational specialties (MOS) specifically. The T&R manuals center around Mission Essential Task lists (METL). The requirements for individuals, groups, MOSs, and the Marine Corps as a whole are organized to meet the METLs.²⁶ The Marine Corps' philosophy on the importance of training can be summed up with a quote from the T&R manual for all Marines, "When a Marine is able to perform his job expertly, that Marine makes a team/section/squad better able to perform its mission."²⁷ The T&R manual follows a building block approach, starting at the individual Marine and works its way up to Marine Air Ground Task Forces (MAGTF). Broken down in the requirements are evaluated events (e-coded events). These e-coded events determine whether or not the individual or group can achieve their METLs and if the comprehensive unit can accomplish their assigned missions, if they are "ready." This is how the Marine Corps prepares for combat. Training sets the conditions both mentally and physically for success and failure on the battlefield. Training is the foundation for victory.

The physical prowess of a Marine is a hallmark of the institution. Physical training increases the performance of duties. The Marine Corps Order 6100.14, Marine Corps Physical Fitness Program, describes physical fitness as a highest priority.²⁸ To build up a Marine's physical capacity, the Marine Corps has adopted a form of functional fitness. The Force Fitness division oversees the development of all aspects concerning physical fitness. The Marine Corps has published a clear end state, "the program will result in Marines who are fit, resilient, and more lethal on the modern battlefield."²⁹ Five programs make up the Marine Corps fitness program: Force Fitness Instructor, Marine Corps Body Composition and Military Appearance,

Water Survival, Martial Arts, and Sports Medicine Injury Prevention Programs. Force Fitness instructors act as the commanding officer's representative and develop unit fitness training plans. The Marine Corps Body Composition and Military Appearance Program sets the standards for height to weight ratios and appearance in uniform. These standards stress the importance of dedication to a healthy lifestyle. The Marine Corps ensure its Marines are prepared to operate in amphibious environments with water survival instruction. The Marine Corps Martial Arts Program combines a weapon-based fighting system with fitness to maximize a Marine's capacity to win on the battlefield. The Sports Medicine Injury Prevention Program mitigates the risk of injury upon joining the Marine Corps. The Marine Corps Recruit Depots and The Basic School are the only locations with a Sports Medicine Injury Prevention Program. There are two tests administered annually to evaluate the fitness level of Marines and the effectiveness of the force fitness programs. The first of these tests is the Physical Fitness Test (PFT). The PFT consists of maximum pull-ups, maximum crunches in two minutes, and a timed three-mile run. The second test, Combat Fitness Test (CFT), measures a Marine's fitness against combat-related tasks. The CFT consists of an 800-meter sprint, maximum repetitions lifting an ammunition can in two minutes, and 300-meter shuttle run course with crawling, buddy drags, and ammunition can carry. Both these tests have associated scores which post to a Marine's permanent record. Failure to make the minimum score results in disciplinary action. The Marine Corps offers a wide array of health-related classes from basic nutrition to advanced instructor courses in every program under the Force Fitness Division. Much effort is applied to raise the fitness level of all Marines to their maximum potential.

In addition to physical fitness the mental or cognitive fitness of Marines is also a high priority. Beyond entry-level schools, Marines expand their knowledge in the profession of arms

through Professional Military Education (PME). The Marine Corps has mandatory professional development tailored for every rank. For example, Marine Corps University (MCU) heads all PME programs. Aboard MCU are several resident courses which span a full year. For the Marines unable to attend a resident course there are non-resident courses available through the Distance Education Program, like online courses offered by most civilian higher education institutions. MCU's purpose is "a continuum of education to improve leadership, sharpen critical thinking skills, and deepen Marines' understanding of warfighting concepts in distributed and joint environments."³⁰ There are few private companies who pull leaders at all levels to spend a year developing and expanding their knowledge. This year devoted to education is a real investment by the institution.

The Marine Corp's investment in enhancing human performance is limited to training and education. The policies regarding the use of PES are strict and carry severe consequences. The Department of Defense (DOD) follows the World Anti-Doping List of Banned Drugs/Substances and the Drug Enforcement Administration (DEA) scheduling of drugs. Using or possession of PES is punishable under the Uniform Code of Military Justice (UCMJ). Punishments include incarceration and a dishonorable discharge from service. This policy stifles potential human performance enhancement. The military places great emphasis on the physical and mental abilities of its service members but limits itself without PES.

D. The Gap between technology and Human capacity

A constant stream of data into today's operational environment, while increasing awareness, can be overwhelming. The warfighter of today has to process information, decide on their course of action, and articulate their decision, often while stressed and fatigued. Has this new and steady stream of data surpassed the human ability to process and use the data effectively

and efficiently? Can we safely boost the human ability to process information, translate data, and decide on a course of action?

At the Basic School (TBS), where every USMC second lieutenant starts his or her career, there is an exercise to demonstrate the value and burden of information on the decision-making process. In the exercise, the instructor begins to read information the students will use to form an order that their notional platoon will execute. The exercise is timed to stress the importance of deciphering the essential and relevant information on time. The students are given a total of 20 minutes to write the order. The instructors start reading aloud the information required to write the order. The students are free to leave at any point once they feel they have enough information to make an informed decision. Some students leave as early as 5 minutes, but most will stay for the full 20 minutes. The relevant information is front-loaded, and the rest of the information is irrelevant. The exercise demonstrates how crucial it is to interpret the applicable information, make a timely decision, and then clearly pass this decision to subordinates. The exercise does not enhance the ability to interpret information but gives an understanding that information can be both useful and a burden if it is only clouding the leader's mind. This exercise is conducted in a classroom free from field stress and lack of sleep.

A real-world example of how technology can overwhelm a single mind, when adding in the pressures of time and accuracy of fires, is described in an interview with Lieutenant Colonel Damon Anthony, Major James Akers, and Lieutenant Colonel Steve Pieper, pilots flying a generation 5 fighter, like the F35. These modern-day aircraft have more information flowing through the cockpit than an Airborne Warning and Control System (AWACS).³¹ A crew of four flies the AWACS and have 13-19 specialists to process and synthesize and forward pertinent data to the forward operators. The F-35 has a crew of one. In this case, unlike the exercise for

new lieutenants, all the information is essential. How can one person flying the most sophisticated fighter jet while doing the job of 19 people be effective? The technology has pushed the limits of what is cognitively possible. Long flight hours combined with the mental agility required to maneuver through contested airspace and the pressure of placing bombs on target does not leave much room to process copious amounts of data or information.

The Airforce, Navy, and Army aviation branches have already explored PES to increase awareness in the cockpit and mask the effects of mental fatigue. The Air Force uses cognitive enhancer called modafinil. Col Paco Geisler described their use while flying missions for Operation Just Cause, "there were no noticeable side effects during Just Cause; we just felt wide awake."³² There has been at least one recorded incident of catastrophic failure during combat flight operations that was attributed the use of PES. In April 2002, during combat operations in Iraq, pilots cited the use of PES as affecting their moral judgment during a friendly fire incident.³³ This was not a failure in moral judgement, but rather information overload in a stressful combat situation that lead to the failure of prosecuting the correct target. The Air Force continues to use PES to aid pilots in the execution of their duties. In the aeromedical after-action reports covering both Operation Desert Shield and Storm over half the pilots said the use of "go pills" was needed for mission accomplishment. The same reports reviewed all the Class A mishaps and none were attributed to the use of PES.³⁴ This use of PES in a real-world high intensity conflict demonstrates the positive effects of PES. Likewise, the Army conducted aviation tests of its own, using appropriate doses of modafinil and dextroamphetamine, resulting in increased alertness and mental function over a placebo.³⁵ This is the extent of current use of PES in the US military today.

Pilots are not the only community mentally affected by the stress of combat. Ground units have the same necessity for perfection, regardless of sleep deprivation and operational stress. Operations can last up to days. All jobs in the military require a stable functioning mental state. In the fire direction center, 10-digit grids, constant radio chatter, lack of sleep, and poor living conditions are part of every day operations. With increased ground sensors, critical movement of special operations troops, mobile friendly units, and more platforms reporting enemy movement, the young troops who operate the radios and send firing data, are required to process more information than ever before. However, they are not offered the same PES as the pilots over their heads.

E. Testing

Physically enhancing service members has not been tested. Special Operations Command requested testing to improve endurance, strength, and recovery of Special Operation Forces. In 2017, Ben Chitty, a project manager for biomedicine, stated, "If there are ... different ways of training, different ways of acquiring performance that is non-material that are preferred, but in many cases, we have exhausted those areas."³⁶ The driving factor behind the physical enhancement of service members is longevity. Today service members are carrying more than their predecessors. Items include personal protective equipment, ammunition, weapons, radios, sensors, food, water, and maybe a rucksack full of gear weighing between 70 and 110. Estimates of body weight ratio to weight carried place these loads well over the recommended amount for a load-bearing unit.³⁷ This weight is not expected to decrease, and the marketing of new gear as light does not translate to lighter loads.

A test to validate any PES has to be done under conditions simulating combat and against evaluated tasks. There are two locations a validating test could take place, at recruit training and

during a service-level exercise. Under this construct, the validation test would begin at the same place every Marine does – the yellow footprints – and end at Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms, California.

Today's Marines step on the yellow footprints on their first day of boot camp in San Diego, California or Parris Island, South Carolina. This initial validation testing would only need to take place at one facility. Recruit training is an extremely controlled environment with multiple disciplines of medicine being practiced including sports medicine, nutritionist, and general practice physicians. Corpsmen and Drill Instructors supervise recruits at all times through all phases of recruit training. A recruit training regiment will have multiple companies in different phases of training, but a single company has multiple platoons going through start to finish at the same time. After, "pick up" one platoon has supplements like creatine, protein, and BCAAs added to their daily diet. One platoon has nothing added to the normal recruit diet. The last platoon adds the physical supplement and a cognitive nootropic like ginseng. All added PES's are entirely natural, with little to no risk. There is virtually no chance for recruits to abuse any substance because of the substantial amount of oversight. Recruit training builds in physical assessments, graded tests, leadership reaction courses which are already used to gather data to determine if the supplements provide an enhanced benefit. Validation testing would provide data on the differences between the test and control platoons in areas such as graduation rate, physical and cognitive test scores, number of injuries requiring medical rehabilitation, and physical and mental health. Mountains of data already exist from previous cycles to compare against this controlled test. The first validation test builds a stable baseline in a completely controlled environment for further testing in the fleet.

Recruit training provides an extremely controlled environment, but recruits receive sleep, three meals a day, and constant supervision. To validate the use of PES for the full force, a test must also be conducted outside of a completely controlled environment. Before deployment, most infantry battalions participate in a service-level exercise aboard MCAGCC Twenty-nine Palms, CA, during which they undergo an evaluation of select individual and collective T&R tasks. This exercise provides an ideal venue for the second PES validation test.

This second test could follow the same basic set up as recruit training battalions since infantry battalions are similarly broken down into companies. During the integrated training exercise (ITX), units undergo a MAGTF level exercise testing all warfighting functions. Some events are individual to platoons and not all companies experience the same events at ITX; some companies conduct air assault, while others are mechanized. However, all companies will experience sleep deprivation, long physically and mentally demanding days, and increased decision-making cycles. Multiple tests may be appropriate to test the effectiveness of PES in all aspects of ITX. This training exercise provides an opportunity to test the benefits of enhancement. One Company is given physical PES, another cognitive, one both, and a control company given nothing extra. ITX is evaluated against T&R tasks and provides feedback to the unit for areas needing sustainment, maintenance, or further training before deploying.

F. The Counter-Argument

PES are highly controversial and widely misunderstood. There are two strong counter-arguments against the use of PES. Ethical implications and lack of formal research on short- and long-term side effects cloud any potential gain or benefit of the use of PES. These two arguments stunt any progress in testing and using PES.

The military seeks to enter the fight with an advantage. The unknown side effects create a moral concern in the military. The US military carries a moral obligation to protect and preserve its service members.³⁸ Without well researched and tested PES, it would be foolish to allow service members to take anything without a real understanding of the risks and benefits. Jessica Wolfendale, a research fellow of philosophy and ethics, who primarily focuses her research on the ethics of war, questions the moral responsibility and moral judgment of an enhanced soldier. She continues to argue a soldier's ability to make moral and ethical decisions crucially impacts the long-term effects of war, and PES could impact this effort.³⁹ If service members operating on PES lose their "conscious morality", it would lead to a loss of trust in the military to operate with honor. This point is echoed by a professor of law and ethics, Richard Ashcroft, who believes PES should be heavily regulated and not used by the military.⁴⁰ Opponents to the military use of PES argue to the moral concern that PES will dehumanize warfare. The loss of morality should be investigated when testing for military use. On the subject of lost morality, ethicists agree if the use of PES were to deny a soldier's ability to make ethical decisions, then PES should not be used to increase performance. However, Chris Wigger and Patricia Oelschlager, military ethics researchers, argue conditions could be set to use PES ethically. Wiggers and Oelschlager argue a moral need exists to test PES for military use further. They recommend using guidelines established by Michael B. Russo M.D.⁴¹ Many pro-PES authors cite Doctor Russo for his work on the ethical use of PES. Doctor Russo uses five questions to determine how the military could test the use of PES ethically. Those questions are: has consent been given, is the medication safe and being used in the correct environment, is the use consistent with its dosage and function, is the use under proper supervision, and finally, have all other options been exhausted.⁴² The questions outlined above address' consent. The military has

legal and moral obligation to protect service members. DOD 6205.02, Policy and Program for Immunizations to Protect the Health of Service Members and Military Beneficiaries, builds the legal framework for enforcing widespread use of PES. Today we vaccinate to build up immunities against threats like influenza, small pox, anthrax, and malaria.⁴³ The health benefit extends beyond the individual member but also preserves the force. As discussed earlier, the Marine Corps training programs, both physical and mental, are robust and extensive. The military has exhausted the traditional methods to push the limits of performance.

Our society and culture heavily influence the ethics of human enhancement, but that does not mean we should ignore the potential PES brings to the battlefield. In a 2003 report responding to ethics, from President George W. Bush, he said: "men remaining human even in moments of great crisis."⁴⁴ President Bush understood, in order to use PES to bridge human performance with technological advancement the risk, the ethics of a warfighter need to remain intact.

G. Conclusion

There is no way to eliminate all risk associated with combat. There have been great leaps and bounds in biochemistry over the last decade, though many of these scheduled substances are banned for use unless approved by a doctor. Jose Conesco was vilified for improving his game with banned substances, however not all PES are bad and can enhance a service member's capability on the battlefield. Throughout history, militaries have always been interested in enhancing soldiers' capabilities on the battlefield, but our recent history has added technology like never seen before on the battlefield. Technology has always added a significant advantage in combat, but a ripple effect is a lack of fusion between technology and human capability. Soldiers, sailors, airmen, and Marines should be afforded the option to increase human

performance to meet technological advancement and bridge the gap from training to combat. The use of performance-enhancing substances can be the link. Any test or evaluation of PES to ultimately improve the warfighters lethality, survivability, and proficiency is a road worth pursuing.

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MASTER OF MILITARY STUDIES

TITLE:
Enhancing Human Potential

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

AUTHOR:
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Master of Military Studies Requirements for the Degree

Executive Summary

Title: Enhancing Human Potential

Author: Major Jack R. Larimore III, United States Marine Corps

Thesis: Have advances in technology exceeded human capability? This paper will investigate whether it is possible to safely boost cognitive and physical ability with performance-enhancing substances to bridge the gap between human capability and technology to win the fight tomorrow? Increased human performance could lead to lowered injury rates, stronger mental health, higher states in readiness, and less of a burden on the Veterans Affairs (VA).

Discussion: Technology has increased significantly since the beginning of warfare. From stick and stones to the nuclear age. There has been no increase in the human performance outside of advancements in training to match technology or the physical and cognitive demand on the operator. History and advances proved in the sports arena demonstrate there may be physical and cognitive enhancers capable of safely increasing human performance.

Conclusion: Through advances in performance-enhancing substances we can increase the capability of the human element in warfare.

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DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

QUOTATION FROM, ABSTRACTION FROM, OR REPRODUCTION OF ALL OR ANY PART OF THIS DOCUMENT IS PERMITTED PROVIDED PROPER ACKNOWLEDGEMENT IS MADE.

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Preface

Performance enhancing substances carry a general sense of disapproval. Research mostly focused on sports and select communities prove there are safe practical uses of performance enhancing substances. The topic of human performance-enhancement has been the centerfold of comic books, movies, and television series but a practical application exists. A seemingly impossible task faces warriors every day and bringing everyone home carries a heavyweight. Military service members need the tools offering the highest opportunity to return home and live full lives.

I want to give thanks to God for the patience to work through a long project. To Dr. Jonathan Phillips thank you for your guidance on this project. To the Leadership Communication Skills Center for their assistance in presenting the information in an understandable format. Finally, to classmates, friends, and family who helped by reading, asking questions, and supporting me along the way.

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A. Introduction

Saturday night sports fans stood in awe as professional baseball player Jose Canseco hit yet another home run. He would eventually be ranked fifth in history for his ability to play baseball. Fans were in shock when he admitted to using performance-enhancing substances (PES) in a tell-all book. Americans cheered Lance Armstrong as he brought home his seventh consecutive Tour de France victory. Months later, his victories carried an asterisk because he used PES to win. Major athletic icons search for anything to give them a competitive edge in the ring, on the field, or on the court. Professional athletes have a lot on the line: lucrative endorsement deals, significant contracts, and ultimately their reputation. They earned their opportunity to compete with years of blood, sweat, and tears— anything to win. These athletes did everything and anything to win, including PES.

Athletes have used PES to increase human performance since the beginning of competition. Gladiators would use a hallucinogenic to mask pain and fatigue.¹ Jose Conseco said, "I do not recommend steroids for everyone...but for certain individuals, I truly believe, because I have experimented with it for so many years, that it can make an average athlete a super athlete. It can make a super athlete incredible."² A pitcher once challenged Jose Conseco with a variety of different pitches in relatively unchanging environment and he consistently hit it out of the park. Now imagine the pitcher, instead of bringing a baseball, brought an arsenal of weapons and the diamond was covered in lethal obstacles; Jose Conseco has to carry 50 pounds of extra weight, restricting his natural movement. Combined with the shock of operating in a new environment with extra gear and the knowledge that if he does not hit a grand slam the penalty is death for not just himself, but his teammates, Jose Canseco must use every tool

necessary to succeed. Jose Conseco, the baseball player, used PES to gain an unfair edge in a baseball game. Jose Conseco's, the warrior, use of PES is more complicated. The difference between the warrior and baseball player is life and death. The challenges of the 21st century demand a change in the cognitive and physical fitness.

Athletes are not alone in their quest to increase human performance. Militaries research how to increase soldiers' performance on the battlefield. In World War II, the Allied Forces experimented with amphetamines to reduce fatigue during combat.³ The experiment was canceled quickly because of adverse side effects experienced by soldiers such as addiction. The Marine operational concept for the future fight looks to technology for an edge to win. However, the military leaves potential on the table by not exploring how PES increases human performance. The future conflict will be competitive — against a peer competitor in a lethal, information-saturated environment. Tomorrow's service members will have more weight on their backs and higher volumes of information to process. Military vehicles, planes, and ships are continually evolving to become stronger, faster, lighter, and complex. Military research focuses on gear and pays little attention to increasing the ability of service members to utilize and maximize their new capabilities. Athletes not only improve their gear with lighter bikes, better bats, and stronger helmets, but also look to improve their own human performance in order to become "incredible athletes." [The military currently does this today in aviation. Aviators use PES in order to accomplish their mission despite a demanding environment.]. Developments in technology can be coupled with increases in human performance in order to enhance lethality on the battlefield. It is possible to safely boost cognitive and physical ability with PES to maximize advanced technology. Increased human performance can lower injury rates, improve mental health, increase readiness and reduce the burden on the Veterans Affairs (VA).

By examining the historical evidence of PES and the current policies regarding their use, I will argue PES can be safely administered and tested today. Safety being paramount is a broad expression, which focuses on the short-term and long-term health of the service member, the types of substances considered and will address the cases against using PES. Warriors like athletes have been around for a long time and history offers numerous military examples of using PES to increase the performance on the battlefield.

B. Defining Enhancement

Enhancement has a wide array of meaning and effects. While Jose Conesco enhanced his athletic performance, this thesis highlights enhancement as a tool for the military, illustrates the distinction between cognitive and performance enhancement, and emphasizes consideration for the use of PES as a military application. In order to understand human enhancement and the effects of PES, it is necessary to look at the definitions of PES and enhancement as defined by ethics and medical experts. Patrick Lin, an ethics professor at California Polytechnic State University at San Luis Obispo, defines PES as "the process of endowing an individual with an ability that goes beyond the typical level or statistically normal range of functioning for humans generally (or the personal unenhanced capabilities of a particular individual), where the ability is either integrated into the body or is so closely worn or connected that it confers an advantage similar to an internal or organic enhancement that transforms the person."⁴ Furthermore, Eric Jungst, the Director for Bioethics at University of North Carolina at Chapel Hill, defines human enhancement as "any medical or biological intervention that aims to temporarily or permanently improve current performance, appearance, or capabilities besides what is necessary to achieve, sustain, or restore health."⁵ Using these two definitions, there are three crucial aspects that the military should use to define enhancement accurately: medical or biological intervention,

“beyond typical range,” and increased quality. The medical or biological intervention involves using the advances in medical sciences to intervene at the point where training or knowledge fails to fill the gap created by new technology. “Beyond typical range” involves looking past what average human capability provides to meet the unique conditions on the battlefield.

Increased quality does not just mean more, but better.

Enhancement, for the purposes of this paper, is neither a new basic training regimen with updated training and readiness standards, nor is it more education on how to properly use new technology. It is the addition of a medicine or chemical compound to speed up the body’s natural ability to recover after long and severe training. It is a chemical to intensify the ability to focus the mind. It is cyber genetics integrated into a system which fuses human biology with the latest technology. Simply stated, this paper defines PES as using scientific and technological advances to increase the level of human ability beyond what naturally occurs in the average service member. Understanding the meaning of PES is only the first step. The next step is to understand the areas of focus: the physical and cognitive domains.

Often the focus of enhancement resides in the physical domain. In sports, the conversation naturally steers towards how to be bigger, stronger, and faster. This emphasis on the human body is the same for the military. Are service members able to increase strength, build endurance, and recover more efficiently than organically possible? Back-to-back and extended deployments, time-intensive work-ups, and everyday training all play a part in the physical break down of service members. Increasingly heavy gear and austere living and working conditions aggravate physical conditioning. Due to the extreme physical demands associated with military service, today’s service members leave the service with more injuries than necessary. With PES, servicemembers can enhance their physical ability and potentially offset injuries. There are a

wide variety of physical PES available today, legal and illegal. It is important to note that most current research on physical PES is done within the context of sports and has a negative bias due to the viewpoint that PES is a form of cheating. The military is not looking for a fair fight; the unfair advantage is not a concern in war.

Supplements, a form of PES, are found everywhere and are used widely across society. Unregulated supplements like creatine, protein, and branch chain amino acids (BCAA) offer a low-cost way for individuals to add nutrients to their diet and maximize any physical gains from training. Supplements are worth mentioning because of the positive aspects of physical enhancement and for increased service-level implementation. Creatines, non-essential amino acids, aid in muscle growth and development. Creatines can be purchased off the shelf and found in some meat products.⁶ In testing, creatine has been proven to increase muscle conditioning and shows to be a powerful brain booster.⁷ While creatine is not traditionally thought of as an enhancement, improved muscle function does translate to better performance and improved body resiliency under stress. Like creatine, protein can be purchased over-the-counter as a supplement. Protein provides essential and non-essential acids the body needs to recover, build, and grow.⁸ In a 2017 test conducted on master age triathletes (ages from 35-60), adding protein to their diet showed significant retention of muscle mass over ten weeks.⁹ This is significant given the harsh training and physical demand of a triathlon. Long periods of exertion required by a triathlon are similar to the requirements of military training. The ability to maintain muscle mass throughout training and extended deployments leads to a healthier service member in the long run. Supplements provide a solid base from which to grow and reduce injuries over time. Currently, service members in deployed settings rely on meals, ready-to-eat (MRE) to provide necessary nutrition. MRE's provide the bare essential nutrients and nothing more.

While supplements are the “tip of the iceberg” when discussing physical enhancement, gene doping modifies human DNA at an elementary level. Gene doping improves almost all attributes of physical performance like speed, endurance, strength, and ability to recover.¹⁰ There are many forms of gene doping, but three merit further discussion: insulin-like growth factor, human growth hormone (HGH), and myostatin.

Insulin-like growth factor (IGF-1) and HGH both had promising results in animal testing. More evaluation and human trials are necessary before using in military application. IGF-1 increases muscle mass absent of training. Training in conjunction with the use of IGF-1 doubles muscle mass gains.¹¹ HGH has been tested in underdeveloped children with promising gains in bone density and muscle mass.¹² Both IGF-1 and HGH work similarly and the human body naturally produces both. As we age these naturally occurring hormones decrease up to 50% within seven years post-puberty. With very limited human trials, Doctor Fred Sattler, a professor of medicine at University of Southern California, reviewed results of medical testing and literature on the subject of IGF-1 and HGH. These results showed an increase in lean body mass, cardiovascular strength, and resiliency to age-related issues with minimal adverse side effects observed.¹³ These two forms of gene doping could play an integral part in physically enhancing service members in the future.

The final form of gene doping is the blocking of a gene’s natural production, myostatin is produced naturally in the human body to monitor muscle development. Myostatin plays an essential role in protecting the body from hurting itself. Too much myostatin has the opposite effect on the body, causing the muscle to waste away and fat to replace it. In 2014, a study using a myostatin inhibitor saw active skeletal muscle growth and strength.¹⁴ Using an inhibitor for the

production of myostatin to increase muscle mass and strength may prove vital to military programs aimed at enhancing human potential.

Going beyond the physical domain, unlocking the power of the mind has become a stand-alone topic. With new technology comes more complex systems and higher quantities of information requiring the exploration of cognitive enhancement. Cognition, according to Alan Baddeley, a professor of psychology at the University of York, is “the storage and manipulation of the information necessary for such complex cognitive tasks as language comprehension, learning, and reasoning.”¹⁵ The goal of cognitive enhancement is to increase attributes such as memory, attention, and problem-solving. Stimulants and nootropics enhance cognitive abilities of service member.

Stimulants can be both pharmaceutical and natural. A stimulate is classified as a catalyst for increased cognitive function. A cognitive stimulant increases attributes such as memory, attention, or problem-solving. The most common example of a stimulant is caffeine, naturally found in coffee, tea, and chocolate and widely used across the globe to increase alertness and mental focus. In several studies, caffeine has shown to increase complex cognitive function significantly.¹⁶ This study is significant because the subjects were in an exhaustive state and prove that stimulants, in the short term, can be effective at increasing cognitive performance. A common pharmaceutical stimulant is Dextroamphetamine. Dextroamphetamine is used to treat ADHD. Dextroamphetamine shows improvement in cognitive attributes like attention and critical thinking.¹⁷ Currently, the U.S. Air Force issues pilots two forms of stimulates, modafinil and dextroamphetamine, to aid in mission effectiveness. A 2005 study illustrated how dextroamphetamine reinvigorates and maintains cognitive output during high stress.¹⁸ A second

type of stimulant is eugregorics. Modafinil, an example of eugregorics, showed fewer side effects than other cognitive enhancers.¹⁹ Stimulants show great promise in increasing the cognitive ability of service members under harsh conditions.

The second type of cognitive enhancers is nootropics. Nootropics are both synthetic and natural. Nootropics work in concert with the central nervous system to aid in absorbing information and improving short- and long-term memory. Originally nootropics were used to treat a wide range of cognitive issues such damage from a disease like a stroke, traumatic brain injury, and learning disabilities such as dyslexia. Another common name for nootropics is "smart drugs."²⁰ While "smart drugs" have synthetically been available since the 1960s, Chinese medicine has been using natural nootropics for centuries. The synthetic form of nootropics is known as Piracetam. Piracetam has undergone many studies over the years and has few adverse side effects. Two attributes of cognitive function most improved through stimulating the brain receptors are memory and learning. A bonus effect is increased blood flow and nutrients to the brain.²¹ Nootropic, in the natural form, is commonly found in nicotine and ginseng. Nicotine, widely used by service members, has many cancer-causing effects. Ginseng, a staple of traditional Chinese medicine, is a non-toxic herb aiding memory and attention with little known side effects.²²

As mentioned earlier, physical and cognitive enhancers can offer a low-risk option for military application. This is not to insinuate; that there are no risks. There is always inherent risk in warfighting operations; military leadership make decisions while understanding that benefits outweigh the risks. Below are two tables outlining the adverse side effects of PES. It is important to note that many of the side effects could be drastically lowered in probability with oversight on

the application of any PES. This oversight is built into the military architecture. The military hierarchy includes medical personnel at the platoon level. The benefits of PES go beyond immediate combat-related benefits. Nootropics and stimulants offer a low-risk option for military members to enhance cognitive function by boosting blood flow to the brain. Increased blood flow could reduce mental related injuries related to military service. Physically increasing bone density, muscle mass, and strength could lead to fewer skeletal and muscle-related injuries from prolonged overuse.

Class	Type	Effects	Unwanted effects
<p>Stimulants</p> <p>Chemical agents that produce a transient increase in psychomotor activity by affecting the central nervous system, enhancing specific body functions like alertness, wakefulness, memory, and locomotion.</p>	<p>Eugrogerics (e.g., Modafinil, Adrafinil)</p>	<ul style="list-style-type: none"> • Promotes alertness, wakefulness, and arousal • Reduces tiredness and drowsiness 	<ul style="list-style-type: none"> • Excitation or agitation, anxiety, insomnia, irritability, nervousness, aggressiveness, tremor, nausea, and sleep disturbance
	<p>Amphetamines (Methylphenidate)</p>	<ul style="list-style-type: none"> • Promotes attention, arousal, mood, and wakefulness • Reduces anxiety, rebound depression, and fatigue 	<ul style="list-style-type: none"> • Highly addictive • Insomnia, agitation, dry mouth, dizziness, tremors, restlessness, increased heart rate, loss of appetite, aggressiveness, and irritability
<p>Nootropics</p> <p>Compounds that act on the CNS to facilitate learning and memory or prevent cognitive impairments induced by diseases and brain damage.</p>	<p>Synthetic (e.g., Piracetam, Oxiracetam)</p>	<ul style="list-style-type: none"> • Promotes memory functions, learning, and memory restoration • Reduces stress, drug addiction, cholesterol levels, and pain 	<ul style="list-style-type: none"> • Excitation, depression, dizziness, and sleep disturbance • Psychomotor agitation, dysphoria, tiredness, memory loss, headache, and diarrhea
	<p>Natural (e.g., nicotine, Panax ginseng)</p>	<ul style="list-style-type: none"> • Promotes memory functions and learning • Reduces memory impairment 	<ul style="list-style-type: none"> • Unknown

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Figure 1: Cognitive Enhancers

Class	Type	Effects	Unwanted effects
Supplements A product intended for ingestion that contains a dietary ingredient intended to add further nutritional value to the diet.	Creatine/ Protein/ and BCAA powders (e.g., vitamins, minerals, herbs, amino acids, metabolite).	<input type="checkbox"/> Increases lean body mass, muscle size and strength <input type="checkbox"/> Promotes energy cycle within the cells	<input type="checkbox"/> Water retention <input type="checkbox"/> Creatinine by-product may produce acidemia <input type="checkbox"/> Waste by-product can stress the kidneys <input type="checkbox"/> Gastro-intestinal discomfort <input type="checkbox"/> Constipation
Gene Doping Gene doping aims to manipulate DNA to improve aspects of athletic performance, such as speed, power, or endurance.	Insulin-like growth factor	<input type="checkbox"/> Increase targeted muscle mass and strength	<input type="checkbox"/> Unknown
	Myostatin	<input type="checkbox"/> Lead to widespread increase in skeletal muscle mass and strength	<input type="checkbox"/> Unknown

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Figure 2: Physical Enhancement Substances

C. Current Programs and Policies

The military needs service members to succeed despite great physical and mental challenges in unknown and uneven terrain. To understand why PES have a place in today's military, we need to know how the military squeezes every bit of performance out of our service members today. How does the military optimize the force for victory on the battlefield? At every level of leadership, all services wrestle with how to best train and prepare service members to win. Although every service has its training manual, this section will specifically analyze how the United State Marine Corps currently prepares its forces for the rigors of combat.

The Marine Corps philosophy of training is "to provide combat-ready units to the nation ... so Marines can survive and succeed in combat."²⁵ To standardize training, the Marine Corps produces a Training and Readiness (T&R) manual that sets standards for the service as a whole, and military occupational specialties (MOS) specifically. The T&R manuals center around Mission Essential Task lists (METL). The requirements for individuals, groups, MOSs, and the Marine Corps as a whole are organized to meet the METLs.²⁶ The Marine Corps' philosophy on the importance of training can be summed up with a quote from the T&R manual for all Marines, "When a Marine is able to perform his job expertly, that Marine makes a team/section/squad better able to perform its mission."²⁷ The T&R manual follows a building block approach, starting at the individual Marine and works its way up to Marine Air Ground Task Forces (MAGTF). Broken down in the requirements are evaluated events (e-coded events). These e-coded events determine whether or not the individual or group can achieve their METLs and if the comprehensive unit can accomplish their assigned missions, if they are "ready." This is how the Marine Corps prepares for combat. Training sets the conditions both mentally and physically for success and failure on the battlefield. Training is the foundation for victory.

The physical prowess of a Marine is a hallmark of the institution. Physical training increases the performance of duties. The Marine Corps Order 6100.14, Marine Corps Physical Fitness Program, describes physical fitness as a highest priority.²⁸ To build up a Marine's physical capacity, the Marine Corps has adopted a form of functional fitness. The Force Fitness division oversees the development of all aspects concerning physical fitness. The Marine Corps has published a clear end state, "the program will result in Marines who are fit, resilient, and more lethal on the modern battlefield."²⁹ Five programs make up the Marine Corps fitness program: Force Fitness Instructor, Marine Corps Body Composition and Military Appearance,

Water Survival, Martial Arts, and Sports Medicine Injury Prevention Programs. Force Fitness instructors act as the commanding officer's representative and develop unit fitness training plans. The Marine Corps Body Composition and Military Appearance Program sets the standards for height to weight ratios and appearance in uniform. These standards stress the importance of dedication to a healthy lifestyle. The Marine Corps ensure its Marines are prepared to operate in amphibious environments with water survival instruction. The Marine Corps Martial Arts Program combines a weapon-based fighting system with fitness to maximize a Marine's capacity to win on the battlefield. The Sports Medicine Injury Prevention Program mitigates the risk of injury upon joining the Marine Corps. The Marine Corps Recruit Depots and The Basic School are the only locations with a Sports Medicine Injury Prevention Program. There are two tests administered annually to evaluate the fitness level of Marines and the effectiveness of the force fitness programs. The first of these tests is the Physical Fitness Test (PFT). The PFT consists of maximum pull-ups, maximum crunches in two minutes, and a timed three-mile run. The second test, Combat Fitness Test (CFT), measures a Marine's fitness against combat-related tasks. The CFT consists of an 800-meter sprint, maximum repetitions lifting an ammunition can in two minutes, and 300-meter shuttle run course with crawling, buddy drags, and ammunition can carry. Both these tests have associated scores which post to a Marine's permanent record. Failure to make the minimum score results in disciplinary action. The Marine Corps offers a wide array of health-related classes from basic nutrition to advanced instructor courses in every program under the Force Fitness Division. Much effort is applied to raise the fitness level of all Marines to their maximum potential.

In addition to physical fitness the mental or cognitive fitness of Marines is also a high priority. Beyond entry-level schools, Marines expand their knowledge in the profession of arms

through Professional Military Education (PME). The Marine Corps has mandatory professional development tailored for every rank. For example, Marine Corps University (MCU) heads all PME programs. Aboard MCU are several resident courses which span a full year. For the Marines unable to attend a resident course there are non-resident courses available through the Distance Education Program, like online courses offered by most civilian higher education institutions. MCU's purpose is "a continuum of education to improve leadership, sharpen critical thinking skills, and deepen Marines' understanding of warfighting concepts in distributed and joint environments."³⁰ There are few private companies who pull leaders at all levels to spend a year developing and expanding their knowledge. This year devoted to education is a real investment by the institution.

The Marine Corp's investment in enhancing human performance is limited to training and education. The policies regarding the use of PES are strict and carry severe consequences. The Department of Defense (DOD) follows the World Anti-Doping List of Banned Drugs/Substances and the Drug Enforcement Administration (DEA) scheduling of drugs. Using or possession of PES is punishable under the Uniform Code of Military Justice (UCMJ). Punishments include incarceration and a dishonorable discharge from service. This policy stifles potential human performance enhancement. The military places great emphasis on the physical and mental abilities of its service members but limits itself without PES.

D. The Gap between technology and Human capacity

A constant stream of data into today's operational environment, while increasing awareness, can be overwhelming. The warfighter of today has to process information, decide on their course of action, and articulate their decision, often while stressed and fatigued. Has this new and steady stream of data surpassed the human ability to process and use the data effectively

and efficiently? Can we safely boost the human ability to process information, translate data, and decide on a course of action?

At the Basic School (TBS), where every USMC second lieutenant starts his or her career, there is an exercise to demonstrate the value and burden of information on the decision-making process. In the exercise, the instructor begins to read information the students will use to form an order that their notional platoon will execute. The exercise is timed to stress the importance of deciphering the essential and relevant information on time. The students are given a total of 20 minutes to write the order. The instructors start reading aloud the information required to write the order. The students are free to leave at any point once they feel they have enough information to make an informed decision. Some students leave as early as 5 minutes, but most will stay for the full 20 minutes. The relevant information is front-loaded, and the rest of the information is irrelevant. The exercise demonstrates how crucial it is to interpret the applicable information, make a timely decision, and then clearly pass this decision to subordinates. The exercise does not enhance the ability to interpret information but gives an understanding that information can be both useful and a burden if it is only clouding the leader's mind. This exercise is conducted in a classroom free from field stress and lack of sleep.

A real-world example of how technology can overwhelm a single mind, when adding in the pressures of time and accuracy of fires, is described in an interview with Lieutenant Colonel Damon Anthony, Major James Akers, and Lieutenant Colonel Steve Pieper, pilots flying a generation 5 fighter, like the F35. These modern-day aircraft have more information flowing through the cockpit than an Airborne Warning and Control System (AWACS).³¹ A crew of four flies the AWACS and have 13-19 specialists to process and synthesize and forward pertinent data to the forward operators. The F-35 has a crew of one. In this case, unlike the exercise for

new lieutenants, all the information is essential. How can one person flying the most sophisticated fighter jet while doing the job of 19 people be effective? The technology has pushed the limits of what is cognitively possible. Long flight hours combined with the mental agility required to maneuver through contested airspace and the pressure of placing bombs on target does not leave much room to process copious amounts of data or information.

The Airforce, Navy, and Army aviation branches have already explored PES to increase awareness in the cockpit and mask the effects of mental fatigue. The Air Force uses cognitive enhancer called modafinil. Col Paco Geisler described their use while flying missions for Operation Just Cause, "there were no noticeable side effects during Just Cause; we just felt wide awake."³² There has been at least one recorded incident of catastrophic failure during combat flight operations that was attributed the use of PES. In April 2002, during combat operations in Iraq, pilots cited the use of PES as affecting their moral judgment during a friendly fire incident.³³ This was not a failure in moral judgement, but rather information overload in a stressful combat situation that lead to the failure of prosecuting the correct target. The Air Force continues to use PES to aid pilots in the execution of their duties. In the aeromedical after-action reports covering both Operation Desert Shield and Storm over half the pilots said the use of "go pills" was needed for mission accomplishment. The same reports reviewed all the Class A mishaps and none were attributed to the use of PES.³⁴ This use of PES in a real-world high intensity conflict demonstrates the positive effects of PES. Likewise, the Army conducted aviation tests of its own, using appropriate doses of modafinil and dextroamphetamine, resulting in increased alertness and mental function over a placebo.³⁵ This is the extent of current use of PES in the US military today.

Pilots are not the only community mentally affected by the stress of combat. Ground units have the same necessity for perfection, regardless of sleep deprivation and operational stress. Operations can last up to days. All jobs in the military require a stable functioning mental state. In the fire direction center, 10-digit grids, constant radio chatter, lack of sleep, and poor living conditions are part of every day operations. With increased ground sensors, critical movement of special operations troops, mobile friendly units, and more platforms reporting enemy movement, the young troops who operate the radios and send firing data, are required to process more information than ever before. However, they are not offered the same PES as the pilots over their heads.

E. Testing

Physically enhancing service members has not been tested. Special Operations Command requested testing to improve endurance, strength, and recovery of Special Operation Forces. In 2017, Ben Chitty, a project manager for biomedicine, stated, "If there are ... different ways of training, different ways of acquiring performance that is non-material that are preferred, but in many cases, we have exhausted those areas."³⁶ The driving factor behind the physical enhancement of service members is longevity. Today service members are carrying more than their predecessors. Items include personal protective equipment, ammunition, weapons, radios, sensors, food, water, and maybe a rucksack full of gear weighing between 70 and 110. Estimates of body weight ratio to weight carried place these loads well over the recommended amount for a load-bearing unit.³⁷ This weight is not expected to decrease, and the marketing of new gear as light does not translate to lighter loads.

A test to validate any PES has to be done under conditions simulating combat and against evaluated tasks. There are two locations a validating test could take place, at recruit training and

during a service-level exercise. Under this construct, the validation test would begin at the same place every Marine does – the yellow footprints – and end at Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms, California.

Today's Marines step on the yellow footprints on their first day of boot camp in San Diego, California or Parris Island, South Carolina. This initial validation testing would only need to take place at one facility. Recruit training is an extremely controlled environment with multiple disciplines of medicine being practiced including sports medicine, nutritionist, and general practice physicians. Corpsmen and Drill Instructors supervise recruits at all times through all phases of recruit training. A recruit training regiment will have multiple companies in different phases of training, but a single company has multiple platoons going through start to finish at the same time. After, "pick up" one platoon has supplements like creatine, protein, and BCAAs added to their daily diet. One platoon has nothing added to the normal recruit diet. The last platoon adds the physical supplement and a cognitive nootropic like ginseng. All added PES's are entirely natural, with little to no risk. There is virtually no chance for recruits to abuse any substance because of the substantial amount of oversight. Recruit training builds in physical assessments, graded tests, leadership reaction courses which are already used to gather data to determine if the supplements provide an enhanced benefit. Validation testing would provide data on the differences between the test and control platoons in areas such as graduation rate, physical and cognitive test scores, number of injuries requiring medical rehabilitation, and physical and mental health. Mountains of data already exist from previous cycles to compare against this controlled test. The first validation test builds a stable baseline in a completely controlled environment for further testing in the fleet.

Recruit training provides an extremely controlled environment, but recruits receive sleep, three meals a day, and constant supervision. To validate the use of PES for the full force, a test must also be conducted outside of a completely controlled environment. Before deployment, most infantry battalions participate in a service-level exercise aboard MCAGCC Twenty-nine Palms, CA, during which they undergo an evaluation of select individual and collective T&R tasks. This exercise provides an ideal venue for the second PES validation test.

This second test could follow the same basic set up as recruit training battalions since infantry battalions are similarly broken down into companies. During the integrated training exercise (ITX), units undergo a MAGTF level exercise testing all warfighting functions. Some events are individual to platoons and not all companies experience the same events at ITX; some companies conduct air assault, while others are mechanized. However, all companies will experience sleep deprivation, long physically and mentally demanding days, and increased decision-making cycles. Multiple tests may be appropriate to test the effectiveness of PES in all aspects of ITX. This training exercise provides an opportunity to test the benefits of enhancement. One Company is given physical PES, another cognitive, one both, and a control company given nothing extra. ITX is evaluated against T&R tasks and provides feedback to the unit for areas needing sustainment, maintenance, or further training before deploying.

F. The Counter-Argument

PES are highly controversial and widely misunderstood. There are two strong counter-arguments against the use of PES. Ethical implications and lack of formal research on short- and long-term side effects cloud any potential gain or benefit of the use of PES. These two arguments stunt any progress in testing and using PES.

The military seeks to enter the fight with an advantage. The unknown side effects create a moral concern in the military. The US military carries a moral obligation to protect and preserve its service members.³⁸ Without well researched and tested PES, it would be foolish to allow service members to take anything without a real understanding of the risks and benefits. Jessica Wolfendale, a research fellow of philosophy and ethics, who primarily focuses her research on the ethics of war, questions the moral responsibility and moral judgment of an enhanced soldier. She continues to argue a soldier's ability to make moral and ethical decisions crucially impacts the long-term effects of war, and PES could impact this effort.³⁹ If service members operating on PES lose their "conscious morality", it would lead to a loss of trust in the military to operate with honor. This point is echoed by a professor of law and ethics, Richard Ashcroft, who believes PES should be heavily regulated and not used by the military.⁴⁰ Opponents to the military use of PES argue to the moral concern that PES will dehumanize warfare. The loss of morality should be investigated when testing for military use. On the subject of lost morality, ethicists agree if the use of PES were to deny a soldier's ability to make ethical decisions, then PES should not be used to increase performance. However, Chris Wigger and Patricia Oelschlager, military ethics researchers, argue conditions could be set to use PES ethically. Wiggers and Oelschlager argue a moral need exists to test PES for military use further. They recommend using guidelines established by Michael B. Russo M.D.⁴¹ Many pro-PES authors cite Doctor Russo for his work on the ethical use of PES. Doctor Russo uses five questions to determine how the military could test the use of PES ethically. Those questions are: has consent been given, is the medication safe and being used in the correct environment, is the use consistent with its dosage and function, is the use under proper supervision, and finally, have all other options been exhausted.⁴² The questions outlined above address' consent. The military has

legal and moral obligation to protect service members. DOD 6205.02, Policy and Program for Immunizations to Protect the Health of Service Members and Military Beneficiaries, builds the legal framework for enforcing widespread use of PES. Today we vaccinate to build up immunities against threats like influenza, small pox, anthrax, and malaria.⁴³ The health benefit extends beyond the individual member but also preserves the force. As discussed earlier, the Marine Corps training programs, both physical and mental, are robust and extensive. The military has exhausted the traditional methods to push the limits of performance.

Our society and culture heavily influence the ethics of human enhancement, but that does not mean we should ignore the potential PES brings to the battlefield. In a 2003 report responding to ethics, from President George W. Bush, he said: "men remaining human even in moments of great crisis."⁴⁴ President Bush understood, in order to use PES to bridge human performance with technological advancement the risk, the ethics of a warfighter need to remain intact.

G. Conclusion

There is no way to eliminate all risk associated with combat. There have been great leaps and bounds in biochemistry over the last decade, though many of these scheduled substances are banned for use unless approved by a doctor. Jose Conesco was vilified for improving his game with banned substances, however not all PES are bad and can enhance a service member's capability on the battlefield. Throughout history, militaries have always been interested in enhancing soldiers' capabilities on the battlefield, but our recent history has added technology like never seen before on the battlefield. Technology has always added a significant advantage in combat, but a ripple effect is a lack of fusion between technology and human capability. Soldiers, sailors, airmen, and Marines should be afforded the option to increase human

performance to meet technological advancement and bridge the gap from training to combat. The use of performance-enhancing substances can be the link. Any test or evaluation of PES to ultimately improve the warfighters lethality, survivability, and proficiency is a road worth pursuing.

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