Military Research Psychology: Advancing Performance and Practice

25

Gerald P. Krueger and Joseph B. Lyons

The focus of the present book is on clinical and organizational practice, which encompasses a broad range of behavioral science topics related to protecting and enhancing the health and well-being of military personnel and their families. The practice of military psychology generally emphasizes prevention of adverse responses to an assortment of environmental and psychological stresses that uniquely accompany military lifestyles and work situations. These include stresses/stressors encountered in: (1) military skills development training and during readiness training and preparation for combat; (2) deployment to unfamiliar and mostly harsh settings, usually overseas; and (3) ultimately, engaging in sustained combat operations, or alternatively in peacekeeping, humanitarian, and nation-building missions.

This chapter is somewhat different from most other chapters in the book. It attempts to provide a sampling of what military *research psychologists* do in several settings. Regardless of specialty, the abiding goal of all military psychologists is to help preserve the health and performance of soldiers, sailors, marines, air force, and coast guard personnel during multiple aspects of their military experience.

Historical Background

U.S. Military Research Labs and Psychological and Behavioral Science

After World War II, the U.S. Army, Navy, and Air Force each retained a sizeable number of research laboratories whose formation was spurred by that war. There was a tremendous growth spurt in military labs during the late 1940s and continuing through the mid-1970s. Before more recent cutbacks attributable to a series of Base Realignment and Closures (BRAC) prompted consolidations, there had been a considerable variety of military research organizations – in all over 50 labs and research centers. The mission of most labs was to ensure our fighting forces continually had the latest technological advances in weapon systems with which to fight; and that our forces in deployed environments overseas had effective logistics and supply systems to sustain them. After doing basic and exploratory research, and much product development work, many labs also performed testing and evaluation of military systems to

G.P. Krueger (✉)
Krueger Ergonomics Consultants,
Alexandria, VA 22306, USA
e-mail: JerryKrueg@aol.com

J.B. Lyons
Human-Centered ISR Division/Human Trust and Interaction Branch, Air Force Research Laboratory,
Wright-Patterson AFB, OH 45433, USA
e-mail: joseph.lyons.6@us.af.mil

S.V. Bowles, P.T. Bartone (eds.), *Handbook of Military Psychology*,
DOI 10.1007/978-3-319-66192-6_25

inform decision makers before committing to expensive procurement actions. Also common were studies to retrofit systems that needed fixing or upgrading after fielding.

About 20–25 of the labs were charged to do medical research of one variety or another (e.g., infectious disease, surgical research, dental and maximal facial injury research, dealing with chemical-biological-radiological threats). Each service also had a lab dedicated to aviation or aerospace medicine. In each of the three major military services, a handful of the medical research labs and other organizations identified as military personnel research centers employed significant numbers of research psychologists and other behavioral research scientists. In the aggregate, over the seven decades since WWII, the U.S. Army, Navy, Air Force, and the Department of Defense employed hundreds of behavioral and social science researchers, most of them as federal civil servants, and to a lesser extent, as active duty scientists or contractor personnel. Additional behavioral scientists worked at the US military academies, at the Uniformed Services University for the Health Sciences, and for numerous public and private university academic labs or for government or privately established research foundations. Much of the work of these many researchers is easily recognizable as being in the realm of military psychology. Collectively, they all worked on an identifiable number of thematic behavioral research programs, designed to:

1. Achieve effective, workable military *personnel selection and job placement* processes.
2. Enhance military *training and the combat preparedness* status of deployable forces.
3. Attain *user-friendly combat systems* (i.e., human engineering of weapons, military materiel systems, etc.) for ensuring mission accomplishment.
4. *Preserve the health, performance, and fighting strength* of combatants and support personnel throughout the military family – in particular, research on how to prevent or attenuate environmental and operational stressors that potentially degrade military performance.
5. Positively influence Department of Defense and individual service-wide *personnel, organizational, and operational policies* regarding numerous issues that impact the lives of millions of military service men and women, and their families.
6. Ensure our *fighting forces returning from combat are supported* in reacclimating to post, camp and station assignments; or in the case of separating veterans, offering them a supportive transition back to civilian life. This included care of wounded vets in treatment at service hospitals and in Veterans Administration programs.

There is no recent singularly focused collection presenting a summary of which US military research organizations employed large numbers of military psychologists. But, one can read about many of them in all three major U.S. military services, in books by Zeidner and Drucker (1988), Gal and Mangelsdorff (1991), Mangelsdorff (2006), Bartone, Pastel, and Vaitkus (2010), Laurence and Matthews (2012), and the U.S. Army Research Institute for the Social and Behavioral Sciences (2015). Military psychology research in various labs is also described in individual book chapters by Krueger (in Cronin, 1998; in Hancock & Szalma, 2008; and in Bartone et al., 2010a).

In summary, a large body of military psychological research has been oriented to personnel selection, including before, during, and after periods of time when the United States employed a conscript draft system (which officially terminated in 1973); then recruitment research; job placement categorization work; and studies of training processes and design of high tech training systems (e.g., for Army training systems, see Goldberg, 2012). A natural follow-on includes many lab-based studies concentrated on individual "soldier performance" (e.g., doing basic military tasks, individual rifle marksmanship, plotting targets on a map, flying airplanes, firing vehicle-mounted weapons, etc.). There was also examination of performance of teams or crews, such as studying the performance of military personnel operating in crew-served weapon systems (e.g.,

tanks, aircraft, helicopters, naval vessels, ships, submarines, missile launchers, etc.). Some recent research psychology trends in the Air Force, as described later in the chapter, tend to be very technology-centric, though with the same emphasis on improving human performance.

Carrying through with this behavioral research included examining both individual and team performance when environmental and organizational stresses were heightened, as for example during sustained and continuous military operations; in environments that included high heat or extreme cold; at high terrestrial altitudes; or studying individuals performing while wearing chemical–biological agent protective uniforms and equipment. Air Force and Navy studies examined fighter pilot performance at high aerospace altitudes, in air-to-air combat scenarios; and sailors performing on naval vessels underway, often on rough seas. Many studies were done in lab experiments, or during field training scenarios; and others while using sophisticated high technology simulators. Opportunities to conduct data collection assessing performance during actual combat operations were less common. There were also numerous psychological examinations of traits of leadership, elements of team cohesion, collective (unit) mission performance, and assessments of the quality of individual and unit mission accomplishment. Reports of such military psychology research studies fill volumes, and many are critically important. However, the incredible array of the above-mentioned research efforts might only be of tangential relevance to the interests or work of clinical military practitioners and operational psychology consultants.

Accordingly, in this chapter we have been deliberate in presenting just a few research psychology selections. These cover four principal areas: (1) research strategies to promote mental health during and after military deployments; (2) studies of psychological adjustment to military life; (3) a few select Navy psychological research studies on adjustment to Navy life, on behavioral health, and on cognitive performance; and (4) a brief description of three contemporary aspects of Air Force human factors/applied psychology research trends: training, human-machine interaction, and Sense–Assess–Augment framework research.

Combatant Stressors and Soldier Performance Effectiveness

The Fuss About Stress

After reading a number of chapters in this book it may appear that military behavioral scientists and clinical practitioners are apt to cite different definitions and connotations for the terms: *soldier stress, combat stress, battle fatigue, combat stress reaction, stress casualty, or even posttraumatic stress (PTS) ~ disorders (PTSD) or injuries (PTSI).* For a research psychologist interested in the effects of stress on "fighting performance," *combat stress* or *operational stress* is often looked at more as being the "stressors" or the *stimuli* in the environment. For example, weather extremes, especially high ambient temperatures and high humidity, or excessive acoustical noise, or even receiving pressure to perform from a demanding boss, can make work "more stressful" and more difficult. Stimuli-stressors of many different sorts can adversely affect performance, even on simple and basic military tasks. *Stressor stimuli*, both physical and psychological, whether manmade or environmentally induced, impinge upon the person (soldier, sailor, airman, or marine) as the stressors affect his/her readiness and ability to perform, to engage in and succeed in a fight.

On the other hand, for the clinical practitioner interested in mental health, *combat stress* often refers to the *response* of a combatant (i.e., more internal, subjective responses) to multiple stressors on the battlefield or in the work environment – responses that begin to manifest individually as clinical symptoms. Such stressors include participating in lengthy arduous work stints, or they could be due to something like having to work in a rough, toxic organizational climate where good unit leadership may be lacking. Since not all stress is "bad stress," some physical and psychological or operational stressors (stim-

uli) may prompt a soldier to perform very well (e.g., serving to heighten one's motivation). Contrarily, the accumulation of stressors may contribute to making the soldier an ineffective combatant on the battlefield. An overly-stressed combat soldier is likely to be one who is physically able, but is otherwise psychologically unable or unwilling to continue the fight as he/she experiences phenomena often referred to as combat fatigue, combat stress reaction or even in contemporary trends, may be categorized as Posttraumatic Stress Reactions (sometimes labeled as PTS-Injury or PTS-Disorder).

Soldiers process or filter many stressors (stimuli) through organizational, social context, and personal variables. Social context variables that might influence how stressors get processed in the military environment include unit cohesion, leadership climate, operational tempo, and others. Personal variables that influence or moderate the stress-outcome relation include past experience, pre-existing psychopathology, and personality characteristics (Bartone, 1998). Bartone suggested that it is important to understand and maintain a conceptual distinction between "stressor" and "response to stress" and to strive to measure and talk about the two separately. Countless journal articles and book chapters describe many aspects of soldier stress and combat operational stress reactions. For notions on how battlefield stress terminology and assessments have changed over the past century, see for instance Campise, Geller, and Campise (2006).

During World Wars I and II, extreme battle stress casualties received considerable attention from military psychiatrists (Jones, 1986). As medical practitioners, psychiatrists focused on effective treatment and return to duty of psychiatric casualties. The many terms employed to describe extreme stress often took on different meanings in discussions of large- and small-scale wars. Causes of extreme stress reactions were attributed to situational factors such as *combat intensity* and *duration*. Very lengthy exposures to actual combat, including intense, lethal, direct, and indirect fire (e.g., in some WW II cases, almost continuous artillery bombardments over months duration) increased the potential for individual psychiatric breakdown and unit disruptions. According to D. Marlowe (1986), a social anthropologist at the Walter Reed Army Institute of Research (WRAIR), the power of the battlefield to break men can never be overstated. Marlowe pointed out that involvement of U.S. armed forces personnel in WW II was substantially different from U.S. combatants participating in the wars in Korea (1950–53), Vietnam (1961–73), the Persian Gulf I & II conflicts (Iraq in 1991 and 2003), and Afghanistan (2001–continuing). The experiences of many combatants, that is, in terms of combat intensity and duration, varied considerably. These later wars of course were not less stressful or deadly to specific infantry platoons engaged in a desperate firefight with the enemy – which may have lasted for hours or even days, but except in rare cases (e.g., the siege at Dien Bien Phu, Vietnam in 1954) such battles did not usually carry on for months at a stretch. Even during the past decade of fighting in Afghanistan, Iraq, and Syria, combat actions have not matched the scale, the intensity, and especially not the weeks and months-long duration of high-intensity main force battles between essentially equipotent forces using massive resources for indirect artillery fire as occurred in WW II.

The incidence of *soldier breakdown* in later wars was as much controlled by the calendar as by the outcome of combat with the enemy. By design, in these more contemporary wars, shorter assignment rotation policies for U.S. military personnel dictated how long an individual's combat tour lasted. In Korea, Vietnam, Bosnia, Afghanistan, and Iraq, individual tours in combat generally were for 1 year or less; but in some instances slightly longer than a year; for example, some personnel served 15-month deployments in Iraq in 2007. Combatants in these later conflicts usually did not envision themselves as being committed for years at a stretch, to the *end of battle*, as was the predominant case in WW II.

It is not practical here to make statements of comparative rates of psychiatric cases between WW II combat and present day conflicts in the Middle East. This is especially the case while the U.S. Defense Department is still implementing

new and frequently changing policies and practices on early prevention, identification, treatment, and tracking of combat stress casualties in numerous contemporary overseas troop deployments. Some of the deployments, for example, the U.S. military "surge" of thousands of additional combatants deployed in Iraq (2007), and also in Afghanistan (2009–2010), involved additional large numbers of military and contractor personnel, many of whom were not directly involved in combat. That is, in some cases smaller numbers (by percentage) of actual combatants were exposed to lengthy durations of combat. The constant change in duration of overseas deployments continues even today. As is described later in this chapter (under MHATs), *intensity* and *duration* of combat exposure remain as important assessment measures of troop mental health status.

Examining Deployment Stress

As Bartone (1998) indicated, if we are to study soldier stress, or stressors, we should concentrate not only on the battlefield, but we should also give due consideration to the entirety of the military setting. The military setting should include: (a) the soldiers' garrison or home-station environment, (b) the forward-deployed environment for troops stationed at overseas locations or on ships or submarines, and (c) the deployed environment for troops on an actual military mission. Missions can range from including exposure to intense stressors associated with an actual attack or rescue operation, to the unique stressors prevalent in the several stages of performing less militarily glamorous peacekeeping and nation-building activities.

Curiously, due to recent extensive employment of advanced technologies such as remotely piloted aerial vehicles (RPVs or drones), we are now witnessing that it is possible to experience the same consequences of combat/deployment stressors without deploying (in the traditional sense) but rather by working in high-operational tempo jobs where one might be exposed to combat-related stressors during one's regular job situated remotely to the theater of operations. Notably, recent research found evidence that RPV and drone operators are susceptible to PTSD while operating on domestic bases far removed (physically but not psychologically) from the actual battlefield. This phenomenon was studied in intelligence, surveillance, and reconnaissance (ISR) operations and reported by Chappelle, Goodman, Reardon, and Thompson (2014), and also by Reardon, Chappelle, Goodman, Cover, Prince, and Thompson (2016). RPV operational missions also involved remotely directed combat search and rescue and close air support. For commentary about the effects of shift work and sustained operations with unmanned aircraft systems, see the section in this chapter about sleep deprivation and fatigue. An extensive discussion of RPV operator performance, some operational psychology issues, and occasional mental health concerns is also presented in the Aeromedical Psychology chapter by Saitzyk, Mayfield, Sharkey, and Coleman (2017), which appears elsewhere in this book.

Bartone (1998) posits that three types of outcome variables are influenced by stress: soldier performance, social adjustment, and health. Stress can lead directly to impaired performance, can contribute to a variety of physical and mental health difficulties, and can result in a variety of social adjustment problems such as family violence, divorce, and substance abuse. Psychological stress in military operations can also have a range of serious consequences, including increased risk of death and serious injury from accidents, inattentiveness and errors of judgment, even friendly-fire incidents and suicide. Additionally, psychological stress can increase the risk of soldier misconduct, alcohol abuse on the job, and violations of the rules of engagement as well as diminish soldier mental health, morale, and psychological readiness to perform the mission.

To offer a better understanding of soldier responses, Bartone, Adler, and Vaitkus (1998) suggested five general categories of psychological stressors salient to military operations, particularly on deployments overseas. The five dimensions capture in a general way the more detailed specific stressors: Isolation, Ambiguity, Powerlessness, Boredom, and Danger/Threat. Table 25.1 summa-

Table 25.1 Dimensions of psychological stress on military operations

Isolation
Deployed to physically remote locations
Encountering obstacles to communication
Units are newly configured, low cohesion
Individuals are cross-attached from other units
Ambiguity
Mission not clear or well defined
Command structure is ambiguous
Role and identity confusion, ambiguity
Powerlessness
Rules-of-engagement are restrictive
Constraints on movement and action
Exposure to suffering of local people
Surrounded by foreign culture and language
Lack of privacy – little control over living arrangements
Relative deprivation – "double standards"
Boredom
Repetitive, monotonous routines and schedules
Lack of meaningful work
Over-reliance on "busy work"
Threat/danger
Danger of death, injury, threat to life or limb
Mines, snipers, disease
Exposure to death of others, including dead bodies

Adapted from Bartone et al. (1998)

rizes a range of stressors in military operations that incorporates the special relevance of modern, non-combat, or peacekeeping activities.

Isolation and boredom are common to numerous military settings wherein troops work in monitoring roles at distant outposts, doing routine patrols, and warily keeping an eye on their adversaries. The powerlessness or helplessness factor, especially in some peacekeeping activities, can be a function of highly restrictive rules of engagement that constrain soldiers from responding in many situations, as well as such experiences as witnessing the suffering of indigenous people in the area of operations without being able to offer much help to them (Bartone, 1998). A sense of powerlessness can also result from travel restrictions, difficulty communicating in a foreign culture and language, and loss of privacy and control over living conditions. Combatant soldiers who are trained to fight may experience ambiguity in adjusting to uncertain missions and to the role of being asked to serve as peacekeepers, which often requires control and restraint (Bartone, 1998). Risks of injury and death vary depending upon the type of operations and one's location relative to the combat action (i.e., front or rear guard). But as the US involvement for over a decade in Iraq and Afghanistan demonstrates, even rear echelon support personnel are not assured protection from physical harm, including being exposed to debilitating losses of limbs or experiencing traumatic brain injury (TBI) due to concussive blasts from enemy improvised explosive devices (IEDs) and other contemporary asymmetric warfare tactics.

We next provide a summary of the findings from important psychological research efforts aimed at identifying stressors in the military setting, and their effects on military operations and on military personnel.

Research on Resilience and Mental Health During Military Deployment

Particularly during the early days of the wars in Iraq and Afghanistan, military psychology researchers at the Walter Reed Army Institute of Research (WRAIR) developed a core source for epidemiological studies, assessment research, and mental health resilience training research conducted mostly with Army soldiers (Bartone, 1999; Adler, Bliese, & Castro, 2011). Much of the research infrastructure established earlier at WRAIR focused on examinations of the mental health of peacekeeping personnel (e.g., Bartone, Adler, & Vaitkus, 1998); on the impact of high operations tempo (e.g., Castro & Adler, 2005; Dolan, Adler, Thomas, & Castro, 2005); on leadership and training as they affect soldier well-being (e.g., Chen & Bliese, 2002); and on the mental health effects on service member retention (Hoge et al., 2002).

One of the major accomplishments at WRAIR was development of a soldier resilience training system called *Battlemind Training*. As a risk communication and training strategy, Battlemind frames mental health issues within the context of

the skills and strengths that soldiers exhibit in combat that help them to survive (Adler et al., 2009). Training content was based on WRAIR research that found an association between pre-deployment resilience training and maintaining adequate soldier mental health during deployment. Post-deployment training was also found to be effective, resulting in fewer returning soldier psychological problems.

In 2007, Battlemind Training was integrated into the institutional army through the Deployment Cycle Support Program and the Army's formal officer and noncommissioned officer career training courses. Adler et al. (2011) noted that prior to Battlemind Training none of the U.S. military services had an empirically-based mental health training program for use in preparing service members for the psychological demands of combat. Battlemind was the first systematic attempt to create a research-based mental health training initiative. The WRAIR developed Battlemind Training program is an example of an Army program configured specifically for soldiers and validated as an early intervention for coping with combat deployment stress (Adler et al., 2011).

A few years later, circa 2010–2011, the Army unveiled a broader approach as it absorbed Battlemind into a more comprehensive resilience training program called the *Comprehensive Soldier Fitness* initiative based on the principles of positive psychology (Cornum, Matthews, & Seligman, 2011; Cornum & Lester, 2012). In this larger scale program, the label Battlemind was replaced by the term *resilience training*. As initially configured, the Comprehensive Soldier Fitness program offered online self-assessment of resilience, online training modules on self-development, and in-depth resilience training. Since then the program encountered some difficulties during its widespread implementation; it has been challenged by several attempts at validation; and it witnessed several notable modifications. But, the concept of providing resilience training to soldiers throughout the deployment experience was established as a desirable contribution to limiting psychological stress, enhancing soldier performance, and lessening the likelihood of deployment-related casualties.

Prior to the US involvement in the conflagrations in the middle-East, most mental health assessments of the impact of soldier exposure to combat were usually done long after combatants had returned home from the battlefield – often years afterward. Charles Hoge (2011) indicated that unique features of the wars in Iraq (Operation Iraqi Freedom: OIF) and Afghanistan (Operation Enduring Freedom: OEF) involved behavioral scientists extensively using epidemiological methods (surveys, program evaluation of population-based screening, and health care utilization studies) to assess the mental health impact of deployment while the wars were still ongoing.

Hoge et al. (2004) reported that the Departments of Defense and Veterans Affairs prompted research early in these two conflicts to inform health policy. For example, in 2003 the DoD established the Deployment Cycle Support Program to evaluate service members for evidence of mental health problems as they returned home from combat. The program led to a refined Post-Deployment Health Assessment (PDHA), a standardized population-wide screening for deployment-related health concerns including such mental health issues as marital problems, depression, PTSD, and substance abuse.

Surveys of representative samples of military personnel were conducted in the various stages of pre-deployment, actual deployment to a mission (usually overseas), mid-deployment phases, during and upon return from employment, and again post deployment, at some reasonable length of time (months) after returning home. Surveys at each of these time frames helped to assess the prevalence, risk factors, and predictors of mental health concerns and a myriad of behavioral problems. In providing important insights about mental health impacts of combat, such research led to the development of new education, prevention, and clinical care strategies. The work also highlighted the challenges in delivering evidence-based treatment for war-related mental health problems of military personnel. The willingness of senior DoD leaders to implement new health policies on the basis of findings from those studies was equally impressive (Hoge, 2011). Hoge (2011) summarized the importance of such behavioral science work this way:

> These surveys have combined classic epidemiological analyses of patterns of disease expression in the population with traditional psychological assessment techniques from social, organizational, educational and behavioral psychology perspectives. This integration has allowed analysis of moderating variables, such as cohesion and leadership, on the expression of traditional mental disorders, such as PTSD, and behavioral outcomes, such as aggression or misconduct, in military units. Population-based deployment mental health screening has been used as a key strategy to mitigate mental health problems, and epidemiological methods have been applied to understand the lessons learned, assess effectiveness, and contribute to improvements. Studies of rates of use of mental health services have provided key data on access to care and burden of treatment in the population and have led to changes in allocation of mental health resources to improve care. (Hoge, 2011)

For a fairly comprehensive description of many such deployment-related research studies, beginning with those during the Persian Gulf War (1990–1991), and mostly conducted by personnel at the WRAIR, see the book by Adler et al. (2011), and also the Army medical services corps book chapter on Mental Health Advisory Teams (MHAT) by McBride, Thomas, McGurk, Wood, and Bliese (2010).

Mental Health Advisory Teams

To provide recommendations to commanders and medical personnel deployed to Iraq, as an outgrowth of the epidemiological studies, the Army surgeon general in July 2003 began sponsoring annual assessments of mental health and well-being of deployed troops. WRAIR researchers conducted anonymous assessments throughout operational theaters, focusing primarily on infantry units (i.e., brigade combat teams). These assemblies of behavioral and psychological assessment personnel took on the name: Mental Health Advisory Teams; as did the numerous reports documenting the 6–8 large studies they conducted. The MHATs also assessed the distribution and availability of in-theater behavioral health resources.

MHAT surveys focused on four main areas of soldier mental health and well-being. These are: (1) *risk factors*, such as combat and deployment experiences; (2) *protective factors*, such as training and willingness to seek care; (3) *behavioral health status* and *performance* indices, such as individual and unit morale, depression, anxiety and acute stress symptoms, suicidal ideation, alcohol and substance abuse; and (4) assessments of self-reported *unethical behaviors*, such as mistreating noncombatants or unnecessarily damaging the property of indigenous people (McBride et al., 2010).

The MHATs conducted surveys of thousands of soldiers and marines in Iraq (OIF) and in Afghanistan (OEF). Some of the first MHATs (2003–2007) reported that 15–20% of deployed soldiers in Army brigade combat teams met criteria for PTSD (termed acute stress in the operational environment) or depression; and about 20% of married soldiers reported marital problems during deployment. Marines studied in regimental combat teams experienced mental health concerns at equivalent rates. The MHATs generally showed that high OPTEMPO: multiple deployments, longer deployments, greater time performing missions away from base camps (i.e., "outside the wire"), and combat intensity and frequency all contributed to higher rates of depression, PTSD, and marital problems. Soldiers with mental health problems were much more likely to report committing ethical violations than were soldiers without mental health problems – a demonstration of the relationship between mental health problems and mission-related behaviors. MHAT studies also demonstrated the strong protective effect of leadership that is generally associated with unit cohesion, good morale, lower incidence of mental health problems, and a lower likelihood of ethical misconduct during deployment (for details see Hoge, 2011; McBride et al., 2010).

For motivated readers, McBride et al. (2010) provide descriptions of MHAT methodological approaches, survey and assessment instruments used in these studies, and they outline some of the interpretative nuances associated with them. Of particular interest to clinical practitioners may be their descriptions of assessments of acute stress, depression and anxiety, suicidal ideation,

divorce intent, and alcohol and substance abuse. Included in the chapter are sample survey questions on each of those topics. Also presented are survey assessments of the effects of individual and unit morale, stress on work performance, and individual reports of unethical behaviors while deployed.

Deciding whether or not pre- and post-deployment screenings are efficacious in determining actual reductions in mental health concerns or behavioral problems is not so simple. Nor for that matter is it simple to determine if other intervening or confounding factors (e.g., undergoing or not, pre-deployment resilience training, or unit leadership, cohesion, other social factors, and intensity and duration of combat exposure, etc.) contribute to or detract from successful soldier-mission performance. Hoge (2011) says additional considerations here should include the low predictive value of the screening instruments in population samples, the high rate of comorbid medical and mental health problems associated with PTSD, and the low-to-moderate effectiveness of treatment modalities for PTSD. For a more extended discussion of the public health, treatment considerations, and clinical challenges that accompany such work, see Adler et al. (2011).

Partial Sleep Deprivation and Soldier Performance

Because the first author of this chapter (Krueger) spent over two decades examining sleep loss and soldier performance, of particular interest to us is McBride et al.'s (2010) documentation of the prevalence of daily partial sleep deprivation of deployed soldiers. In OIF (MHAT V, 2007), soldiers indicated that in order to feel well rested, they usually needed on the average about 6.4 h of sleep per day. However, they self-reported receiving on average only about 5.6 h of sleep per 24-hr. day. Both of these values are considerably less than the 7–8 h per day shown to be necessary to maintain optimal cognitive functioning (Belenky et al., 2003; Krueger, 2010b, 2012). These later two citations will lead one to an extensive research literature on the study of soldier performance, and sleep deprivation concerns during sustained and continuous operations. Additionally, the U.S. Army Field Manual (FM 6-22-5; 2009) provides highly specific guidance for basic sleep scheduling factors, as well as environmental and related factors for ensuring good sleep discipline in training and in combat zones. These are also listed in Krueger (2012). Also, an excellent summary of behavioral science work on managing pilot fatigue in aviation setting was provided by Caldwell (2012).

In addition to our earlier commentary about the possibility of developing PTSD in drone operations, the introduction of unmanned aircraft systems (UAS) has at times required drone pilots to engage in extended duty days and varying shift schedules likely to reduce operator effectiveness because of operator fatigue. In a 10-year old study of USAF MQ-1 Predator (drone) crews working on rotational shifts in sustained operations, reported decreased mood and quality of life as well as increased fatigue, emotional exhaustion, and burnout. In all shifts and shift rotation schedules, declines in mood and cognitive and vigilance performance were observed. These decrements were more pronounced on both day and night shifts when compared to evening shifts and on rapid shifts when compared to slow shift rotation schedules. Crews also reported moderate to high levels of task-related boredom. Overall, the environment created by UAS operations using shift work significantly increased the likelihood of personnel reporting symptoms consistent with Shift Work Disorder (Thompson et al., 2006).

On a related matter, clinical practitioners may want to consult discussions (Krueger, 2012; Krueger, Leaman, & Bergoffen, 2011; also Caldwell et al., 2009) on deployment use of psychoactive compounds that affect cognition (*cogniceuticals,* i.e., hypnotics, stimulants, and nutritional supplements): (1) to provide assistance to soldiers for staying alert and awake while performing satisfactorily during lengthy missions, and (2) to help combatants obtain needed sleep even when the noisy battlefield or their own circadian physiology suggests it

is not a particularly good time to fall asleep. Practitioners may also want to consider medical concerns that arise regarding the long-term consequences associated with the sustained use of either hypnotic sleeping pills, or of any class of stimulants, including ingesting large amounts of caffeine and/or so-called functional energy drinks (FEDs) in deployed settings. For some allied nations' air forces involved in OEF, the initial plan to "prescribe" such drugs during combat missions was meant to last just a few weeks of air operations. However, in his work, Krueger came upon unconfirmed reports of some allied aviators (i.e., fighter pilots) experiencing addiction problems after repeated use of hypnotics to induce sleep between flight sorties. Reportedly this was deemed to be due to the exigencies of war, as these pilots eventually took such drugs for several months duration during sustained operations.

While more could be said, this provides an overview of U.S. Army psychological research programs and activities that support the work of clinical and organizational practitioners. In what follows, we offer a sampling of important psychological research activities being conducted by research psychologists in the United States Navy and Air Force.

U.S. Navy Psychological Research Programs

The U.S. Navy's psychological research programs seek to improve performance, protect service members from psychological and physical harm, and better integrate human capabilities with the systems our sailors and marines must operate. For decades, such research efforts were geographically dispersed at several naval medical research labs. In 1999, the Naval Health Research Center in San Diego, California assumed command and control of the subordinate commands: Naval Submarine Medical Research Lab in Groton, Connecticut, the Naval Aerospace Medical Research Lab (formerly at Pensacola, Florida), the Environmental Health Effects Lab, and the Directed Energy Bioeffects Lab – the later three of these now are co-located along with Air Force labs at Wright-Paterson Air Force Base, Ohio (Van Orden & Nice, 2006).

The contributions of Navy military and civilian psychologists have always been quite varied. With organizational continuity dating back to the 1940s, they tout a distinguished history (see Crawford, 1970). Here we focus attention on only a few specific Navy research areas that may be of interest to clinical practitioners and operational psychologists. These include research with sailors and marines focused on: (a) psychological adjustment to military life, (b) understanding and enabling healthy behavior, and (c) understanding and improving cognitive performance.

Psychological Adjustment to Military Life

Van Orden and Nice (2006) suggested that because of the military's unique customs and traditions, for new recruits, the transition from civilian life to the military culture can be challenging for some individuals. Physical and mental requirements vary among specific military occupations. Subcultures exist between, and even within, the armed service branches. Appropriately *selecting* service members and then *monitoring their adjustment* to military culture is highly necessary because of both operational readiness and financial considerations.

Personnel Selection Since WW II psychological testing for selection and classification focused mainly on psychological and mental achievement factors, attitudes, motivation, and mental health. Attrition from military service was most often the result of a combination of factors including pre-service demography, social background, and in-service experiences such as service history, satisfaction, and job and training performance (LaRocco, Pugh, Jones, & Gunderson, 1977; Hoiberg & Pugh, 1978). Each military service uses tests to screen candidates for particular military occupations. Most military enlisted personnel are initially categorized for technical abilities by the Armed Services Vocational Assessment

Battery (ASVAB); and then either before and certainly during training they are further tested for individual skill qualifications and competencies. For a comprehensive history of military testing, but one which is primarily focused on Army testing, see Ramsberger, Wooten, and Rumsey (2012) and also Rumsey (2012).

In each service candidates for specialized training, for example, to qualify for assignments in aviation and submarine specialties, must complete additional psychological evaluation. For example, the Navy tests volunteers for the submarine service by focusing on personality variables that correlate with a sailor's ability to adjust and adapt to the unique stresses of living and working aboard a submarine for months at a time. Psychologists at the Naval Submarine Medical Research Lab at Groton, Connecticut developed a 240-item self-report questionnaire (called Subscreen) to identify candidate submariners (officers and enlisted personnel) who exhibit psychological traits that may hinder successful adaptation to the submarine environment. Subscreen produces a probability estimate of likely attrition due to misconduct, alcohol/drug abuse, and mental health disorders before new submariners accomplish satisfactory submarine tour assignments. Enlisted students identified as having a > 80% probability of negative fleet attrition are referred to the mental health clinic for a mental health status interview and additional evaluation (Bing, America, Lamb, & Severinghaus, 2005). The goal of course is to reduce psychological disqualifications and psychologically based medical evacuations during operational submarine deployments.

Physical and Emotional Health In medical and psychological studies of over 60,000 recruits, NHRC researchers found that their Sailors Health Inventory Program 40-item questionnaire was a more useful attrition predictor than either educational credentials or mental ability scores (Booth-Kewley, Larson, & Ryan, 2002; Larson, Booth-Kewley, & Ryan, 2002). These NHRC researchers examined whether or not reports of physical symptoms can play a part in psychological assessment. Strong associations were identified between anxiety, depression, and total number of physical symptoms (e.g., headaches, back pain, etc.). Factor analyses indicated emotional distress combined with certain physical complaints form a common factor that predicts basic training attrition (Larson et al., 2002). Physical symptom reports may constitute a valuable role in military selection screening, because acknowledging physical discomforts carries less of a stigma than does acknowledging emotional disturbances. Respondents may be more honest on items measuring physical discomfort (Van Orden & Nice, 2006).

Navy researchers also sought to understand the role that *positive psychological traits* play in lowering attrition risk. Previous attrition rate studies focused mainly on negative traits or events (e.g., anxiety, depression, history of trauma). Those early studies paid little attention to the beneficial role of such positive constructs as optimism, hope, or self-esteem. Subsequently, personnel selection studies at NHRC considered balanced assessments of attrition, taking account of both positive and negative characteristics in assessing individuals holistically. Exploratory work determined that various measures of positive-focused psychological traits reflect a common broad factor, *positivity,* which may have incremental validity over personality scores for predicting a positive outcome (adaptive coping) but not a negative or undesirable outcome (physical symptoms), (Van Orden & Nice, 2006).

Enabling Health Behavior and Health NHRC researchers found that two broad dimensions form health behaviors: preventive behavior and risk-taking behavior. A considerable amount of NHRC research addresses encouragement of wellness behaviors, a component of preventive behavior, and the reduction of substance use/abuse, a component of risk-taking behavior (Van Orden & Nice, 2006). Emphasizing the practice of good nutrition and weight control, two important preventive behaviors, are continual topics of research at NHRC. Although recruits must meet body composition standards upon entry into the Naval service, too often a high percentage of Navy personnel fail to meet body fat standards

(in some years ranging from ~10% to 20%). The original equations used throughout the Department of Defense to estimate body fat from anthropometric measurements were developed at NHRC, work led by Beckett and Hodgdon (1984), and described for its historical significance by Friedl (2012); see also Peterson (2015). After carrying out extensive surveys of nutritional knowledge of Navy personnel, NHRC researchers helped develop nutritional education programs conducted throughout the Navy. They also help refine Navy weight-loss and weight-management programs. Additionally, NHRC researchers conduct studies on smoking and tobacco use, alcohol abuse issues and testing, and educating about HIV/AIDs.

Cognitive Performance

The process of appropriately integrating human physical and cognitive abilities with the machines that military personnel use is usually referred to as human factors engineering (HFE) or human systems integration (HSI). Over time, these disciplines evolved from a focus primarily on safety toward a greater emphasis on improving overall system performance. The evolution of command and control systems on-board many Navy ships, submarines, and in Navy and Marine aircraft and helicopters, led to requirements for systems to provide decision support to enable effective human decision making in dynamic and information-intensive settings (Van Orden & Nice, 2006). Among the many studies undertaken by NHRC researchers, just two HFE areas are described here: (a) operator situational awareness to ensure effective and timely decisions within a complex command and control system; and (b) performance sustainment and/or enhancement during extended operations and the presence of operator fatigue.

Situational Awareness Naval and Marine Corps operations are replete with examples of how operating crews of high-performance systems (ships and submarines at sea, fighter jets on carrier cruises, helicopters and aircraft in performance of close air support missions, etc.) must sustain "shared" excellent situation awareness (SA), whether in readiness training or in actual combat. SA refers to individual operators or crews having a continual understanding of a complex, dynamic environment and system (i.e., sophisticated weapon systems) in which they are operating. SA is multifaceted, relying on the ability of the operator to perceive the relevant elements in the environment, to integrate and comprehend the meaning of these elements, and to predict future system states based on this understanding (Endsley, 1995).

A number of unfortunate incidents point to the need for continued research on SA in numerous Navy settings. An often cited example is the one involving the USS Greenville fast-attack nuclear submarine operating off the coast of Hawaii in 2002. There, after having lost good SA, the crew surfaced their sub beneath a Japanese tourist vessel and sank it. NHRC researchers continue to examine the underlying cognitive abilities that support SA for submariners and other vehicle crews. One program of such NHRC research places emphasis on working memory and long-term working memory, especially in crews, as they strive to develop team SA as an important component of individual and crew-oriented expertise. Soldiers, sailors, and marines also are often at significant risk when they lose SA in training or combat. Current operations involve placing them in urban patrol situations that can become hostile fire events in a matter of seconds. Maintaining individual and team SA is critical to team effectiveness and survival. NHRC focuses on understanding the factors that contribute to and degrade SA in marines during urban warfighting (Van Orden & Nice, 2006).

Why should these research efforts be of interest to clinical practitioners and operational psychologists? In addition to being situationally aware of such work for general psychological interest sake, we should be aware that uniformed psychologists occasionally are assigned to specially configured safety panels or teams charged to conduct "post-accident/incident forensic analyses." In such roles, it will likely be the psychologist who is expected to represent the stance of the

operator personnel in such inquiries. [As a matter of interest, a military psychologist served on the panel/team that investigated the NASA space shuttle Challenger disaster of January 1986.]

Operator Fatigue As the U.S. Navy is arguably the largest employer of shift workers in the world, NHRC research on operator fatigue has been underway for decades (Van Orden & Nice, 2006). Early research at NHRC focused on understanding the basic neurophysiology of sleep. More recent fatigue and sleep deprivation research at NHRC included a variety of efforts from basic science laboratory investigations, for example, studies of health effects of sleep deprivation, and taking naps in the workplace as an operational strategy – (Naitoh, Kelly, & Englund, 1990), ranging to operationally applied methods and techniques including assessments of the influence of sleep deprivation on performance in Marine Corps field training exercises. Additional studies at the Naval Postgraduate School included assessments of sleep gained or missed by large numbers of sailors aboard numerous Navy vessels in operations underway at sea (Lewis-Miller, Matsangas, & Kenney, 2012). Operational psychologists should familiarize themselves with this seminal research on military operator fatigue and sleep deprivation before undertaking to advise fleet commanders (e.g., in aircraft carrier task forces) about the nuances of sleep loss, circadian rhythm physiology, individual and crew performance in sustained and continuous operations, and the like. Senior flag officers (e.g., admiral task force leaders) will expect the nearest psychologist and/or a senior medical officer such as a flight surgeon, to represent the sailors in decision making and policy formulation about work schedules, crew rest, and the like. Clinical practitioners should also be attuned to such research as they grapple with treating military personnel who have undergone what otherwise may look like exposure to straightforward traumatic events – but which in fact may have been preceded by individuals experiencing significant amounts of sleep loss and sustained workloads (see also Campbell et al., Chap. 15, this volume). The U.S. Air Force also supports extensive research on psychological issues. The next and final section provides a few key examples.

US Air Force Human Factors Applied Psychology Research Trends

As was mentioned at the beginning of this chapter, during the past two decades many of the military labs were consolidated. The U.S. Air Force Research Laboratory (AFRL), the premier research institution of the Air Force, is headquartered at Wright-Patterson Air Force Base, Ohio. AFRL is now identified as the Air Force's lead lab. It directs the activities of numerous subsidiary organizations and research activities. While AFRL is heavily involved in the full gamut of research spanning from materials science to information science, research psychology plays an important role in supporting the airmen of today and those of tomorrow. The majority of research psychology conducted in AFRL is done within the 711th Human Performance Wing. There are three contemporary Air Force directions in human factors/applied psychology research with significant relevance for research psychology: (1) advancements in the science of training, (2) the Sense–Assess–Augment (S–A–A) paradigm, and (3) research on human–machine interaction. It should be noted that this is not intended to cover all of the research psychology work conducted within AFRL, but rather provides a few examples. For readers interested in a detailed description of the cognitive research programs conducted from 1960 to 2009, at the former USAF School of Aerospace Medicine at Brooks AFB, San Antonio, Texas, it is recommended to consult the comprehensive summary prepared by James C. Miller (Miller, 2013).

Training

Training is essential across the military services as airmen, marines, seamen, and soldiers prepare for high operations tempo, high-risk and dynamic situations they will encounter during military operations. This training comes at a high cost

both financially and personally as military members are often required to spend considerable time in training. Training combat pilots exemplifies these challenges as the Air Force spends significant funding and time training them.

The Air Force has been seeking new cost-effective methods for training to include such innovative approaches as Distributed Mission Operations (DMO). The DMO concept facilitates concurrent training of airmen with live, as well as computer-assisted virtual, and constructive assets/actors (synthetic digital representations of teammates) in a common mission rehearsal and planning environment (Chapman & Colegrove, 2013).

The benefits of the DMO are evident when one considers activities such as coalition training with multiple teams from different countries coming together for joint training exercises/events. The costs of such training are considerable; yet sizeable costs can be mitigated through DMO as it enables real-time distributed training and offers potential constructive (i.e., synthetic) participants that can reduce the logistics and costs associated with training even further. For instance, training with coalition partners can be cost prohibitive as it typically requires face-to-face interaction, travel to various locations, movement and maintenance of expensive equipment (i.e., aircraft), and the development and execution of costly operational exercises/scenarios (e.g., Red Flag). In contrast, imagine a world where pilots from one country can virtually connect with pilots from another country in cyberspace without losing any psychological fidelity, yet absent the costs of travel, aircraft, and physical scenarios. Imagine further, a world where one might train with synthetic partners (i.e., digital teammates) rather than solely other humans. While developed in the context of fast-moving jets (i.e., fighters) DMO concepts such as live, virtual, and constructive (LVC) methods can be applied across the gamut of domains relevant to military practitioners. Medical training, training for cyber or Intelligence, Surveillance and Reconnaissance (ISR) analysts, and combat arms training for soldiers, as well could be enhanced using advances in LVC technologies to reduce the time burden on operators, and to reduce the financial burden on the military services.

Other training innovations at AFRL involve pioneering research on training needs analysis and training evaluation. Training needs analysis (i.e., determining what should be trained) is inherent in the strategy of any training program. Traditional methods for needs analysis might involve using methods such as conducting a job analysis to identify the knowledge, skills, abilities, and other characteristics of a job. AFRL researchers generated a new method of training needs analysis in the development of the Mission Essential Competencies (MECs) project. In training, MECs represent high-level functions required by individuals, teams, or teams of teams, to enable successful completion of a combat mission during adverse conditions The MEC process facilitates the identification of the supporting competencies, knowledge and skills, and experiences necessary for mission success (Alliger, Beard, Bennett, Symons, & Colegrove, 2013). The use of MECs allows operators to focus attention toward the critical components of one's job, thus leveraging only the essential portions of a training scenario. This not only saves time and money, but it also enhances the training experience by ensuring that the right competencies are acquired and matured. Once the appropriate competencies are identified, trainers assess performance against these standards/goals. Performance assessment is complex, and can be cognitively taxing for many individuals.

AFRL has led innovations to reduce the assessment burden of assessing team training and performance by developing methods such as the Scenario-based Performance Observation Tool for Learning in Team Performance (SPOTLITE). Simply put, SPOTLITE is a structured way to assess performance for really complex performance criteria. It provides a basis for structuring performance assessment during training with special emphasis on team-based learning and performance metrics/tools (MacMillan, Entin, Morley, & Bennett, 2013). Tools such as this can be useful for evaluating trainees (or teams of trainees) by providing a seamless evaluation structure from which to base performance metrics.

Performance measurement tools like SPOTLITE can help trainers have a structured way to assess team performance and other complex constructs by organizing the performance dimensions into seamless categories for real-time rating. For instance, imagine, being given the task of assessing team decision making in a medical context. SPOTLITE could provide practitioners with a set of structured performance dimensions for assessors to rate in real-time. This could not only ease the assessment burden for practitioners but it could also help to facilitate more accurate assessments by providing a standardized method to capture the information.

Sense–Assess–Augment Framework

The Sense–Assess–Augment framework offers a paradigm for research in AFRL related to: sensing individual and team cognitive states, assessing the impact of that state on performance, and augmenting performance through individual manipulations or technology adaptation (see Galster & Johnson, 2013). The sensing component involves the development of sensors to detect human cognitive states off-body (e.g., eye tracking, voice patterns, facial expressions, etc.), on-body (e.g., cardiac activity, electroencephalogram (EEG), skin temperature, etc.), and/or in-body (e.g., measures of cortisol, oxytocin, catecholamines, etc.) (Galster & Johnson, 2013).

Anyone with a Fitbit® or other fitness/health tracking device knows that the commercial sector is inundated with devices for gauging everything from physical activity to one's calorie intake. One role of DoD research psychology is to examine the feasibility of such devices for supporting a military mission. At times, existing Commercial-Off-the-Shelf (COTS) tools or devices may be sufficient, whereas other military needs may require development of novel sensors given the mission space and constraints of the ruggedized military environment. These technologies could be useful to those who are interested in human state sensing in austere environments.

The assessment component attempts to evaluate the sensed data on some element of performance. An example of this could be workload measures that signal how well a team is performing during a team-based task (Funke, Knott, Salas, Pavlas, & Strang, 2012). Other methods could use physiological sensing to measure operator fatigue, workload, stress, etc. Once the signals are sensed either through on-, off-, or in-body mechanisms and those signals are analyzed in reference to some performance objective, the individuals or teams may be augmented where necessary. This augmentation could come in a variety of potential forms to include things like technology that sheds task load when a high level of user workload or stress is detected. Other augmentation strategies could include use of noninvasive transcranial stimulation to modulate user learning, engagement, or performance (McKinley, Bridges, Walters, & Nelson, 2012; McKinley, McIntire, Bridges, Goodyear, & Weisend, 2013). Ultimately, the Sense–Assess–Augment framework provides a useful model for planning and executing research and development for the explicit goal of improving human performance – particularly that of military pilots and aviation crews.

Human–Machine Interaction

Research psychologists at the AFRL also do considerable amounts of work in the area of human-machine interaction. Advanced technology in the form of complex automation and autonomous systems (i.e., robotics, drones, etc.) pervades not only the military landscape but also commercial and private domains. The military recognizes this expansion of technology and has responded with research psychology investments in several domains, including human–machine interface design and research on *human–machine trust*. AFRL's research on interface design examines methods for task delegation to autonomous systems, facilitation of supervisory control of multiple semi-autonomous platforms (e.g., consider an individual attempting to control multiple drones at once), and the development of intuitive prescribed action commands to foster predictability and shared awareness for human operators

of unmanned, semi-autonomous platforms (Miller et al., 2013). The challenges of managing or teaming with multiple platforms (i.e. vehicles, whether they be ground or air vehicles) are extreme, whether they are automated, semi-autonomous, or fully autonomous. Thus, AFRL research psychology activities aim to understand how much control to give to technology (versus to a human operator); how that control is transferred from the human to and from the technology back to the human; how to design interfaces to facilitate interactions that enhance overall performance; and to understand the costs and benefits of different human–machine interaction strategies. This is important because these human–machine interface methods and control strategies can be instrumental in enabling one operator to control multiple semi-automated vehicles – thus helping to break the one-operator–one-vehicle paradigm.

Advances in the capabilities of semi-autonomous and other automated systems raise questions about *human reliance* (i.e., trust) on the technology. Thus, another area of research for AFRL is research focusing on the *human–machine trust* process. Establishing optimal (i.e., calibrated) trust of technology is important for human–machine performance (Lee & See, 2004). The AFRL is focused on research to: identify the antecedents of human-machine trust, examine the role of transparency in the trust process, evaluate trust in the context of fielded Air Force systems, and study the situational/contextual factors that impact the trust process. In terms of trust antecedents, researchers at AFRL examine constructs such as personality (Lyons, Stokes, & Schneider, 2011), suspicion in an automation context (Lyons, Stokes, Eschleman, Alarcon, & Barelka, 2011), and emotion (Stokes, Lyons, Littlejohn, Natarian, Case, & Speranza, 2010). This research on antecedents of trust facilitates awareness of the set of factors that influence the trust process. One key take away from this line of research is that the set of trust antecedents postulated in the literature (including human factors such as traits, situational factors such as the novelty of the automation, and learned trust factors such as performance (for a review see Hoff & Bashir, 2015) do influence trust perceptions of fielded automation systems among actual operators (Lyons, Ho, Fergueson, et al., 2016; Lyons, Koltai, et al., 2016). This helps practitioners to better understand and plan for the gamut of influences that shape operator trust and reliance on technology.

Transparency is one factor in human–machine interactions that influences the trust process. Transparency can be defined as a method for establishing shared awareness and shared intent between humans and machines (Lyons, 2013). As technology increases in capability and as equipment system designers continue to provide technology in the forms of automated, semi-autonomous, and autonomous systems, it will be imperative for humans (designers and users) to understand the capabilities/limitations of the technology, the intent of the technology, and the analytical underpinnings of the technology. One recent study demonstrated that enhanced transparency of a complex emergency landing planner technology did increase trust among commercial pilots (Lyons et al., 2016c). Further, as intelligent technology and humans begin to share tasks, goals, and responsibilities, it will be critical from a trust perspective for the human–machine systems to effectively navigate complex team-based activities such as transfer of control/authority, cooperation, coordination, and back-up behavior.

Trust-based research on applied systems focuses on systems such as the Air Force's Automatic Ground Collision Avoidance System (AGCAS). Researchers analyzed the antecedents of trust of the AGCAS platform from the perspective of test pilots (Lyons, Ho, Koltai, et al., 2016), and subsequent studies of operational pilots are currently underway. This work is critical for expanding trust in automation research to more operational settings with actual operators using real systems that have significant personal relevance. Field studies are necessary for understanding the dynamic nature of the trust process and for evaluation of the contextual influences on trust. Contextual influences on trust might include factors such as automation bias (Lyons & Stokes, 2012) and the role of multitasking on trust.

Automation bias represents an individual's preference for or against automated systems. Some people work very seamlessly with technology, whereas others might approach a novel technology with some skepticism. Other factors such as one's attentional resources also influence reliance on technology. In one such study, research participants were found to engage in overreliance on a low reliability automated aid when they were tasked with dual versus single task scenarios (Guznov, Nelson, Lyons, & Dycus, 2015). Research in this area is critical if we are to enjoy the benefits of semi-automated and autonomous systems in the future, lest we fall victim to suboptimal reliance strategies. After all, a useful tool is no good if it sits on a shelf. Further, reliance on a bad tool can be catastrophic in a high-consequence domain where lives are on the line – such as many military domains. Appropriate reliance on automated technology is highly relevant also in the private sector where consumers are already being faced with decisions regarding how much they should or should not rely on technology (e.g., autonomous cars). This line of research can help practitioners in the military by identifying known pitfalls of suboptimal reliance strategies; identifying trust issues in novel technologies from a person, technology, or contextual perspective; and providing guidance to technology developers to support the trust-based needs of operators (e.g., transparency) to facilitate appropriate reliance.

While certainly not exhaustive of all of the research psychology work being done at the AFRL (such a paper would be beyond the scope of this small section), the examples above highlight a few of the activities and research areas with high relevance to research psychology within the Air Force Research Laboratory.

Concluding Remarks

What we have presented in this chapter is merely a small sample (a taste) of the type of research done by military psychologists in the laboratories – research that may interest clinical practitioners and organizational psychologists. Research psychology remains a robust discipline and fulfills many needs within the DoD. Its many programs impact a wide gamut of DOD applications: personnel selection and classification, training, human-machine interaction design, human performance sustainment and enhancement, preparation of personnel for combat operations, and stress control and management.

The ultimate goal of all such research programs is to transfer general findings and principles from research to the "line military" in terms that impact and improve military doctrine, policies, and practices. That is, we strive to institutionalize the "research findings" into action. Unfortunately that has not always been the case, and some important research and the "lessons learned" do not always get promulgated, nor transferred into practice. Several Army Field manuals have "doctrinalized" a few of the items written about above. For example, clinical practitioners may want to consult the U.S. Army Field Manual 4–02.51 on Combat and Operational Stress Control (2006), which in addition to stress control, covers such topics as – behavioral health, how to assess unit needs, consultation and education, and traumatic event management. As described earlier, the Army Field Manual No. 6–22-5 (2009) addresses these and other issues on Combat and Operational Stress Control for Leaders and Soldiers as well.

Whether doing work on the process of selecting the best job applicants for military careers, elucidating and ameliorating the stressors of deployments, or best methods for treating soldiers for PTSD, there will always be a need for military research psychology. The contributions of research psychology to clinical and organizational practice are strong; but they could be improved through continued collaboration among researchers and practitioners. Researchers need a good understanding of the constraints and needs of operational users. Fortunately, most of the DoD labs have always incorporated military operators into the lab structure to provide such insights. However, in more recent budgetary times, with increasing emphasis on "doing more with less" – the success of research psychology programs hinges on continuing close coordina-

tion and collaboration with practitioners and operational psychologists to ensure our research findings transition to operational use.

References

Adler, A. B., Bliese, P. B., McGurk, D., Hoge, C. W., & Castro, C. A. (2009). Battlemind debriefing and battlemind training as early interventions with soldiers returning from Iraq: Randomized by platoon. *Journal of Consulting and Clinical Psychology*, *77*, 928–940.

Adler, A. B., Bliese, P. D., & Castro, C. A. (Eds.). (2011). *Deployment psychology: Evidence-based strategies to promote mental health in the military*. Washington, DC: American Psychological Association.

Alliger, G. M., Beard, R., Bennett, W., Symons, S., & Colegrove, C. (2013). A psychometric examination of mission essential competency (MEC) measures used in Air Force Distributed Mission Operations training needs analysis. *Military Psychology*, *25*, 218–233.

Bartone, P. T. (1998). Stress in the military setting. In C. Cronin (Ed.), *Military psychology: An introduction* (pp. 112–146). Needham Heights, MA: Simon & Schuster.

Bartone, P. T. (1999). Hardiness protects against war related stress in army reserve forces. *Consulting Psychology Journal: Practice and Research*, *51*, 72–82.

Bartone, P. T., Adler, A. B., & Vaitkus, M. A. (1998). Dimensions of psychological stress in peacekeeping operations. *Military Medicine*, *163*, 587–593.

Bartone, P. T., Pastel, R. H., & Vaitkus, M. A. (2010). *The 71F advantage: Applying Army research psychology for health and performance gains*. Washington, DC: National Defense University Press. Retrieved from http://ndupress.ndu.edu/Portals/68/Documents/Books/71F-Advantage.pdf

Beckett, M. B., & Hodgdon, J. A. (1984). *Techniques for measuring body circumferences and skinfold thicknesses* (NHRC Technical Report No. 84-39). San Diego, CA: Naval Health Research Center.

Belenky, G., Wesensten, N. J., Thorne, D. R., Thomas, M. L., Sing, H. C., Redmond, D. P., … Balkin, T. J. (2003). Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: A sleep dose-response study. *Journal of Sleep Research*, *12*, 1–12.

Bing, M. N., America, A., Lamb, J., & Severinghaus, R. (2005). *The prediction of submarine officer advanced course ascendency from Subscreen test scores*. Groton, CT: Naval Submarine Medical Research Lab. DTIC # ADA 593-523. Retrieved from https://e-hrinnovations.com/Bing_TR1238_SORT.pdf

Booth-Kewley, S., Larson, G. E., & Ryan, M. A. K. (2002). Predictors of Navy attrition I: Analysis of 1-year attrition. *Military Medicine*, *167*, 760–769.

Caldwell, J. A. (2012). Understanding and managing fatigue in aviation. Chapter 24, pp. 379–391. In G. Matthews, P. A. Desmond, C. Neubauer, & P. A. Hancock (Eds.), *The handbook of operator fatigue* (pp. 107–123). Farnham Surrey, UK: Ashgate Publishing.

Caldwell, J. A., Mallis, M. M., Caldwell, J. L., Paul, M. A., Miller, J. C., & Neri, D. E. (2009). Fatigue countermeasures in aviation. *Aviation, Space, and Environmental Medicine*, *80*, 29–59.

Campise, R. I., Geller, S. K., & Campise, M. E. (2006). Combat stress. In C. H. Kennedy & E. A. Simmer (Eds.), *Military psychology: Clinical and operational applications* (pp. 215–240). New York, NY: Guilford Press.

Castro, C. A., & Adler, A. B. (2005). Operations tempo (OPTEMPO). *Military Psychology*, *17*, 131–136.

Chapman, R., & Colegrove, C. (2013). Transforming operational training in the Combat Air Forces. *Military Psychology*, *25*, 177–190.

Chappelle, W., Goodman, T., Reardon, L., & Thompson, W. (2014). An analysis of post-traumatic stress symptoms in United States Air Force drone operators. *Journal of Anxiety Disorders*, *28*, 480–487.

Chen, G., & Bliese, P. D. (2002). The role of different levels of leadership in predicting self and collective efficacy: Evidence for discontinuity. *Journal of Applied Psychology*, *87*, 549–556.

Cornum, R., Matthews, M. D., & Seligman, M. E. P. (2011). Comprehensive soldier fitness: Building resilience in a challenging instructional context. *American Psychologist*, *66*, 4–9.

Cornum, R. L., & Lester, P. B. (2012). Comprehensive soldier fitness: Why? And why now? In J. H. Laurence & M. D. Matthews (Eds.), *The Oxford handbook of military psychology* (pp. 4–14). New York, NY: Oxford University Press.

Crawford, M. P. (1970). Military psychology and general psychology. *American Psychologist*, *25*, 328–336.

Dolan, C. A., Adler, A. B., Thomas, J. L., & Castro, C. A. (2005). Operations tempo and soldier health: The modernizing effect of wellness behaviors. *Military Psychology*, *17*, 157–174.

Endsley, M. R. (1995). Towards a theory of situation awareness. *Human Factors*, *37*, 32–64.

Friedl, K. (2012). Body composition and military performance – Many things to many people. *The Journal of Strength and Conditioning Research*, *26*(Supplement 2), S87–S100.

Funke, G. J., Knott, B. A., Salas, E., Pavlas, D., & Strang, A. J. (2012). Conceptualization and measurement of team workload: A critical need. *Human Factors*, *54*, 36–51.

Gal, R., & Mangelsdorff, A. D. (Eds.). (1991). *Handbook of military psychology*. New York, NY: Wiley.

Galster, S. M., & Johnson, E. M. (2013). *Sense-Assess-Augment: A taxonomy for human effectiveness*. AFRL-RH-WP-TM-2013-0002. Wright-Patterson AFB, OH: U.S. Air Force Research Laboratory. Retrieved from http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA585921

Goldberg, S. (2012). Psychology's contribution to military training. In J. H. Laurence & M. D. Matthews

(Eds.), *The Oxford handbook of military psychology* (pp. 241–261). Oxford, UK: Oxford University Press.

Guznov, S., Nelson, A., Lyons, J. B., & Dycus, D. (2015). The effects of automation reliability and multi-tasking on trust and reliance in a simulated unmanned system control task. *HCI International* 2015-Posters' Extended Abstracts, pp. 616–621. Retrieved from http://link.springer.com/chapter/10.1007%2F978-3-319-21383-5_103

Hoff, K. A., & Bashir, M. (2015). Trust in automation: Integrating empirical evidence on factors that influence trust. *Human Factors*, *57*, 407–434.

Hoge, C. W. (2011). Public health strategies and treatment of service members and veterans with combat-related mental health problems. In A. B. Adler, P. D. Bliese, & C. A. Castro (Eds.), *Deployment psychology: Evidence-based strategies to promote mental health in the military* (pp. 17–34). Washington, DC: American Psychological Association.

Hoge, C. W., Castro, C. A., Messer, S. C., McGurk, D., Cotting, D. I., & Koffman, R. L. (2004). Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *The New England Journal of Medicine*, *351*, 13–22.

Hoge, C. W., Leiskar, S. E., Guevera, R., Lange, J., Brundage, J. F., Engel, C. C., & Orman, D. T. (2002). Mental disorders among U.S. military personnel in the 1990s: Association with high levels of health care utilization and early military attrition. *The American Journal of Psychiatry*, *159*, 1576–1583.

Hoiberg, A., & Pugh, W. H. (1978). Predicting Navy effectiveness: Expectations, motivation, personality, aptitude and background variables. *Personnel Psychology*, *31*, 841–852.

Jones, F. D. (1986). Future directions of military psychiatry. In R. A. Gabriel (Ed.), *Military psychiatry: A comparative perspective* (pp. 181–204). New York, NY: Greenwood Press.

Krueger, G. P. (1998). Psychological research in the military setting. In C. Cronin (Ed.), *Military psychology: An introduction* (pp. 14–30). Needham Heights, MA: Simon & Schuster.

Krueger, G. P. (2008). Contemporary and future battlefields: Soldier stresses and performance. In P. A. Hancock & J. L. Szalma (Eds.), *Performance under stress* (pp. 19–44). Aldershot, UK: Ashgate Publishing.

Krueger, G. P. (2010a). U.S. Army uniformed research psychologists: Making a difference yesterday, today, and tomorrow. In P. T. Bartone, R. H. Pastel, & M. A. Vaitkus (Eds.), *The 71F advantage: Applying Army research psychology for health and performance gains* (pp. 1–44). Washington, DC: National Defense University Press.

Krueger, G. P. (2010b). Sustaining human performance during security operations in the new millennium. In P. T. Bartone, B. H. Johnsen, J. Eid, J. M. Violanti, & J. C. Laberg (Eds.), *Enhancing human performance in security operations: International and law enforcement perspectives* (pp. 205–228). Springfield, IL: Charles C. Thomas Publisher.

Krueger, G. P. (2012). Soldier fatigue and performance effectiveness: Yesterday, today and tomorrow. In G. Matthews, P. A. Desmond, C. Neubauer, & P. A. Hancock (Eds.), *The handbook of operator fatigue* (pp. 393–412). Farnham Surrey, UK: Ashgate Publishing.

Krueger, G. P., Leaman, H. M., & Bergoffen, G. (2011, May). *Effects of psychoactive chemicals on commercial driver health and performance: Stimulants, hypnotics, nutritional, and other supplements* (TRB Truck and Bus Safety Synthesis Program Report No. 19). Washington, DC: National Academies – Transportation Research Board. Retrieved from http://www.trb.org/Publications/Blurbs/165501.aspx

LaRocco, J. M., Pugh, W. M., Jones, A. P. & Gunderson, E. K. E. (1977). Situational determinants of retention decisions (NHRC Technical Report. No. 77-3). San Diego, CA: Naval Health Research Center.

Larson, G. E., Booth-Kewley, S., & Ryan, M. A. K. (2002). Predictors of Navy attrition: II. A demonstration of potential usefulness for screening. *Military Medicine*, *167*, 770–776.

Laurence, J. H., & Matthews, M. D. (Eds.). (2012). *The Oxford handbook of military psychology*. New York, NY: Oxford University Press.

Lee, J. D., & See, K. A. (2004). Trust in automation: Designing for appropriate reliance. *Human Factors*, *46*, 50–80.

Lewis-Miller, N., Matsangas, P., & Kenney, A. (2012). The role of sleep in the military: Implications for training and operational effectiveness. In J. H. Laurence & M. D. Matthews (Eds.), *The Oxford handbook of military psychology* (pp. 262–281). New York, NY: Oxford University Press.

Lyons, J. B. (2013). Being transparent about transparency: A model for human-robot interaction. In: D. Sofge, G.J. Kruijff, & W.F. Lawless (Eds.) *Trust and autonomous systems: Papers from the AAAI spring symposium* (Technical Report SS-13-07). Menlo Park, CA: AAAI Press. Retrieved from http://www.aaai.org/ocs/index.php/SSS/SSS13/paper/view/5712

Lyons, J. B., Ho, N. T., Fergueson, E., Sadler, G., Cals, S., Richardson, C., & Wilkins, M. (2016). Trust of an automatic ground collision avoidance technology: A fighter pilot perspective. *Military Psychology*, *28*, 271–277.

Lyons, J. B., Ho, N. T., Koltai, K., Masequesmay, G., Skoog, M., Cacanindin, A., & Johnson, W. W. (2016). A trust-based analysis of an Air Force collision avoidance system: Test pilots. *Ergonomics in Design*, *24*, 9–12.

Lyons, J. B., Koltai, K. S., Ho, N. T., Johnson, W. B., Smith, D. E., & Shively, J. R. (2016). Engineering trust in complex automated systems. *Ergonomics in Design*, *23*, 13–17.

Lyons, J. B., & Stokes, C. K. (2012). Human-human reliance in the context of automation. *Human Factors*, *54*, 111–120.

Lyons, J. B., Stokes, C. K., Eschleman, K. J., Alarcon, G. M., & Barelka, A. (2011). Trustworthiness and IT

suspicion: An examination of the nomological network. *Human Factors*, *53*, 219–229.

Lyons, J. B., Stokes, C. K., & Schneider, T. R. (2011). Predictors and outcomes of trust in teams. In N. A. Stanton (Ed.), *Trust in military teams* (pp. 31–48). Surrey, UK: Ashgate.

MacMillan, J., Entin, E. B., Morley, R., & Bennett, W. (2013). Measuring team performance in complex and dynamic military environments: The SPOTLITE method. *Military Psychology*, *25*, 266–279.

Mangelsdorff, A. D. (Ed.). (2006). *Psychology in the service of national security*. Washington, DC: American Psychological Association.

Marlowe, D. (1986). The human dimension of battle and combat breakdown. In R. A. Gabriel (Ed.), *Military psychiatry: A comparative perspective* (pp. 7–24). New York, NY: Greenwood Press.

McBride, S. A., Thomas, J. L., McGurk, D., Wood, M. D., & Bliese, P. D. (2010). U. S. Army mental health advisory teams. In P.T. Bartone, R. H. Pastel, & M. A. Vaitkus (Eds.), *The 71F advantage: Applying Army research psychology for health and performance gains* (pp. 209–245). Washington, DC: National Defense University Press. Retrieved from http://ndupress.ndu.edu/Portals/68/Documents/Books/71F-Advantage.pdf

McKinley, R. A., Bridges, N., Walters, C. M., & Nelson, J. (2012). Modulating the brain at work using noninvasive transcranial stimulation. *NeuroImage*, *59*, 129–137.

McKinley, R. A., McIntire, L., Bridges, N., Goodyear, C., & Weisend, M. P. (2013). Acceleration of image analyst training with transcranial direct current stimulation. *Behavioral Neuroscience*, *127*, 936–946.

Miller, C. A., Draper, M. H., Hamell, J. D., Calhoun, G., Barry, T., & Ruff, H. (2013). Enabling dynamic delegation interactions with multiple unmanned vehicles: Flexibility from top to bottom. In D. Harris (Ed.): EPCE/HCII 2013, Part II, LNAI 8020, pp. 282–291.

Miller, J. C. (2013). Cognitive performance research at Brooks Air Force Base, Texas, 1960–2009. Retrieved from https://www.smashwords.com/books/view/299706

Naitoh, P., Kelly, T. L., & Englund, C. (1990). Health effects of sleep deprivation. In A. J. Scott (Ed.), *Shiftwork. State of the art reviews in occupational medicine* (pp. 209–237). Philadelphia, PA: Hanley & Belfus, Inc.

Peterson, D. D. (2015). History of the U.S. Navy body composition program. *Military Medicine*, *180*, 91–96.

Ramsberger, P. F., Wooten, N. R., & Rumsey, M. G. (Eds.). (2012). *A history of the research into methods for selecting and classifying U.S. Army personnel 1917–2011*. Lewiston, NY: Edwin Mellen Press.

Reardon, L., Chappelle, W., Goodman, T., Cover, S., Prince, L., & Thompson, W. (2016). Prevalence of posttraumatic stress symptoms in United States Air Force intelligence, surveillance, and reconnaissance agency imagery analysts. *Psychological Trauma*, *8*, 55–62.

Rumsey, M. G. (2012). Military selection and classification in the United States. In J. H. Laurence & M. D. Matthews (Eds.), *The Oxford handbook of military psychology* (pp. 129–147). New York, NY: Oxford University Press.

Stokes, C. K., Lyons, J. B., Littlejohn, K., Natarian, J., Case, E., & Speranza, N. (2010, May). Accounting for the human in cyberspace: Effects of mood on trust in automation. *Proceedings of the IEEE International Symposium on Collaborative Technologies and Systems* (pp. 180–187), Chicago, IL.

Thompson, W. T., Lopez, N., Hickey, P., DaLuz, C., Caldwell, J. L., & Tvaryanas, A. P. (2006). *Effects of shift work and sustained operations: Operator performance in remotely piloted aircraft (OP-REPAIR)* (HSW-PE-BR-Technical Report 2006-0001). Brooks City Base, TX: United States Air Force 311th Human Systems Wing.

U.S. Army Research Institute for the Social and Behavioral Sciences. (2015). *U.S. Army Research Institute for the Social and Behavioral Sciences 1940–2015: 75 years of science and innovation.* Fort Belvoir, VA: Author. Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/1007292.pdf

U.S. Department of the Army. (2006). *Combat and operational stress control*, *U.S. Army Field Manual 4-02.51*. Washington, DC: Department of the U.S. Army.

U.S. Department of the Army. (2009). *Combat and operational stress control manual for leaders and soldiers*, *U.S. Army Field Manual 6-22.5*. Washington, DC: Department of the U.S. Army.

Van Orden, K. F., & Nice, D. S. (2006). National security interests at the Naval Health Research Center. In A. D. Mangelsdorff (Ed.), *Psychology in the service of national security* (pp. 55–70). Washington, DC: American Psychological Association.

Zeidner, J., & Drucker, A. J. (1988). *Behavioral science in the Army: A corporate history of the Army Research Institute*. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.