Norrholm SD, Maples-Keller JL, Rothbaum BO, Tossell CC. Remote Warfare with Intimate Consequences: Psychological Stress in Service Member and Veteran Remotely-Piloted Aircraft (RPA) Personnel. J Ment Health Clin Psychol (2023) 7(3): 37-49

JOURNAL OF MENTAL HEALTH AND CLINICAL PSYCHOLOGY
www.mentalhealthjournal.org

Review article Open Access

# Remote Warfare with Intimate Consequences: Psychological Stress in Service Member and Veteran Remotely-Piloted Aircraft (RPA) Personnel

Seth Davin Norrholm[1,2*], Jessica L. Maples-Keller[3], Barbara O. Rothbaum[3], Chad C. Tossell[2]

[1]Neuroscience Center for Anxiety, Stress, and Trauma, Department of Psychiatry and Behavioral Neurosciences, Wayne State University School of Medicine, Detroit, Michigan, USA
[2]Department of Behavioral Sciences and Leadership, United States Air Force Academy, Colorado Springs, Colorado, USA
[3]Department of Psychiatry and Behavioral Sciences, Emory University School of Medicine, Atlanta, Georgia, USA

**Article Info**

**Article Notes**
Received: September 24, 2023
Accepted: December 21, 2023

***Correspondence:**
*Dr. Seth Davin Norrholm, Department of Psychiatry and Behavioral Neurosciences, Wayne State University School of Medicine, Detroit, Michigan, USA.
Email: SNorrholm@wayne.edu



**Keywords:**
Behavioral health
Moral injury
Burnout
Drones
RPA
Military psychology

## Abstract

The use of remote piloted aircraft (RPAs) has been a part of military operations for decades and this type of service can present its own unique constellation of combat experiences and psychological consequences. The RPA crewmember experience has typically involved surveillance, targeting, striking, and after-battle assessments of individuals of interest to a host country or agency from a distance that can span several thousand miles. These operators are engaged in physically remote activities that carry a significant degree of intimacy due to the live, high-resolution, high-fidelity images and sounds that are available to the combatants in real-time. The potential psychological consequences of this type of military occupational specialty can include the symptoms of depression, anxiety, and posttraumatic stress disorder (PTSD) as well as moral injury, mental exhaustion or burnout, and disturbed sleep. The following narrative review examines the current state of RPA warfare from a psychological trauma perspective with an emphasis on the evolution of the inherent technology, the operator force, the psychological experiences and consequences of this type of service, and potential preventative interventions for servicemembers. A key objective of this narrative review is to integrate the available peer-reviewed empirical data, experiential military perspectives and analyses, clinician observations from this unique population, and exemplar reports from those with lived experience on an RPA crew regarding psychological consequences of this military occupational specialty.

## Introduction

Military actions of the United States and many other countries worldwide often rest on several principles, one of which is the use of disciplined violence (e.g., lethality) to enforce foreign policy and to engage in one's national defense[1]. Traditionally, these principles were coupled with objectives that included territorial gain, financial seizures, ideological pursuits, or political purposes[2,3], and it has been generally accepted that loss of life on both sides of a conflict is to be expected[4]. Throughout recorded history, the loss of life and the wide-ranging effects of human conflict have exacted a psychological toll for combatants, survivors, their compatriots, and their families and loved ones[5]. The relatively new onset of technologically advanced remote piloted aircraft (RPAs; e.g., MQ-1 Predator, MQ-9 Reaper), often called 'drones' or uncrewed aircraft vehicles (UAVs), has provided military forces with a tactical advantage with little to no physical risk to aircrews themselves and the execution of targeted strikes with fewer civilian and bystander losses but numerous *psychological* risks.

The following is a narrative review of the psychological health problems that can arise in this unique population of warfighters with evidence and experiences provided from sources spanning peer-reviewed scientific journal articles, published books by military, servicemember, and Veteran stakeholders, clinician perspectives, and first-hand accounts of the lived experience of RPA armed service members. For organizational purposes, the review covers the following topic areas of particular relevance to the remote piloted aircraft warrior including the unique experience of this type of service, the potential consequences associated with this military occupational specialty, RPA-specific job parameters, ethical questions that can arise, the military ecosystem within which these individuals work, and what the future and next steps might look like moving forward. Additionally, the evolution of combat experiences from the World Wars to Vietnam to Korea to the more modern conflicts in the Middle East and eastern Europe requires our field to examine posttraumatic consequences through the lens of the 21st century warfighter with a potential reconceptualization of combat trauma and the nature of post-trauma clinical and operational aftermaths.

## Methods

The MEDLINE/PubMed, APA PsycInfo, and Google Scholar databases were searched through September 1, 2023, using the terms "posttraumatic stress disorder *and* remote piloted aircraft," "PTSD *and* RPA," "PTSD *and* RPA pilots," "posttraumatic stress disorder *and* drone," "PTSD *and* drone," "PTSD *and* drone pilots," "mental health *and* remote piloted aircraft," "mental health *and* RPA," and "mental health *and* RPA pilots." Searches yielded a total of 48 peer-reviewed articles, 15 published books, and 8 publicly available government/military reports. The lists of references for these sources were reviewed to identify any sources not captured by our search. Two anonymized clinical vignettes are included in this review. Participants provided written informed consent for the clinical research studies from which these narratives were obtained including for the publication of de-identified numeric, clinical, and demographic data. The studies for which they participated, and contributed to, were approved by the Emory University Institutional Review Board.

## The Experience

### Remotely-Piloted Aircraft: An Increasing Warfare Presence

In the U.S. Air Force alone, RPA numbers have increased from approximately 20 vehicles in 2005 to over 300 in 2020[6]. Additionally, the frequency of Combat Air Patrols (CAPs), the primary mission for RPA teams, increased from 5 per day in 2004 to 65 daily in 2014[7]. The rise in RPA deployment is partially attributed to the simultaneous fighting of two counterinsurgency wars in Iraq and Afghanistan which required ongoing surveillance to locate potential combatants "hiding in plain sight" as well as to safeguard servicemembers from an aerial vantage point[8]. From January 2015 until January 2019, there were roughly 5,900 RPA strikes in Afghanistan alone[9]. Even though these wars have waned, current and future RPA concepts keep humans in the loop for ethical and effective operations in conflict[10]. It has become apparent to military and civilian stakeholders that the introduction and expansion of this machinery into 21st century conflicts have brought new challenges and sources of distress for the crews that operate, control, and team with these remote-piloted military aircraft.

### The Remotely-Piloted Aircraft Experience for Human Operators

The typical crew required for RPA-based missions includes the vehicle operator or pilot, a sensor operator responsible for camera and weapons controls, and a mission intelligence officer that coordinates communications with other analysts and host operational agencies[11]. In general, the scope of work for an RPA crew includes the surveillance and monitoring of swaths of physical terrain and the activities of individuals of interest to the host country or agency; the latter being 'routine' activities that may be interrupted by events requiring weapons delivery (i.e., strikes)[12]. Although often physically situated in the continental United States, RPA crews regularly experience battlefield stimuli in the form of real-time streaming of the visual and auditory elements of combat missions, which may involve tracking specific individual(s) over extended periods of time[13]. These servicemembers are exposed to potentially traumatic events through witnessing attacks and resulting injury and death, as well as the loss of attachment to people they have been tracking, grief following the loss of 'friendly' forces and allies, and negative emotions tied to the loss of life and property following executed missions[14]. The RPA crew experience can also include switching tasks from silent surveillance to active engagement in what has been termed a type of 'psychological whiplash'[15]. For years, many RPA pilots were "deployed in garrison" meaning that they would commute to their operating base often located in the United States, fly RPA missions (sometimes using deadly force) with aircraft flying in overseas locations, and then drive back home into civilian contexts after their long shift[16]. The long-term effects of these types of 'whiplash' are still being investigated and not yet well understood.

## The Consequences

The available literature regarding the psychological consequences of serving in an RPA crew (pilots and support staff) reveals that RPA-based crews exhibit greater psychiatric symptoms, *in general*, as compared to crews that work with crewed military aircraft[3,17-19]. The

works cited above note that the most frequently reported problems have been diagnosed depressive and adjustment disorders as well as relationship and 'life' problems and the most common RPA crew individual symptoms are depressed mood, guilt, poor concentration, irritability, anxiety, and sleep disturbance[3,20] – all clinical features that span more than one DSM-5 diagnostic category[21] and can be a feature of, or co-morbid with, major depressive and posttraumatic stress disorder (PTSD) symptoms. An ongoing question in the field of military psychology is whether PTSD and its associated co-morbidities (e.g., major depressive disorder, anxiety disorders) apply to this unique type of remote warfare and how it is assessed, diagnosed, treated, and handled regarding fitness for duty. This question and its related components (e.g., type of trauma exposure, duration of trauma exposure, RPA crew culture) are addressed in detail below.

## PTSD

The nature of remote pilot operations, which can include the implementation and witnessing of death to combatants and civilian bystanders, inherently lends itself to the experience of a psychological trauma and its consequences like PTSD[22]. PTSD is a heterogeneous psychological condition that can develop when individuals are exposed to situations or events in which their own health and livelihood, or that of someone else, is threatened (e.g., natural disasters, acts of terrorism, sexual assault). The symptoms of PTSD are divided into clusters that span re-experiencing/intrusive memories, avoidance of stimuli associated with the traumatic event, negative alterations in cognition and mood, alterations in arousal and physiological reactivity, and the presence of symptoms within these clusters for a period of time greater than one month[21]. It has been well established that military activities including deployment to combat theaters, active participation in (and observation of) battlefield operations, firing or discharging weapons of war, witnessing the injury or death of combatants, compatriots, civilians, or bystanders, and sustaining debilitating or physically traumatic injuries, are all associated with greater risk for developing the symptoms of PTSD[23-27]. In fact, the history of interventions for PTSD is driven by war[28]. In the last century alone, the battlefield for U.S. forces has shifted from largely demarcated danger (e.g., frontlines) and safety (e.g., green zones) areas, to urban-based, guerilla-type warfare and insurgency (e.g., Operations Iraqi Freedom/Enduring Freedom/New Dawn), to far less defined battle zones that can include non-human aggressors (e.g., enemy remote piloted aircraft) and physical separation from the conflict (e.g., U.S./allied remote piloted aircraft crews; Global War on Terror; the Russia/Ukraine and Hamas/Israeli conflicts). This evolution of combat experiences requires a concurrent potential recalibration of how we conceptualize trauma and the phenomenological clinical presentations of post-trauma aftermaths.

With the publishing of the DSM-V, the first criterion for a diagnosis of PTSD (termed Criterion A) is exposure to an event described above through direct exposure, witnessing the trauma, learning that a relative or close friend was exposed to the trauma, or indirect exposure to aversive details of the trauma, usually in the course of professional duties[21]. As will be discussed throughout this review, many aspects of an RPA crew member's duties and experiences possess the potential for a Criterion A event to occur despite being physically distant from threat. The indirect exposure element, of particular concern for crewmembers observing and participating in remote operations through multimedia feeds, was recently added in the transition from DSM-IV to DSM-5. In fact, it specifies that exposure through electronic media, television, movies, or pictures does not count *unless* this exposure is work-related as would be the case for RPA crew members. Thus, it does not include viewing upsetting events covered by the media on television such as when the world witnessed the terrorist events of September 11, 2001.

## Common Psychological Consequences Observed in RPA Crew Members

The unique circumstances associated with service on an RPA crew which can include sustained periods of vigilance, high psychological and occupational risks tied to errors in judgment, imagery of death and destruction, anonymous work with little to no recognition, and potential stigma attached by other service members who are immersed in combat, in theater, produces a number of common psychological consequences alluded to above such as relationship problems, depression, and adjustment disorders[29]. Some reports reveal that between 46-48% of RPA operators experienced psychological consequences that significantly affected work or personal life[17,18]. Further, 8.2% of RPA operators received a mental health diagnosis within their first two years in this line of service[3].

The generation of this review was spurred by clinical, research, and *in-vivo* interactions between RPA personnel and the authorship team which consists of one active-duty U.S. Air Force senior leader (CCT), 2 clinical psychologists (BOR, JMK), and a translational neuroscientist (SDN). The following are two clinical vignettes obtained from direct interviews between two Veterans and our authorship team (anonymized for privacy reasons). The presence of RPA-related PTSD was confirmed through administration of the Clinician-Administered PTSD Scale for DSM-5 (CAPS-5[30]).

## Clinical Vignette 1

*Tom is a U.S. Air Force veteran who served as an MQ-9 Reaper sensor operator for an RPA operating in a Middle*

*Eastern combat theater. He had been surveilling a High Value Individual (HVI) for several weeks and his crew was finally given a nine-line (line of fire) and cleared hot to execute a strike with a Hellfire (given permission to fire) on the home of the target individual. Tom's job was to guide the missile to the target, a house on a farm. Upon impact, the house was destroyed in a plume of smoke and fire. The crew noticed a squirter (escaping combatant) exit the rear of the leveled home. Upon further inspection, the crew saw that the running, and clearly wounded, individual was carrying a bulky object over his shoulders – a small child of toddler age who was not moving. Tom's most distressing posttraumatic symptoms centered on intrusive memories of the child's lifeless body and the gruesome pile of debris and human remains left by the missile strike. In addition, he had excessive feelings of guilt and blame, disturbed sleep with nightmares related to the attack, and avoidance of activities that involved family or children (e.g., birthday parties, cookouts).*

- Description of a DSM-5 Criterion A trauma reported by a treatment-seeking combat veteran who worked on an RPA crew in the U.S. Air Force and was interviewed by one of the authors (SDN). As can be seen in the narrative, Tom's symptoms spanned both PTSD consistent and moral injurious after-effects which are discussed in greater detail below.

### Clinical Vignette 2

*Jane worked for six years at a U.S. Air Force Base as part of a division focused on safe use of RPAs and her role was to conduct safety investigations regarding potential RPA errors. As part of this role, she regularly reviewed footage of RPA missions in which errors may have occurred including events such as midair collisions and unintended casualties; this task often involved repeated viewing of footage in order to assess for possible contributing factors. She noticed after 3 years of working in this role that she began to experience significant irritability and began to withdraw socially. Over time, symptoms increased, and she began to have nightmares in which she perceived herself in the actual experience of RPA events she had reviewed. She started to experience significant guilt, sleep difficulties, avoidance of situations in which she was exposed to military related cues, and significant startle reactions to loud noises. She presented to treatment several years later at the prompting of her partner and was at first quite distant and tended to minimize her symptoms. After assessment and providing her with feedback related to her significant PTSD symptoms, she responded with, "I was never deployed. I've never seen real combat – I just watched videos. I can't have PTSD." Once she engaged in Prolonged Exposure therapy, she opened up to her therapist about the full extent of her symptoms and impact on her life and was able to experience improvement after a few months of treatment.*

With regard to PTSD related to experiences to those described above, recent estimates suggest that approximately 4-6% of RPA pilots in the U.S. meet the symptom criteria for PTSD[19,31], although earlier work suggested markedly lower rates closer 1% and below[17,32]. For comparison, some estimates suggest approximately 4-18% of returning servicemembers from the conflicts in Iraq and Afghanistan exhibit high levels of PTSD symptom expression[25,33,34]. Approximate prevalence rate for PTSD in the general population is 9%[21]. Much of the work in this area has been pioneered by the Chappelle research group whose focus has been on the unique features of this military occupational specialty (MOS) as compared to other warfighter specialties. As described previously, the use of RPA-based operations is continuing to increase[35], and this rise in remote operations highlights the nuanced nature of possible posttraumatic stress in this population. These service members are fighting electronic warfare with potentially traumatic, work-related exposures occurring via high fidelity and high resolution audio and visual feeds, respectively; a means of trauma exposure that was not always included in earlier clinical, operational definitions of PTSD symptomatology[21,36,37]. Potentially distressing mission elements (and the most likely DSM-5 Criterion A index traumas) for RPA crews include, but are not limited to, locating, tracking, targeting and destroying enemy combatants and their assets, witnessing the maltreatment, torture, or killing of friendly forces and civilians, overseeing the protection and movement of U.S. and allied forces, and assessing the aftermath of targeted military strikes, including first responder and mortuary activities[19,20]. The latter aspect will be discussed further below.

## The Job

### Remotely-Piloted Aircraft Warfare vs Conventional Warfare

Based on the data accumulating in a growing body of literature in this area, it appears as though the experience of RPA crews in battle shares some similarities with 'conventional,' in-theater warfare while also displaying a uniqueness and divergence from other types of military operations. With regard to similarities, reports from RPA warfighters have shown that these service members, although remote, experience levels of responsibility, connectedness, emotional reactivity, and autonomic nervous system arousal similar to that described by combatants physically located on the battlefield[38-40]. Principal differences between RPA crews and more traditional battlefield combatants stem from the prolonged time periods that remote combat requires as these teams monitor targeted individuals and positions over time often from initial identification, through maintenance of targets' daily routines including times with family and friends, termed "Pattern of Life" or POL missions, to execution of a strike package, until post-strike assessment of physical

damage, casualties, and related losses[8]. In short, this degree of involvement with targets can create a sense of "intimacy" not seen with more conventional "boots on the ground" warfare[41]. It differs from conventional warfare that may involve eye contact or physical contact with the enemy prior to weapons discharge as it is a one-sided intimacy. Blair and House (2017) described this intimacy as "Cognitive Combat Intimacy" and define it as a relational attachment to a human target mediated by the high quality sensor resolution used and dwell time, defined as the duration of time observing a target of interest which could span days to months to years[42]. Interestingly, RPA pilots who have transitioned back to crewed aircraft have noted that when they fly *in theater* over areas they previously flew over as remote pilots there is a sense of familiarity or "déjà vu" which speaks to the high degree of overlap between these two very different piloting experiences[8]. This may also reflect the vividness and immersive quality of current electronic technology used within this area of work such that as technology advances, electronic stimuli may more closely garner a sense of "real life."

## Remotely-Piloted Aircraft Personnel: Risk vs. Resilience

Given that service on an RPA crew is associated with psychological consequences, there is a need to better understand risk versus resilience for mental health effects in this population. As described previously, RPA operation requires a multi-person team for each mission and, as such, one's role on the team may play a significant role in risk versus resilience for occupational or posttraumatic stress. For example, it has been reported that RPA operators/pilots and support staff were at greater risk for emotional disengagement, emotional exhaustion, burnout, and PTSD symptoms as compared to crewed aircraft pilots[3]. In their recent work, Bufford and colleagues (2022), further explored RPA crew mental health and found that a large sample of RPA crew members could be divided into a "distressed" group and a psychologically healthy group. Members of the distressed group included greater numbers of imagery analysts, weapons-strike pilots, and females whereas the healthy group included more sensor operators and males[43]. Not surprisingly, the distressed individuals reported more PTSD symptoms and psychological problems, a greater number of medical complaints, and increased usage of psychosocial services.

Evidence provided by Kieffer and Stahlman (2021), in a comprehensive study of USAF personnel during the decade and half spanning 1 October 2003 to 30 June 2019, suggest that mental health disorders, behavioral health problems, complaints of fatigue, and sleep disturbances differ between RPA pilots, crewed aircraft pilots, RPA support staff, and those in other USAF occupations (the latter four study groups categorized by their Air Force Specialty Code, AFSC). In this study, contrary to other empirical work, RPA and crewed aircraft pilots showed *lower* mental and behavioral health risks as compared to other USAF occupations, and associated RPA support staff members display risks in these two areas equal to that of the other USAF specialties. Regarding disturbed sleep, RPA pilots, crewed aircraft pilots, and RPA support staff all showed higher risks as compared to other USAF specialties. The available data support the general consensus that RPA-related work comes with psychological risks, however, the direction and severity of those risks remains unclear. For example, it is not yet known whether the reported reduced risk of psychopathology in RPA pilots truly reflects a lower vulnerability or rather lower tendency for pilots to report problems. Active duty service members are reluctant to report PTSD or other signs of distress until they have separated from the military[44].

## Remotely-Piloted Aircraft: Striking from a Distance

A common theme of this narrative review is the unique risks assumed by service members and Veterans whose military service included RPA-based operations. The uniqueness of RPA-related psychological consequences is related, in part, to the combination of attacking/killing another from a remote distance while not at risk for any immediate physical harm to oneself - a far cry from the trench warfare associated with the more "traditional" conflicts like the two World Wars and U.S. military action in Vietnam, Korea, and the Persian Gulf. It may be that RPA-related, post-trauma consequences have less to do with the activation of stressor and fear neural circuits and more to do with very human aspects of socio-politico-cultural-theological influences such as moral injury[45], or the psycho-behavioral results of acting against one's own "conscience" or "perpetrating, failing to prevent, bearing witness to, or learning about acts that transgress deeply held moral beliefs or expectations[46]." This notion is consistent with the trajectory of weapons development throughout the history of human warfare – one in which technological advances have provided the practical and tactical means to further distance oneself from the *actual* violence needed to take the life of another. In other words, we've progressed from lunging with fists to the launching of deadly projectiles, first from our own hands (e.g., rocks), then with simple machines (e.g., arrows from bows, bullets from firearms), and next to stationary or mobile platforms as directed missiles under our control to varying degrees (e.g., via rockets, crewed fighters, or remote-piloted aircraft). RPAs now represent a lethal means that can be controlled from a maximum distance (~7,000 miles), with reduced collateral damage on site, operator presence in the safety of one's home country or a 'green zone,' and full high-definition details of the attack scenario and outcome. The high quality of the audio and video feeds provided by

RPAs have been described as "inviting" and "[drawing] you in," with voyeuristic views of the battlefield in a manner once described as "Predator porn[8]."

From a sensation and perception perspective, RPA crews may be susceptible to unique forms of distress that stem from the compression of time and space that occurs due to the disconnect between one's *actual* distal proximity to the theater and the *perceived* proximal location just inches from the high-definition video feed and consequent perceptual immersion[47]. Depending on the perspective taken by the RPA crew members at a given time during an operation, he or she may be buffered by the physical distance such that *defensive* stress response systems (e.g., hypothalamic-pituitary-adrenal and sympathoadrenal axes) are not activated to the extent that they might be with conventional in-theater warfare. This is not to say that the sympathetic division of the autonomic nervous system is not activated as this has been routinely reported to increase in RPA crews prior to an *offensive* strike against enemy combatants[48]. Conversely, a perceived connection to targets may be inflated by the perceived closeness provided by the real-time, high-definition video feeds. In contrast, traditional, crewed aircraft pilots often deploy lethal weapons from a high-altitude vantage point far removed from their missiles' impact and their effects on targets and the surrounding areas. Of note, during the rapid expansion of RPA operations following the onset of the Global War on Terror, many U.S. Air Force pilots were pulled from their crewed aircraft duties and retrained to fly RPAs[8]. RPA crews often continue operations and observations after missile strikes to assess damage and report potentially aversive details of death and destruction[40]; activities that deem RPA crews' missions to have no perceived start or finish which can make conceptualization for many, especially former crewed aircraft pilots, difficult. It may be that exposure to the aftermath of an attack may mitigate what has been described as a dissociated 'video game' mentality when it comes to killing remotely[3,49]. Not surprisingly, exposure to post-strike death of bystanders has been linked to increased PTSD symptoms in RPA crews[29]. This is discussed further below.

## The Ethics

### The Morality of Remotely-Piloted Aircraft Operations

The ability of combatants to kill from a distance raises salient moral questions which contribute to the types of moral conundrums linked to psychological distress. Are weapons that can be fired and controlled remotely ethical and within "accepted" forms of combat and warfare? Do they follow the same rules of engagement? Where is the line (and who draws it) between a strategic, military, or tactical advantage and attacking from a position of cowardice or dishonor? This point is thoroughly discussed in Phelps' book *On Killing Remotely* in which the honor and bravery of modern-day fighter pilots is contrasted with the shame initially applied to knights who chose bows and arrows over hand-to-hand combat[8]. The latter potentially violating moral or ethical rules that dictate one should not kill someone who can not retaliate from a distance[3]. Acceptability is closely tied to notions such as societal impressions, archetypes, heroism, and culture potentially through a process Campo describes as 'critique-accept-repeat'[39] in which novel weapons are first criticized, ultimately accepted, and their use repeated across conflicts.

A common theme discussed with respect to RPA warfare is the conceptualization of distance. Two primary distance considerations that influence those who engage in remote killing with RPAs are physical distance and empathetic or cognitive distance. As described by Holmes (1986), Gray (1998), and Grossman (2009), conventional thinking has been that the greater the physical distance between attacker and target, the less resistance on the part of the attacker to killing and the greater the cognitive and empathetic distance perceived[4,50,51]. This is due in large part to the potential to see the aftermath of an attack including the victim's physical (e.g., graphic wounds) and psychological (e.g., screaming in pain, anguish) reactions. Firing a firearm at close range or physically attacking another with fists or a handheld weapon provides an up-close view of these reactions whereas a high-altitude strike by a crewed fighter aircraft would avoid seeing these reactions altogether in almost all cases. The uniqueness of RPA warfare is that the operators are likely at a *very* far physical distance but intimately close to the physical and psychological effects of their actions on victims because of the technology provided. Grossman (2009) and Phelps (2021) suggest that there are at least six forms of distance to be considered when discussing RPA crew responses to killing remotely: (1) physical (actual units of length), (2) cultural (differences in ethnicity, religion, race), (3) moral (balance between the attacker's ethical belief systems and the victims'), (4) social (how classes of people are viewed), (5) mechanical (physical buffers between attacker and victim like a scope, sight, or computer screen), and (6) empathetic (how well the attacker can relate or identify with the victims). One way in which these six levels of distance can been conceptualized is the degree to which a combatant can dehumanize the victim and maximize most of these distances[8,42,51,52].

There are two significant ethical concerns that arise from RPA-based warfare that have received little attention both empirically and operationally. First, RPA crews regularly perform their mission specific tasks in the presence of an audience consisting of support personnel, military leadership, and higher-ranking authority figures. As such, there is an added element of social anxiety on top

of the potential psychological stressors and risks already noted – crews are concerned with making mistakes or looking incompetent in front of others. The presence of overseeing authority figures also introduces elements of demand, compliance, and dissonance if the orders from above are inconsistent with the crew's personal values. Second, RPA warfare is regularly conducted at the direction of ground forces who require life-saving assistance. Joint Terminal Attack Controllers (JTACs) are servicemembers coordinating ground operations in theater who can call in close-air support or airborne munitions and resources. It is the JTACs who might frantically contact an RPA crew to escape a situation in which they are under heavy enemy fire whose exit is blocked by enemy forces. RPA pilots have reported feelings of survivor's guilt from their "in garrison" positions because they could not save the lives or prevent significant injuries in friendly or allied forces. Survivor's guilt in an RPA crew may be qualitatively different than for other service members because of the increased degree of control that these operators perceive as having during operations and decreased physical threat.

As noted previously, the DSM-5 definition of Criterion A trauma has changed to include exposure to trauma through electronic media *if* this exposure is work-related. While RPA exposure currently meets this DSM-5 revised Criterion A trauma definition and research indicates some RPA personnel do report PTSD symptoms, Veterans and service members may themselves experience confusion regarding their own PTSD symptoms related to their RPA work. As Jane said above, "I was never deployed…I can't have PTSD." As described in this review, RPA crews may experience moral injury and it is important to note that moral injury can be effectively treated using gold-standard PTSD interventions[53,54]. Additional research regarding symptom presentations in RPA personnel is warranted and outreach and psychoeducation related to the potential psychological impact of RPA experiences are necessary (see *Future Directions* below).

## The RPA Ecosystem

### Remotely-Piloted Aircraft Personnel: Individual Differences, Culture, and Context

It should be clear at this point that RPA crew responses to killing, as with historically more conventional warfare, is a complex process and varies widely. As described by Phelps (2021), for example, some of the service members who work in remote aircraft operations describe feelings of satisfaction, pride, accomplishment, and occupational competence. Conversely, others report more negative reactions including guilt, anger, frustration, intrusive memories, numbness or detachment, and disturbed sleep. These reactions are often overlaid upon job-related adverse conditions such as shift work, long hours, monotony, and understaffing and often returning to civilian life following missions. Not surprisingly, the post-killing emotional reactions of RPA crews will depend on mission-specific elements such as the safety of friendly ground forces, the degree of civilian or bystander casualties and damage, the overall success completing the mission's primary objectives[39], and team support and cohesiveness.

Acceptability of RPA usage in battle has not been without its own unique psychological problems within the military culture. In the Marines, for example, RPA pilots have described the negative attitudes directed at them by fellow service members especially when compared to crewed aircraft, or "real pilots" as the culture defines them[8,55]. There are questions related to whether or not RPA crews meet the criteria of "warrior ethos" – a concept grounded in physical courage and strength in the face of fear, danger, threats to survival, or long odds[8,56]. In addition, the military community initially mocked RPA crews as merely playing a video game that didn't require nearly the training for crewed aircraft flight nor the risk that came with in-theater combat operations[42,57]. As described by Phelps (2021), many would argue that the psychological risks taken on by RPA crews contribute to a modern-day version of warrior ethos.

Given that RPA-related combat can include remote killing, it may be that individuals engaged in this type of warfare may be more susceptible to a subtype of "killing-related PTSD" which might be qualitatively different from PTSD resulting from index traumas that did not involve the taking of another's life (i.e., "non killing-related PTSD"[19]). Previous studies of traumatized servicemembers from different combat theaters as well as law enforcement officers have suggested that those who actively participated in seriously injuring or killing someone experienced more severe PTSD symptoms[38,58,59]; findings consistent with those of Chappelle and colleagues (2019) who reported that witnessing or sharing blame or responsibility for civilian bystanders being killed was predictive of PTSD symptom presence. In his empirical work with U.S. Air Force RPA crews, Phelps (2021) found that those directly or indirectly involved in killing by deploying RPA-borne weapons reported the highest degree of self-reported psychological trauma (73% of 254 Airmen sampled) with crew members who assisted (i.e., sensor operators; 11% of 254 Airmen) or watched the deadly strikes (i.e., intelligence personnel; 11% of 254 Airmen) following far behind. Phelps describes this distribution as related to the degree of participation and "ownership" each crew member experiences during a deadly strike.

Allusions to a 'video game' mentality described above can also be applied to psychological means by which RPA crews may attempt to prevent or stave off moral injury – through a process called moral disengagement, or the

reduction in blame, guilt, or shame from killing that one may experience if the killing is justified or if widely held ethical considerations do not apply[60]. For example, if the RPA crew was eliminating a high-ranking terrorist leader responsible for the prior deaths of U.S. service members, moral disengagement could permit this crew to absolve themselves of any murder accusations or self-condemnation[61]. There are also instances when RPA crews cannot morally disengage, and these situations can include when they are in active communication with ground forces and are limited in ability to respond due to limited munitions, permissions, or environmental obstacles. An inability to assist fellow service members (i.e., those known as troops-in-contact or TICs) when there are significant or deadly consequences can contribute to a sense of moral injury which will be further discussed below.

The act of killing by an RPA crewmember and its psychological effects may be influenced by the crew's perception of whether or not the target "deserved" to die. This can be governed by a process that Phelps (2021) describes as "target attractiveness," or the degree of benefit to friendly forces, allies, and citizens that may come from eliminating someone who has engaged in nefarious and deadly behavior. In short, the more attractive the target, the lower the resistance to killing by RPA operators. At one end of the attractiveness continuum would be a bad actor who perpetrated many heinous crimes against others and on the opposite end would be an individual associated with a terrorist group but who was never observed committing heinous acts. Put another way, a target's place on the attractiveness continuum can be determined by how much humanity he has shown during prior surveillance (e.g., the family man who played with his kids versus the cold-hearted terrorist that built and planted IEDs while being observed[62]. It is not difficult to see how posttraumatic consequences could emerge in the case of killing someone who showed a great deal of humanity and very little nefariousness.

Despite what the evidence provided in this review might suggest (e.g., RPA crews are at high risk for *general* psychological problems), very recent work shows that RPA pilots appear at *less* risk for developing PTSD than their crewed aircraft colleagues[29,63] as compared to other service members with different MOSs. This may be related to the assessment tools used (e.g., PTSD Checklist/PCL versus Clinician Administered PTSD Scale/CAPS[30,64]) and the sensitivity of these measures to posttraumatic consequences specifically linked to moral injury which can include guilt, remorse, and existential/philosophical conflicts[14]. These consequences may not be adequately covered by the negative alterations in cognitions and mood (which includes cognitions such as "I am a bad person") nor alterations in arousal (which includes strong negative feelings) sub-clusters of DSM-5 PTSD symptoms. It has been suggested that there are over 600,000 different ways to meet the diagnostic criteria for PTSD[65] and each of these ways requires meeting at least 1 symptom requirement in the Intrusive, Avoidant, and Distress/Impairment clusters and 2 symptoms in the Negative Alterations and Arousal clusters. Of note, there has been a call by some to use 'moral injury' as a classification of trauma type (i.e., Criterion A) and not necessarily a trauma consequence[66,67]. Nevertheless, it is quite possible that RPA-related posttraumatic stress syndrome profiles are more heavily weighted toward the guilt and shame constructs[45] (and not the other symptom clusters) in which instance these would not be counted as cases of full-blown PTSD. In other words, the unique nature of RPA warfare might lead to sub-syndromal diagnostic PTSD which could be clinically relevant but missed in larger, epidemiological assessments. In fact, Phillips and colleagues (2019) reported that 30% of their study sample of 40 RPA crew members reported a sub-threshold level of PTSD symptoms with no cases of probable PTSD. Lastly, emerging neuroimaging research has suggested that there are distinct brain regions activated by fear-based index traumas (i.e., threat to self or others) versus moral injury-based index traumas (i.e., self-referential conflicts) with some overlapping neural underpinnings[68].

Chappelle and colleagues (2019) reported that the most commonly endorsed symptoms in RPA personnel who met diagnostic criteria for PTSD were trouble falling or staying asleep, avoiding memories, thoughts, or feelings related to the stressful experience, irritability and anger, feeling distant or cut-off from other people, and feeling very upset when something reminded [them] of the stressful experience. Previous work has described the RPA crew members as seeking to reconcile the very human features of their strike targets (i.e., they eat, sleep, have sex) with the often heinous, terroristic acts they inflict on others[8].

In addition to the capability of killing from a distance, RPA-based warfare also provides a potential insulating role with diffusion of responsibility. In a typical RPA strike, troops in contact on the ground or intelligence analysts identify the target, higher leadership authorizes the use of lethal force, the pilot fires the weapon, the sensor operator coordinates the path of the missile to the target. This structure provides for a meting out of the responsibility among the crew members and support staff and allows each individual involved to displace their blame and guilt on others or the group as a whole. For example, an individual combatant may make the personal decision not to act to take a life but as part of a larger team or crew, his reservations may be muted or overruled (social science has taught us much about group dynamics in situations such as these). Bandura described this as a form of moral disengagement at the agency level – dispersing blame among several

people so that the single individual can feel a sense of absolution[69]. He further theorized that disengagement occurs on multiple levels including consideration of one's behavior, the qualities (or humanity) of the victim, and the impact, either good or bad, of the outcome. Lastly, Bandura postulates that moral injury is not encompassed by posttraumatic stress disorder diagnostic criteria but the continuous self-critique that comprises moral injury represents a distinct process.

Given the hundreds or thousands of potential presentations of PTSD[65], moral injury should be considered one of the factors that can vary. Moral injury has been observed as long as PTSD has been described, and effective treatments for PTSD such as prolonged exposure (PE) effectively address moral injury[53].

Taken together, however, results of recent studies suggest that the greatest predictors of distress in RPA crews are a perceived lack of meaning[22] and overextension at work[22,31,70]; occupational adversities that may not actually be RPA specific per se but related to overextension within working conditions. This latter point is reviewed extensively in previous work by Chappelle and colleagues[19,31,71,72]. For example, prior research has suggested that RPA crews may share similar occupational stressors as servicemembers engaged in image analysis, intelligence operations, and cyber warfare – specialties that all include elements of around the clock working conditions[72].

## The Future

### From RPA Operations by a Select Few to Everyone as a Drone Operator

As a means of increasing resilience and reducing risk of psychological consequences, it must also be acknowledged that the landscape of RPA usage is evolving within theaters of conflict so that remote operations are not just military crew members "inside the box" and potential enemies for troops down range extends to non-human "drone" aggressors. Traditionally, RPA combat actions have been carried out by trained combatants in direct engagement with adversaries. However, a shift is occurring where civilians without military training are increasingly able to acquire drones for use in warfare (e.g., surveillance in the war in Ukraine[73]). From drones that can easily fit in a backpack to model airplanes and those with lighter payloads, the range of available drones continues to expand and play a more prominent role in modern and future warfare[74], including civilian combatants[75]. As the utilization of drones becomes more widespread, civilians engaged in drone activities may face unique challenges and stressors that require further research to assess and address, particularly in terms of their mental well-being[76]. Perhaps the proliferation of drone warfare in conflicts like the one in Ukraine, where multiple actors engage in such activities, the direct mental health impacts on individuals may be diluted. However, further research is needed to fully comprehend the complex dynamics at play in this evolving landscape.

### The Future of RPA Crew Performance: Practical implications

Based on the psychological consequences described throughout this review, there are several practical considerations to consider in terms of building resilience and mitigating risk. For example, a broader understanding of the potential psychological impacts of working on an RPA crew is critical for the optimization of crew member effectiveness and mission success but also for the appropriate assessment of service member health and readiness. A few areas stand out in terms of priorities in the immediate future.

### Training Recommendations

In the previous sections, we discussed the roles of the RPA crew to include initial surveillance, execution of a strike mission, followed by a battle damage assessment (BDA); all aspects which could contribute to the onset of psychological problems and distress. Phelps (2021) suggests that one strategy might be a diffusion of responsibility in which RPA crews are divided into teams with each responsible for one of the mission elements previously listed. There are some areas in RPA operations in which tasks are divided such as the launch and recovery elements (LRE) that maintain the aircraft, coordinate takeoff and landing at a forward operating site, and then pass the aircraft on to a mission control element (MCE) which controls the tactical operations of the mission (often from a stateside base thousands of miles away). However, this division of labor is highly skewed toward the MCE element which flies the aircraft close to 99% of the time. These types of "handoffs" are technically and logistically possible and relatively simple; the determining factor would be leadership recognizing the role such an approach could have in terms of preventing long-term mental health consequences. A related possibility is the use of a second crew to conduct battle damage assessments after an initial crew has coordinated a strike, but this may not be feasible because of the increased personnel and resources required.

As mentioned previously, risk factors for psychological problems in RPA crews include long working hours and exhaustion; a point illustrated by Chappelle and others (2019) who found parallel rates of arousal (e.g., falling or staying asleep, difficulty concentrating, irritability) in both PTSD+ and non-PTSD in their assessment of 715 RPA operators and support staff. While not a targeted approach meant specifically for RPA crews, the implementation of ergonomic and operator-centered preparations may help

to mitigate the accumulation of adverse mental health effects that could, in turn, lead to situations such as burnout and emotional exhaustion[77]. Interestingly, a 2016 study by Barron and colleagues showed that high job performance in both crewed and uncrewed pilots was predicted by the same subsets of personality traits and qualification[78] save for one factor. Success in RPA pilots specifically was linked to greater pre-military knowledge about, and aptitude for, aviation-related topics such as navigation, aerodynamics, meteorology, and aircraft design and maintenance. The authors of the Barron study suggested that prior knowledge of aviation in general is a proxy measure of passion for their field and that this, in turn, might buffer against the adverse psychological effects of RPA work.

### Symptom Monitoring in Active Duty

As of this writing, the U.S. Air Force, as an example, has placed clinical psychologists with the necessary security clearance within RPA operating units. This may have helped to reduce reports of PTSD symptoms since the outset of formal empirical studies of trauma in this area[31]. Assistance of this type is not only useful in the screening for full threshold PTSD but also in the monitoring of potential problems that could affect servicemember performance such as subsyndromal PTSD signs and symptoms like increased arousal, vigilance, and sleep disturbances. Taken together, the key vulnerability factors for RPA crews with respect to potential psychological distress are one's age, whether or not the remote piloted aircraft is used for strikes or surveillance, low levels of familial or social support, long work hours, the lack of a formal or informal setting for psychological processing post-strike (this can differ across service branches), and the injury or loss of friendly forces, civilians, or a target with whom an RPA operator had become "close"[8,39,40]. It should be noted that having strong familial bonds can also serve as a risk factor when it comes to killing remotely due to feelings of guilt, shame, moral injury, or identification with targets that have strong family ties. Greater cultural acceptance of this type of "resources check" is one way in which resilience can be fostered over increasing risks.

### Autonomy and the Future of RPAs

In parallel with the increasing involvement of civilians in a wider range of drone activities, there is a notable shift towards greater reliance on technology to perform many functions of RPA operations[79]. Autonomous systems are poised to harness a range of AI technologies, including visual perception, facial recognition, and advanced decision-making capabilities, to conduct diverse operations across air, ground, space, and maritime domains with varying degrees of human intervention[80]. As AI-driven autonomy progresses humans may assume supervisory roles over a greater number of RPAs, reducing direct interactions but potentially inflicting greater losses[81]. However, the precise impact of this transformation on human operators and their psychological well-being remains an area of uncertainty. While numerous studies have examined the increasing workload of humans managing a growing number of increasingly autonomous systems, research specifically focused on how this will impact humans involved in these operations is limited[17]. Addressing these emerging challenges is crucial to ensure the well-being and effective performance of RPA operators in an evolving technological landscape.

### Limitations and Future RPA Operator and Crew Considerations

As the field of military psychology weighs the bio-psycho-social effects of RPA borne warfare on air crews and service branches at large, there are important points of consideration to address. First, it must be recognized that active duty and Veteran RPA crews are difficult to access, and these operations are often conducted with security and classification protections in place. As such, valid and reliable data can be difficult to generate. Second, as with many military-based studies and assessments, the data gathered may be rooted in self-report and thus subject to population wide under-reporting often seen in samples where the report of psychological symptoms or problems is viewed as weak, unbecoming, or potentially disqualifying[82]. Third, there are clearly going to be differential effects depending on prior service experiences (i.e., crewed vs. uncrewed; in-theater deployment vs. deployment-in-garrison), role(s) on RPA crews during missions, physical and mental health history, military status and rank, and cultural acceptance, to name a few. Lastly, even when RPA personnel do present for treatment, the high security of their missions may preclude their willingness to disclose and process the details of the experience.

## Conclusions

Crews of remote piloted aircraft experience unique mission situations related to their duties that can include remote, albeit highly vivid, interactions with targets and assets over extended periods of time. These duties may include the witnessing, implementing, and/or sharing in the responsibility for killing combatants or civilian bystanders. Potentially traumatizing events such as these can haunt service members, eliciting psychological reactions that can include PTSD symptoms related to re-experiencing and unwanted intrusive thoughts and memories of the event (B criteria) as well as negative alterations in cognition and mood (D criteria). Additionally, common reactions include symptoms of adjustment disorders, depression, and problems in interpersonal and intimate relationships. The psychological consequences emerging from RPA-based operations may also be biased

toward phenomenon related to moral injury which may not be adequately covered by the self-report and clinician administered measures most often used to quantify PTSD symptoms (the Clinician Administered PTSD Scale and not the Moral Injury Events Scale[83]), although to be clear, moral injury is not a diagnosis.

However, the most problematic sources of distress for RPA crews, based on a decade and a half of research, appear to be operational in nature (e.g., shift work hours, ergonomics, long and tedious surveillance missions) and not combat-related. On a positive note, the nature of RPA-based work may inherently serve as a buffer to subsequent mental health problems by increasing situational awareness, reducing operational uncertainty, and mitigating battlefield risks. It is clear that RPA-based operational stressors can increase risk for subsequent psychological problems (including depression and PTSD), and these should be monitored by command, medical corps, and other supplementary and embedded resources. This is an important area of future research and services particularly given that RPA use and remotely tasked personnel continue to increase significantly over time.

## Acknowledgment

The views expressed in this paper are those of the authors and do not necessarily reflect the official policy of position of the U.S. Air Force, the Department of Defense, or the U.S. government.

## Funding

Dr. Norrholm has received funding from the State of Michigan Office of Licensing and Regulatory Affairs (LARA) and the Congressionally Directed Medical Research Program (CDMRP)/Department of Defense, and Department of Veterans Affairs. Drs. Maples-Keller and Rothbaum have received funding from COMPASS pathways, Wounded Warrior Project (WWP), and Multidisciplinary Association of Psychedelic Studies (MAPS).

## Conflict of Interest

The authors report no conflicts of interest, financial or otherwise, associated with the included work.

## Authorship Statement

S.D.N performed the literature searches and took the lead in writing the manuscript. B.O.R. and J.L.M.K. contributed to the framework of the review, provided clinically relevant suggestions and experiences, and contributed writing in several aspects of the manuscript. C.C.T. provided a military perspective for the literature review and covered findings, contributed to the context of remote piloted aircraft experience, and contributed writing throughout the manuscript. All authors reviewed and approved the final and revised version of the work.

## References

1. Keegan J. A history of warfare. New York, NY: Vintage Books. 1993.
2. O'Connell R. Of arms and men: a history of war, weapons, and aggression. New York, NY: Oxford University Press. 1990.
3. Saini RK, MS VKR, Chail A. Cry in the sky: Psychological impact on drone operators. Ind Psychiatry J. 2021; 30(Suppl 1): S15-S19. DOI: 10.4103/0972-6748.328782.
4. Grossman D. On killing: the psychological cost of learning to kill in war and society. New York, NY: Back Bay Books/Little, Brown and Company. 2009.
5. Grossman D, Christensen L. On combat: the psychology and physiology of deadly conflict in war and in peace. 3rd ed. Millstadt, Illinois: Warrior Science Publications. 2008.
6. Cancian M. U.S. military forces in FY 2020: Air Force. Center for Strategic and International Studies. 2020. (https://www.csis.org/analysis/us-military-forces-fy-2020-air-force).
7. Hardison CM, Aharoni E, Larson C, et al. Stress and Dissatisfaction in the Air Force's Remotely Piloted Aircraft Community. Santa Monica, CA: RAND. 2017.
8. Phelps KW. On Killing Remotely. New York, NY: Little, Brown and Company. 2021.
9. Journalism BoI. Drone Wars: The Full Data. (thebureauinvestigates.com/stories/2017-01-01/drone-wars-the-full-data cancentral.com/can-stats/history-of-the-can).
10. Jordan J. The future of unmanned combat aerial vehicles: An analysis using the Three Horizons framework. Futures. 2021; 102848.
11. Gregory TS, Tse ZT, Lewis D. Drones: balancing risk and potential. Science 2015; 347(6228): 1323. DOI: 10.1126/science.347.6228.1323-a.
12. Arkin WM. Unmanned: Drones, data, and the illusion of perfect warfare. New York, NY: Little, Brown and Company. 2015.
13. Velicovich B, Stewart CS. Drone warrior. New York, NY: HarperCollins. 2017.
14. Hijazi A, Ferguson CJ, Ferraro FR, et al. Psychological dimensions of drone warfare. Current Psychology. 2019; 38: 1285-1296.
15. Ortega HJ Jr. Challenges in monitoring and maintaining the health of pilots engaged in telewarfare. MSMR. 2013; 20(3): 2. (https://www.ncbi.nlm.nih.gov/pubmed/23550926).
16. Gettinger D. Burdens of War: PTSD and Drone Crews. Center for the Study of the Drone, Bard College. (http://dronecenter.bard.edu/burdens-war-crews-drone-aircraft/).
17. Otto JL, Webber BJ. Mental health diagnoses and counseling among pilots of remotely piloted aircraft in the United States Air Force. Medical Surveillance Monthly Report. 2013; 20: 3-8.
18. Wallace D, Costello J. Eye in the sky: understanding the mental health of unmanned aerial vehicle operators. Journal of Military and Veterans Health. 2017; 25: 36-41.
19. Chappelle W, Goodman T, Reardon L, et al. Combat and operational risk factors for post-traumatic stress disorder symptom criteria among United States air force remotely piloted aircraft "Drone" warfighters. J Anxiety Disord. 2019; 62: 86-93. DOI: 10.1016/j.janxdis.2019.01.003.
20. Kieffer JW, Stahlman S. Mental health disorders, behavioral health problems, fatigue and sleep outcomes in remotely piloted aircraft/manned aircraft pilots, and remotely piloted aircraft crew, U.S. Air Force, 1 October 2003 - 30 June 20019. Medical Surveillance Monthly Report. 2021; 28(8): 14-21.
21. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, DSM-5. Arlington, VA: American Psychiatric Association. 2013.

22. Prince L, Chappelle WL, McDonald KD, et al. Reassessment of psychological distress and post-traumatic stress disorder in United States Air Force Distributed Common Ground System operators. Mil Med. 2015; 180(3 Suppl): 171-8. DOI: 10.7205/MILMED-D-14-00397.

23. Xue C, Ge Y, Tang B, et al. A meta-analysis of risk factors for combat-related PTSD among military personnel and veterans. PLoS One. 2015; 10(3): e0120270. DOI: 10.1371/journal.pone.0120270.

24. Kessler RC, Sonnega A, Bromet E, et al. Posttraumatic stress disorder in the National Comorbidity Survey. Arch Gen Psychiatry. 1995; 52(12): 1048-60. (In eng) (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=7492257).

25. Gates MA, Holowka DW, Vasterling JJ, et al. Posttraumatic stress disorder in veterans and military personnel: epidemiology, screening, and case recognition. Psychol Serv. 2012; 9(4): 361-382. DOI: 10.1037/a0027649.

26. Southwick SM, Morgan CA, Darnell A, et al. Trauma related symptoms in veterans of Operation Desert Storm: A two-year followup. American Journal of Psychiatry. 1995; 59: 97-107.

27. Friedman MJ. Prevention of Psychiatric Problems among Military Personnel and Their Spouses. N Engl J Med. 2010; 362(2): 168-170. DOI: 10.1056/NEJMe0911108.

28. Stein MB, Rothbaum BO. 175 Years of Progress in PTSD Therapeutics: Learning From the Past. Am J Psychiatry. 2018; 175(6): 508-516. DOI: 10.1176/appi.ajp.2017.17080955.

29. Reardon L, Chappelle W, Goodman T, et al. Prevalence of posttraumatic stress symptoms in United States Air Force intelligence, surveillance, and reconnaissance agency imagery analysts. Psychol Trauma. 2016; 8(1): 55-62. DOI: 10.1037/tra0000046.

30. Weathers FW, Blake DD, Schnurr PP, et al. The Clinician-Administered PTSD Scale for DSM-5 (CAPS-5). National Center for PTSD.

31. Chappelle W, Goodman T, Reardon L, et al. An analysis of post-traumatic stress symptoms in United States Air Force drone operators. J Anxiety Disord. 2014; 28(5): 480-7. DOI: 10.1016/j.janxdis.2014.05.003.

32. Wood J, Chappelle W, Correll T, et al. Prevalence of posttraumatic stress disorder in remotely piloted aircraft operators in the United States Air Force. Wright-Patterson AFB, OH: U.S. Air Force School of Aerospace Medicine. 2016. (AFRL-SA-WP-SR-2015-0005).

33. Litz BT, Schlenger WE. PTSD in service members of the Iraq and Afghanistan wars: a bibliography and critique. PTSD Research Quarterly. 2009; 20(1): 1-8.

34. Richardson LK, Frueh CB, Acierno R. Prevalence estimates of combat-related post-traumatic stress disorder: critical review. Australian and New Zealand Journal of Psychiatry. 2010; 44: 4-19.

35. Gertler J. U.S. Unmanned aerial systems. In: Service CR, ed. 2012.

36. American Psychiatric Association. (DSM-IV) Diagnostic and statistical manual of mental disorders, Fourth Edition. 4th ed. Washington, D.C.: American Psychiatric Press, Inc., 1994.

37. American Psychiatric Association. (DSM-III-R) Diagnostic and statistical manual of mental disorders, Third Edition-Revised. 4th ed. Washington, D.C.: American Psychiatric Press, Inc., 1987.

38. Maguen S, Lucenko BA, Reger MA, et al. The impact of reported direct and indirect killing on mental health symptoms in Iraq war veterans. J Trauma Stress. 2010; 23(1): 86-90. DOI: 10.1002/jts.20434.

39. Campo J. Distance in war: the experience of MQ-1 and MQ-9 aircrew. Air and Space Power Journal. 2015.

40. Chappelle W, Skinner E, Goodman T, et al. Emotional reactions to killing in remotely piloted aircraft crew members during and following weapon strikes. Military Behavioral Health. 2018; 6: 357-367.

41. Christen M, Narvaez D, Zenk JD, et al. Trolley dilemma in the sky: Context matters when civilians and cadets make remotely piloted aircraft decisions. PLoS One. 2021; 16(3): e0247273. DOI: 10.1371/journal.pone.0247273.

42. Blair D, House K. Avengers in wrath: moral agency and trauma prevention for remote warriors. (https://lawfareblog.com/avengers-wrath-moral-agency-andtrauma-prevention-remote-warriors).

43. Bufford RK, Frise A, Paloutzian RF, et al. Psychological and spiritual factors affecting well-being among military personnel engaged in remote combat. Psychol Trauma. 2022. DOI: 10.1037/tra0001352.

44. Medicine Io. Study on Assessment of Ongoing Efforts in the Treatment of PTSD. Institute of Medicine (IOM). 2014.

45. Drescher KD, Foy DW, Kelly C, et al. An exploration of the viability annd usefulness of the construct moral injury in war veterans. Traumatology. 2011; 17: 8-13.

46. Litz BT, Stein N, Delaney E, et al. Moral injury and moral repair in war veterans: a preliminary model and intervention strategy. Clin Psychol Rev. 2009; 29(8): 695-706. DOI: 10.1016/j.cpr.2009.07.003.

47. Gregory D. From a view to a kill: drones and late modern war. Theory, Culture, and Society. 2011; 28: 188-215.

48. Bryant-Lees KB, Prince L, Goodman T, et al. Sources of Stress and Psychological Health Outcomes for Remotely Piloted Aircraft Operators: A Comparison Across Career Fields and Major Commands. Mil Med. 2021; 186(7-8): e784-e795. DOI: 10.1093/milmed/usaa257.

49. Wright T. Do games make better drone operators than pilots? Video gamers' psychology might be better-suited to flying drones. Air & Space Magazine.

50. Gray JG. The Warriors: Reflections on Men in Battle. Lincoln, NE: University of Nebraska Press. 1998.

51. Holmes R. Acts of war: the behavior of men in battle. New York, NY: Free Press. 1986.

52. Shalit B. The psychology of conflict and combat. New York, NY: Praeger. 1988.

53. Foa EB, E. H, Rothbaum BO, Rauch SAM. Prolonged Exposure Therapy for PTSD: Emotional Processing of Traumatic Experiences, Therapist Guide. 2nd ed. New York, NY: Oxford University Press. 2019.

54. Jones KRS, Rauch SAM, Smith ER, et al. Moral injury, posttraumatic stress disorder, and prolonged exposure. In: Currier JM, Drescher KD, Nieuwsma JA, eds. Addressing moral injury in clinical practice. Washington, D.C.: American Psychological Association. 2021: 123-141.

55. Armour C, Ross J. The health and well-being of military drone operators and intelligence analysts: a systematic review. Military Psychology. 2017; 29(2): 83-98.

56. Pressfield S. The warrior ethos. New York, NY: Black Irish Entertainment. 2011.

57. Ricks TE, Morris DJ. Can drone operators get PTSD? Foreign Policy. 2015.

58. MacNair RM. Perpetration-induced traumatic stress: The psychological consequences of killing. Westport, CT: Praeger Publishers/Greenwood Publishing Group. 2002.

59. Komarovskaya I, Maguen S, McCaslin SE, et al. The impact of killing and injuring others on mental health symptoms among police officers. J Psychiatr Res. 2011; 45(10): 1332-6. DOI: 10.1016/j.jpsychires.2011.05.004.

60. Enemark C. Drones, risk, and moral injury. Critical Military Studies. 2019; 5: 150-167.

61. Fiske ST. Social beings: core motives in social psychology. Hoboken, N.J.: J. Wiley. 2004.

62. Martin R. Report: high levels of burnout in U.S. drone pilots. Morning Edition. NPR.

63. Nelson DA, Wilson M, Kurina LM. Post-traumatic stress disorder among U.S. Army drone operators. Aerospace Medicine and Human Performance. 2022; 93(7): 562-570. DOI: https://doi.org/10.3357/AMHP.6016.2022.

64. Weathers FW, Litz BT, Keane TM, et al. The PTSD Checklist for DSM-5 (PCL-5) – Extended Criterion A [Measurement instrument]. (https://www.ptsd.va.gov/).

65. Galatzer-Levy IR, Bryant RA. 636,120 Ways to Have Posttraumatic Stress Disorder. Perspect Psychol Sci. 2013; 8(6): 651-62. DOI: 10.1177/1745691613504115.

66. Stein NR, Mills MA, Arditte K, et al. A scheme for categorizing traumatic military events. Behavior Modification. 2012; 36(6): 787-807.

67. Resick PA, Straud CL, Wachen JS, et al. A comparison of the CAPS-5 and PCL-5 to assess PTSD in military and veteran treatment-seeking samples. Eur J Psychotraumatol. 2023; 14(2): 2222608. DOI: 10.1080/20008066.2023.2222608.

68. Barnes HA, Hurley RA, Taber KH. Moral Injury and PTSD: Often Co-Occurring Yet Mechanistically Different. J Neuropsychiatry Clin Neurosci. 2019; 31(2): A4-103. DOI: 10.1176/appi.neuropsych.19020036.

69. Bandura A. Disengaging morality from robotic warfare. The Psychologist. (https://thepsychologist.bps.org.uk/volume-30/february-2017/disengaging-morality-robotic-war).

70. Phillips A, Sherwood D, Greenberg N, et al. Occupational stress in Remotely Piloted Aircraft System operators. Occup Med (Lond). 2019; 69(4): 244-250. DOI: 10.1093/occmed/kqz054.

71. Chappelle W, McDonald K, Thompson B, et al. Prevalence of high emotional distress and symptoms of post-traumatic stress disorder in U.S. Air Force active duty remote piloted aircraft operators (2010 USAFSAM survey results). Wright-Patterson AFB, OH: U.S. Air Force School of Aerospace Medicine, 2012. (AFRL-SA-WP-TR-2013-0002).

72. Chappelle WL, McDonald KD, Prince L, et al. Symptoms of psychological distress and post-traumatic stress disorder in United States Air Force "drone" operators. Mil Med. 2014; 179(8 Suppl): 63-70. DOI: 10.7205/MILMED-D-13-00501.

73. Kunertova D. The war in Ukraine shows the game-changing effect of drones depends on the game. Bulletin of Atomic Scientists. 2023; 79(2): 95-102.

74. Dass R. Militants and drones: a trend that is here to stay. The Royal United Services Institute for Defence and Security Studies. 2022. (https://www.rusi.org).

75. Crowley M, Johnstone MN, Murray G. Entering the firing line: how civilians become legitimate targetsin war as technology becomes a double-edged sword. Journal of Information Warfare. 2023; 22(1): 1-9.

76. Holz J. Victimhood and trauma within drone warfare. Critical Military Studies. 2023; 9(2): 175-190.

77. Otto MCB, Van Ruysseveldt J, Hoefsmit N, et al. The Development of a Proactive Burnout Prevention Inventory: How Employees Can Contribute to Reduce Burnout Risks. Int J Environ Res Public Health. 2020. DOI: 10.3390/ijerph17051711.

78. Barron L, Carreta T, Rose M. Aptitude and trait predictors of manned and unmanned aircraft pilot job performance. Military Psychology. 2016; 28(2): 65-77.

79. Lushenko P. Review of the special issue 'robotics, autonomous systems, and warfare, 'Small Wars and Insurgenices 31, 4 June 2020.'. Small Wars & Insurgencies. 2021; 32(3): 550-570.

80. Johnson J. Artifical intelligence and future warfare: implications for international security. Defense & Security Analysis. 2019; 35(2): 147-169.

81. Muller O. "An Eye Turned into a Weapon": A philosophical investigation of remote controlled, automated, and autonomous drone warfare. Philosophy & Technology. 2021; 34(4): 875-896.

82. Wisco BE, Marx BP, Wolf EJ, et al. Posttraumatic stress disorder in the US veteran population: results from the National Health and Resilience in Veterans Study. J Clin Psychiatry. 2014; 75(12): 1338-46. DOI: 10.4088/JCP.14m09328.

83. Sun D, Phillips RD, Mulready HL, et al. Resting-state brain fluctuation and functional connectivity dissociate moral injury from posttraumatic stress disorder. Depress Anxiety. 2019; 36(5): 442-452. DOI: 10.1002/da.22883.