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UNDERSTANDING MOTIVATIONAL FACTORS OF

PROBLEMATIC VIDEO GAMING IN THE USMC AND US NAVY

by

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14. ABSTRACT

The overarching aim of the study was to assess attributes and aspects of video gaming in the United States Navy (USN) and Marine Corps (USMC). Data were collected from two USN surface ships (in port) and three commands of the USMC. Sailors completed a cross-sectional survey and a 10-day activity log. Marines completed the survey and participated in semi-structured focus groups. Response rates to the surveys ranged from ~7.5% for Marines to ~22.5% for Sailors. Respondents consisted of 86 Sailors and 927 Marines (age MD=24 years, 92.4% males, 84.2% enlisted). From the 1,013 ADSMs, 91.6% reported playing video games (VGs) (age MD=23 years, 94.3% males, 86.1% enlisted). The information provided in the Marine focus groups along with the survey data of both Marines and Sailors suggest that video gaming is highly prevalent in the military. Many ADSMs began playing video games at 7 or 8 years of age. In general, self-identified gamers used problem-focused and emotion-focused coping styles more frequently than dysfunctional coping styles. Recreation was the most frequently reported motivational dimension for playing VGs, followed by coping with stress. Respondents reported playing VGs at home/off duty more often than when on duty or when underway/deployed. Sailors seem to be more consistent than Marines in their gaming habits. Depending on the setting, gamers reported playing VGs on average 3.75-6 days in a typical week for ~2-3 hours/day. Gamers reported playing VGs generally later in the day (i.e., after work and before bedtime) with 5% to 18% of gamers sleeping later due to VGs. Most gamers reported playing VGs in their racks or the mess decks/common areas when deployed/underway. Gamers reported symptoms of depression (~23% of ADSMs), generalized anxiety disorder (~19%), excessive daytime sleepiness (~33%), and AUDIT-C scores suggestive of heavy drinking (39%). Also, ~32% of gamers reported dissatisfaction with their life. More excessive gamers tended to be younger, used dysfunctional coping styles more frequently, and played video games more frequently and for more hours. Also, more excessive gamers were more likely to report sleeping later because of playing video games, and exhibited more symptoms of major depression, generalized anxiety, and excessive daytime sleepiness. Depending on the criterion used, the prevalence of disordered gaming in the study samples ranged from 0 to 4.85%. Of those who reported playing VGs, ~50% of Marines and 25% of Sailors were identified as problematic gamers. We developed several recommendations and action items, including suggestions for follow-on research.

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From the 1,013 ADSMs, 91.6% reported playing video games (VGs) (age MD=23 years, 94.3% males, 86.1% enlisted). The information provided in the Marine focus groups along with the survey data of both Marines and Sailors suggest that video gaming is highly prevalent in the military. Many ADSMs began playing video games at 7 or 8 years of age. In general, self-identified gamers used problem-focused and emotion-focused coping styles more frequently than dysfunctional coping styles. Recreation was the most frequently reported motivational dimension for playing VGs, followed by coping with stress. Respondents reported playing VGs at home/off duty more often than when on duty or when underway/deployed. Sailors seem to be more consistent than Marines in their gaming habits. Depending on the setting, gamers reported playing VGs on average 3.75-6 days in a typical week for ~2-3 hours/day. Gamers reported playing VGs generally later in the day (i.e., after work and before bedtime) with 5% to 18% of gamers sleeping later due to VGs. Most gamers reported playing VGs in their racks or the mess decks/common areas when deployed/underway.

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I. INTRODUCTION

A. BACKGROUND

Active-duty service members (ADSMs) spend a significant amount of their free time playing video games. This recreational activity is not unexpected given the relatively young age of many ADSMs and the prevalence of video gaming in the US population. The military operational environment, however, is characterized by high levels of occupational stress and poor sleep conditions, which can result in an increased risk of depression, anxiety, and sleep disorders. In such conditions, video games may serve as an effective strategy for coping with stress.

In contrast, excessive video gaming becomes a problem when it negatively affects well-being and behavior. For instance, some studies have found that excessive video gaming is associated with high stress levels (Milani et al., 2018), lower psychosocial well-being and psychological functioning (von der Heiden, Braun, Müller, & Egloff, 2019), loneliness and depression (Lemmens, Valkenburg, & Peter, 2011), and delinquency and aggressive behavior (Engelhardt, Bartholow, Kerr, & Bushma, 2011; Ewoldsen et al., 2012; Milani et al., 2018). Video gaming may also interfere with sleep when gamers stay up late or awaken early to play video games instead of sleeping (Matsangas, Shattuck, & Saitzyk, 2020). In extreme cases, video gaming behavior is characterized as an addiction. In the scientific literature, Internet Gaming Disorder (IGD) is associated with poor emotional regulation, impaired prefrontal cortex functioning and cognitive control, degraded working memory and decision-making capabilities, and a neuronal deficiency similar to substance-abuse addictions (Kuss, Pontes, & Griffiths, 2018).

B. STUDY AIMS AND OBJECTIVES

The overall aim of the project was to assess various characteristics of video gaming in the Marine Corps and US Navy. The specific objectives were:

- Assess the prevalence of video gaming.

- Assess the prevalence of problematic video gaming and/or addiction to video gaming.
- Explore why Marines and Sailors engage in video gaming.
- Explore whether Marines and Sailors use gaming as a maladaptive coping mechanism.
- Identify key intrinsic factors (e.g., demographic characteristics) and extrinsic factors (e.g., occupational or other) associated with video gaming.
- Assess the effect of video gaming on Marines' and Sailors' behavior, quality of life, and everyday functioning.
- Provide recommendations focused on Marine and Sailors to promote healthy coping behaviors in response to stressors.

C. REPORT STRUCTURE

The Methods section in this report describes the methods used to conduct the study and collect the data. The Results section describes the findings from the survey and the focus groups. The Conclusions section provides an overview of our findings and discusses the importance of these findings. The Recommendations section proposes potential routes for future research. This report also includes the following appendices:

- Appendix A: Detailed group characteristics.
- Appendix B: Pairwise correlation analysis among study variables.
- Appendix C: Exploratory factor analysis (EFA)

II. LITERATURE REVIEW

A. INTRODUCTION

Video gaming is a popular and increasingly prevalent activity worldwide. According to a poll of the Computer and Video Games Industry, over 164 million adults in the United States with an average of 33 years play video games (Entertainment Software Association, 2019).

A video game is defined as "a game which we play thanks to an audiovisual apparatus and which can be based on a story" (Esposito, 2005). The term "video gaming" encompasses playing a variety of game types on several different technological platforms, including gaming consoles, hand-held devices, personal computers, and smartphones.

Because video gaming is so broadly defined, researchers have attempted to classify video games into various genres. In 2006, Apperley grouped video games into four main genres, each containing more specific sub-genres: simulation, strategy, action, and role-playing (Apperley, 2006). Other researchers have used more detailed classification systems. For example, Qaffas (2020) described 16 genres: adventure, role-playing, shooter, platform, puzzle, strategy, hack-and-slash, real-time strategy, turn-based strategy, point-and-click, indie, racing, sport, fighting, arcade, and strategy games. According to a recent survey conducted by the Entertainment Software Association (ESA), "casual" games, which are simple games targeted to a wide audience, are the most popular type of game (played by 71%), followed by action games (played by 53%), and shooter games (played by 47%). In terms of technological platform preferences, the survey found that the most common devices used for video gaming are smartphones (60%), personal computers (52%), and dedicated games consoles (49%) (Entertainment Software Association, 2019).

B. PROBLEMATIC VIDEO GAMING

Video gaming in moderation can be beneficial to a certain extent but playing video games excessively may be problematic for the player's well-being and behavioral

health. There is an ongoing debate, however, about what exactly constitutes problematic video gaming (Brunborg et al., 2013).

Video gaming behaviors could be considered as a continuum with addiction anchored at the upper end of the spectrum (Ferguson, Coulson, & Barnett, 2011; Kuss & Griffiths, 2012). Indeed, some researchers have stated that aspects of internet gaming addiction are similar to substance-related addictions (Kuss & Griffiths, 2012). From a behavioral perspective, video game addiction can be defined as an uncontrollable excessive and compulsive use of computer or video games that leads to social and emotional problems (Lemmens, Valkenburg, & Peter, 2009). Along these lines, Wittek and colleagues later defined video game addiction as the problematic or pathological use of video games, whereby gaming leads to functional impairments in daily life (Wittek et al., 2016).

In 2005, Griffiths suggested that addictive behaviors such as video gaming include six components: salience (i.e., when the activity becomes the most important activity in a person's life and dominates thoughts), mood modification, tolerance (i.e., when increasing amounts of the activity are required to achieve the desired effects), withdrawal when the activity is discontinued or reduced, conflicts between the addict and those around them or from within the individual, and relapse (i.e., the tendency to revert to earlier patterns of activity after periods of abstinence or moderation) (Griffiths, 2005). More recently, King and colleagues documented an emerging consensus that problematic video gaming is characterized by three dimensions: withdrawal, loss of control, and conflict (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013). Of note, the loss of control is not explicitly included in Griffith's six-component model because it is subsumed by conflict (King et al., 2013).

Recognizing problematic video gaming as an addiction may be advantageous for diagnosing and treating excessive video gaming. However, an ongoing scholarly debate still exists regarding the diagnostic conceptualization, criteria, and assessment of problematic gaming (Király & Demetrovics, 2017), with some researchers proposing that diagnosis should focus on neurocognitive differences between problematic and normal gamers (Vaccaro & Potenza, 2019). Notably, addiction to video gaming should be distinguished from high engagement with video games, which involves intense interest or

prioritization of playing video games (Charlton & Danforth, 2007). Addiction is characterized by stress, anxiety, and depression, whereas high engagement is only associated with anxiety (Loton, Borkoles, Lubman, & Polman, 2016). However, high engagement with video games paired with maladaptive coping – e.g., inability to be mindful of out-of-game responsibilities – may be a precursor to video gaming addiction (Loton et al., 2016). Ultimately, research on video gaming behavior indicates that time spent playing video games is not necessarily a reliable indicator of problematic video gaming because excessive amounts of time spent gaming must also be paired with problematic behaviors (e.g., Brunborg, Mentzoni, & FrØyland, 2014; Király, Tóth, Urbán, Demetrovics, & Maraz, 2017; Loton et al., 2016).

Problematic video gaming is considered a diagnosable mental disorder, and has been added to recent editions of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013, p. 795) and in the World Health Organization's International Classification of Diseases (ICD-11) (World Health Organization, 2019b). In the revised DSM-5, Internet Gaming Disorder (IGD), which had been referred to by many different names previously, was included as an emerging disorder that warrants further research (Feng, Ramo, Chan, & Bourgeois, 2017). IGD was defined as "persistent and recurrent use of the Internet to engage in games, often with other players, leading to clinically significant impairment or distress." Studies of the prevalence of IGD have shown that IGD affects only a small subset of individuals who play video games, and that IGD has not increased in prevalence to the same extent that Internet usage has increased in recent years. Diagnosis with IGD requires that an individual meets at least five of the following nine criteria:

1. Preoccupation with Internet gaming
2. Withdrawal symptoms when the Internet is taken away
3. Tolerance: the need to spend increasing amounts of time engaged in Internet gaming
4. Unsuccessful attempts to control Internet gaming use
5. Continued excessive Internet use despite knowledge of negative psychosocial problems

6. Loss of interests, previous hobbies, and entertainment as a result of, and with the exception of, Internet gaming use
7. Use of Internet gaming to escape or relieve a dysphoric mood
8. Has deceived family members, therapists, or others regarding the amount of Internet gaming
9. Has jeopardized or lost a significant relationship, job, or educational or career opportunity because of Internet gaming use.

More recently, the World Health Organization included Gaming Disorder (GD) in the 11th edition of the International Classification of Diseases (ICD-11) (World Health Organization, 2019a). Resulting from addictive behaviors, GD is characterized by a pattern of persistent or recurrent gaming behavior ("digital gaming" or "video-gaming"), which may be online (i.e., over the Internet) or offline. Gaming Disorder may involve poor self-control over gaming behaviors, increased priority given to gaming, and continuation or escalation of gaming behaviors despite negative consequences. According to ICD-11, a diagnosis of GD requires that gaming behavior occurs over a period of at least 12 months, although gaming behavior can be continuous or sporadic in nature. In severe cases, a shorter duration of gaming may be sufficient for diagnosis.

Given its negative effects, problematic video gaming has become an issue of public concern. It is not a surprise, therefore, that debate is ongoing regarding whether governments should implement policies aimed to regulate video games and prevent problematic video gaming behavior (Kuss, 2018; Shek; Swanton, Blaszczynski, Forlini, Starcevic, & Gainsbury, 2019). Only a few countries have implemented such policies which serve to limit the availability of video games, reduce risk and harm of video gaming (e.g., issuing warning messages), and provide help and mental health services for video gamers (Király et al., 2018). Notably, in 2021, China instituted a policy limiting video gaming to three hours per week for children under the age of 18.

Of note, our review showed there is a lack of consensus regarding which term to use to define severe video gaming with researchers oftentimes using terms like "problematic", "excessive" or "disordered" gaming. In this chapter, we will use the term "problematic" to describe video gaming severity that is not considered "normal".

C. PREVALENCE OF PROBLEMATIC VIDEO GAMING

Several studies have investigated the prevalence of problematic video gaming. A study published in 2009 surveyed 1,178 American youths (aged 8 – 18 years) and determined that approximately 8% of video game players exhibited pathological patterns of play (Gentile, 2009). In contrast, a survey of 4,028 adolescents identified that 4.9% of the gamers reported problematic gaming (Desai, Krishnan-Sarin, Cavallo, & Potenza, 2010). In 2015, a study showed that the prevalence of Internet Gaming Disorder in a sample of 1,247 young adults from the US (aged 18 – 24 years) was 1.04% , whereas another study in a sample of 5,777 adults (aged 18 and older) from the US showed a prevalence of 0.32% (Przybylski, Weinstein, & Murayama, 2017).

In a meta-analysis of 33 studies, it was estimated that 3.1% of gamers exhibited behaviors consistent with problematic video gaming (Ferguson et al., 2011). These numbers were corroborated in a study in the Netherlands (N = 902 participants) that estimated the prevalence of problematic gaming at 3.3% among adolescents and young adults (Haagsma, Pieterse, & Peters, 2012). In a study conducted in Norway (N = 3,389 participants), video gamers were classified into four groups based on their survey responses. The four groups were addicted gamers (1.4%), problematic gamers (7.3%), engaged gamers (3.9%), and normal gamers (87.4%) (Wittek et al., 2016). A recent review of 67 studies of naturalistic populations between 1998 and 2016 showed that the overall prevalence of IGD ranged from 0.7–15.6% (Feng et al., 2017). Another review published in 2018 indicated that the prevalence of IGD ranged from 0.21% to 57.5% in various general population samples from Korea, China, and the US (Darvesh et al., 2020). The wide range in prevalence estimates can be attributed to differences in the definition or criteria used to classify addicted and problematic video gamers.

Several studies on video gaming behavior and prevalence have been conducted within the US military. In 2009, approximately 19% of the first-year cadets in the U.S. Military Academy reported moderate or higher levels of experience playing video games (Orvis, Horn, & Belanich, 2009). A survey of 10,000 U.S. Army soldiers in 2010 indicated that fewer than 43% of soldiers played video games at least once per week (Orvis, Moore, Belanich, Murphy, & Horn, 2010). The prevalence of video gaming had

an inverse relationship with rank and experience; approximately 46.4% of enlisted personnel reported playing video games compared to 24.1% of officers, and junior enlisted soldiers report the highest frequency (51–59%) compared to 11–37% for senior enlisted/officer ranks play much less. The fact that young service members are more likely to be involved in video gaming has been verified by other studies as well (Edwards-Stewart, Smolenski, Reger, Bush, & Workman, 2016). In recent years, service members have significantly increased their use of personal technology (e.g., smartphones and tablets), which is commonly used to play video games, at home and while on deployment (Bush & Wheeler, 2015). Further, we identified a study from Norway that specifically addressed problematic video gaming in the military. In this study, 8.8% of veterans from the Norwegian Armed Forces who had been previously deployed to Afghanistan showed symptoms indicative of problematic gaming (Myrseth, Olsen, Borud, & Strand, 2017).

Studies of sleep in the military have demonstrated that many ADSMs engage in video gaming before bedtime. In a survey of Marines involved in security duties (N = 1,169 ADSMs), 26.8% reported playing video games prior to sleep, and 21.7% noted that they played video games when they could not sleep (Matsangas et al., 2020). These results were in line with findings from survey data collected between 2012 and 2015 from the same population of Marines (Aldridge, 2016). In 2017 and 2018, the Naval Postgraduate School Crew Endurance team conducted a study at the U.S. Military Academy to assess Cadet sleep-related behaviors and sleep patterns (Shattuck, Shattuck, & Matsangas, 2018). Even though not explicitly focused on video gaming, the study results provided insights regarding the use of light-emitting devices before sleep. Specifically, USMA Cadets reported using light-emitting devices before sleeping on average 25.4% ± 20.2% of the nights, with individual use of light-emitting devices ranging from 0 to 75% of nights assessed. The median duration of using the light-emitting device was 90 ± 60 minutes.

Our review has failed to identify any recent estimates of the prevalence of video gaming in the military. The advent of the COVID-19 pandemic, however, has increased the number of players and online gaming activities in the general population (King, Delfabbro, Billieux, & Potenza, 2020; Nicola et al., 2020). This increase, in conjunction

with a lack of other social activities, may in turn lead to excessive video gaming and increase the risk for developing problematic behaviors (Király et al., 2020).

D. EFFECTS ON HUMANS

Playing video games can be beneficial in terms of cognitive, motivational (e.g., resilience in the face of failure), emotional (e.g., mood management), and social domains (e.g., prosocial behavior) (Granic, Lobel, & Engels, 2014). Studies have shown that video gaming is associated with improvements in visual selective attention (Green & Bavelier, 2003), processing speed (Dye, Green, & Bavelier, 2009), and executive function (e.g., decision making and problem solving) (Buelow, Okdie, & Cooper, 2015). In a meta-analysis examining the relationship between video gaming and improvements in health-related outcomes, video gaming improved 69% of psychological therapy outcomes, 59% of physical therapy outcomes, 50% of physical activity outcomes, 46% of clinician skills outcomes, 42% of health education outcomes, 42% of pain distraction outcomes, and 37% of disease self-management outcomes (Primack et al., 2012). Online gaming may also result in strong social ties, especially if gamers form social attachments that involve within-game and out-of-game social activities (Steinkuehler & Williams, 2006; Trepte, Reinecke, & Juechems, 2012).

Video gaming can be beneficial for regulating and managing mood and stress (Russioniello, O'Brien, & Parks, 2009). In a study of ADSMs and retired service members, individuals who reported playing video games on a daily or weekly basis exhibited less threat and war content in their military dreams compared to individuals who played video games less frequently (Gackenbach, Ellerman, & Hall, 2011). These findings suggest that, even though escapism is generally associated with negative outcomes, some aspects of escaping through video games may reduce stress and help mood and emotion management (Kosa & Uysal, 2020). This result may be particularly beneficial for individuals exposed to high levels of stress.

Video gaming is also associated with negative effects, especially when gaming habits become problematic for the gamers' psychological health. Video gaming has been tied to lower psychosocial well-being and loneliness (Lemmens et al., 2011), psychosomatic symptoms, and behavioral and social problems (Brunborg et al., 2014;

Milani et al., 2018; Müller et al., 2015). Specifically, video gaming may be related to a lack of real-life friends (Kowert, Domahidi, Festl, & Quandt, 2014), and there is evidence that video game behaviors may interfere with forming and maintaining romantic partnerships (Hertlein & Hawkins, 2012). Excessive video gamers are at risk of having lower educational and career attainment, problems with peers, and lower social skills (Mihara & Higuchi, 2017). Specifically, video gaming may interfere with academic achievement (Anderson & Dill, 2000; Brunborg et al., 2014; Chiu, Lee, & Huang, 2004; Gentile, 2009), and real-life judgment (Fortes et al., 2020).

Several studies have identified a link between video gaming and psychological outcomes, including mental illness and impairments in psychological functioning. For example, video gaming has been associated with more severe symptoms of depression (Andreassen et al., 2016; Brunborg et al., 2014; Loton et al., 2016). Video gaming may also be related to anxiety, but this association is less clear. Loton and colleagues showed that, after accounting for coping, addiction is associated with anxiety (Loton et al., 2016). In contrast, results from another study showed addictive use of video games was inversely related to symptoms of anxiety (Andreassen et al., 2016). In the same study, it was identified that the addictive use of video games was positively associated with attention-deficit/hyperactivity disorder (ADHD) and obsessive-compulsive disorder (OCD) (Andreassen et al., 2016).

Some association between problematic video gaming and psychological functioning appears to exist with regard to psychological symptoms, affectivity, coping, and self-esteem (von der Heiden et al., 2019). In one study, video gaming addiction was negatively associated with conscientiousness and positively associated with neuroticism; and poor psychosomatic health was positively associated with problematic and engaged gaming (Wittek et al., 2016). Further, more severe symptoms of IGD were associated with denial and behavioral disengagement coping styles, which are both considered maladaptive (Schneider, King, & Delfabbro, 2017). Notably, the relationship between video gaming and mental health appears to be modulated by the type of game played and the motivation for playing. For example, playing violent games has been associated with violence desensitization, aggressive thoughts, aggressive behavior, and delinquency (Anderson & Dill, 2000; Anderson & Murphy, 2003; Engelhardt et al., 2011; Ewoldsen

et al., 2012). A review of the neurobiological correlates involved in IGD (N=853 studies) showed that, compared to healthy controls, gaming addicts have poorer response-inhibition and emotion regulation, impaired prefrontal cortex functioning and cognitive control, poorer working memory and decision-making capabilities, decreased visual and auditory functioning, and a deficiency in their neuronal reward system, similar to those found in individuals with substance-abuse addictions (Kuss et al., 2018).

Studies conducted within the military have demonstrated that playing video games can have negative effects on sleep, with many gamers playing video games before bedtime (Joint Mental Health Advisory Team 8 (J-MHAT 8), 2013; Kurtz, 2020; Matsangas, Shattuck, & Saitzyk, 2017; Matsangas et al., 2020; Mentzoni et al., 2011). Also, this pattern of sacrificing sleep to maintain video gaming schedules was clearly identified in a case series of three Marines (Eickhoff et al., 2015). The Marines reported playing video games from 30 hours to more than 60 hours per week, in addition to maintaining a 40-hour or more workweek. Also, there is evidence that engaging in stimulating activities (e.g., playing violent video gaming) before sleep may perpetuate sleep disturbances by increasing arousal before sleep (Troxel et al., 2015). Overall, these findings emphasize the need to address video gaming as an important factor for optimal time management in ADSMs, especially regarding sleep.

E. MOTIVATIONAL FACTORS OF PLAYING VIDEO GAMES

To understand the nature of video gaming, it is important to assess why people play them. Many conceptual and theoretical approaches for classifying the motivations to play video games have been developed. In general, two high-level explanations are widely accepted. The first approach focuses on the positive perspective of playing video games as a recreational activity with entertainment value. The second approach focuses on the negative side of video gaming, where gaming is a mechanism to avoid and escape from real-life problems. For example, problematic video gamers are likely to "escape" into video games as a maladaptive coping strategy for dealing with adverse emotional experiences (Di Blasi et al., 2019). Unsurprisingly, studies show that ADSMs play video games both as a recreational/entertainment activity and to deal with stressors experienced

in deployment (Hosek, Kavanagh, & Miller, 2006; Mental Health Advisory Team (MHAT) V, 2008; Troxel et al., 2015).

Other more in-depth and nuanced theories and taxonomies have also been proposed. The Uses and Gratification theory, which is focused on understanding why and how people consume media, originated in the late 1950s and early 1960s (Katz, Blumler, & Gurevitch, 1973, 1974; Krcmar & Strizhakova, 2009). This theory postulates that people *use* media to fulfill their needs and that they receive *gratification* from the satisfaction of using media. Based on this theory, Sherry and colleagues proposed a six-dimension taxonomy to explore why individuals play video games (Sherry, Lucas, Greenberg, & Lachlan, 2006). The six dimensions are: 1) arousal (i.e., to stimulate emotions), 2) challenge (e.g., personnel accomplishment), 3) competition, 4) diversion (e.g., filling time or escaping from stress), 5) fantasy (e.g., to do things impossible in real life), and 6) social interaction.

Bartle suggested that players can be classified into four groups in terms of their motives to engage in game play: "achievers" who strive to accomplish the game aims, "explorers" who are interested in exploring the game world, "socializers" who focus on relationships and role-playing, and "killers" who focus on annoying other players (Bartle, 2003). Using these four gamer identities, Yee proposed an alternative classification system for player motivation (Yee, 2006), which consists of three main components and 10 subcomponents:

- Achievement
    - Advancement – the desire to gain power, progress rapidly, and acquire in-game symbols of wealth or status.
    - Mechanics – having an interest in analyzing the underlying rules and system to optimize performance.
    - Competition – the desire to challenge and play against other players.

- Social
    - Socializing – having an interest in chatting and interacting with other players.
    - Relationship – the desire to form long-term and meaningful connections with others.
    - Teamwork – deriving satisfaction from being part of a group effort.

- Immersion
    - Discovery – finding and knowing things that most players don't know about (e.g., "Easter eggs").
    - Role-playing – creating a persona with a background story and interacting with other players to create an improvised story.
    - Customization – having an interest in personalizing the appearance of their character and game environment.
    - Escapism – using the online environment to avoid thinking about real-life problems.

In 2011, Demetrovics and colleagues identified that previous studies examining motivation for playing video games, while insightful, were also limited because they focused on specific games genres (Demetrovics et al., 2011). To address this limitation, they proposed a more comprehensive model of motivational factors – including social, escape, competition, coping, skill development, fantasy, and recreation factors – which was designed to be more inclusive of a variety of game types (Demetrovics et al., 2011). Most notably, their approach explores includes recreation as a major motivating factor in video game playing, an item missing in earlier models (Sherry et al., 2006; Yee, 2006).

The self-determination theory (SDT) has also been used to explain the motivational factors associated with video gaming (Deci & Ryan, 1985, 2008; Ryan & Deci, 2000). Under the larger conceptual "umbrella" of SDT, are two sub-theories: cognitive evaluation theory (Deci & Ryan, 1985) and the basic psychological need theory (Deci & Ryan, 2000). SDT postulates that self-motivation, mental health, and well-being are improved when the three innate psychological needs (autonomy, competence, and relatedness) are satisfied. Autonomy is a sense of volition or willingness when doing a task (Deci & Ryan, 1980, 2000), competence is the need for challenge and feelings of efficiency (Deci, 1975), and relatedness is feeling connected with others (Ryan & Deci, 2001). In relation to game playing, the level of satisfaction of the three human needs within a gaming environment independently predicts player motivation to play games (Ryan, Rigby, & Przybylski, 2006).

Lastly, multiple studies have shown that video gaming may be motivated by using gaming as a means for coping with problems and stress (Plante, Gentile, Groves, Modin, & Blanco-Herrera, 2019; Snodgrass et al., 2014). Individuals with emotion-focused coping styles have been shown to have a higher tendency to use games for recovery from

everyday stress (Reinecke, 2009), whereas problematic video gamers tend to preferentially adopt dysfunctional coping strategies like distraction and avoidance (Milani et al., 2018).

F. FACTORS ASSOCIATED WITH PROBLEMATIC VIDEO GAMING/ADDICTION

Research on the factors that relate to problematic video gaming and addiction has revealed that some individual characteristics are closely associated with excessive video gaming. Males spend twice as much time playing video games than females (Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010), and being male is associated with a higher risk of being addicted to video gaming (Haagsma et al., 2012; Wittek et al., 2016). Additionally, being young has been identified as a risk factor for developing a video gaming addiction (Wittek et al., 2016). Personality traits that have been associated with excessive video gaming habits include low levels of self-esteem (Ko, Yen, Chen, Chen, & Yen, 2005), self-efficacy (Jeong & Kim, 2011), high levels of neuroticism (Mehroof & Griffiths, 2010), sensation seeking (Mehroof & Griffiths, 2010), and anxiety and aggression (Mehroof & Griffiths, 2010). Additionally, depression is commonly comorbid with IGD (Wang, Cho, & Kim, 2018), and lower levels of satisfaction with daily life are associated with more severe video gaming behavior (Ko et al., 2005). There are also some intrinsic factors of video games themselves that may influence problematic gaming behaviors. Some of these intrinsic factors include reward and punishment features, earning experience points, managing in-game resources (e.g., money), and mastery components (e.g., speed of completion) (Griffiths & Nuyens, 2017; King, Delfabbro, & Griffiths, 2011).

G. IDENTIFICATION SCALES AND CLASSIFICATION OF SEVERITY

In the last 20 years or so, numerous instruments have been used to assess disordered gaming. We found two reviews of these instruments in our literature search. The first review was conducted prior to the inclusion of IGD in the DSM-5 (King et al., 2013). The second review, however, incorporated the ICD-11 criteria in the assessment of the gaming disorder tools (King, Chamberlain, et al., 2020). Specifically, in the most

recent review, King and colleagues assessed a) whether current tools were consistent with the DSM-5 and ICD-11 criteria; b) which tools were being used in specific research areas (i.e., epidemiological, neurobiological, interventions); and c) which tools had received the most evidential support for their psychometric properties.

King and colleagues' review concluded that the GAS-7 (Lemmens et al., 2009), IGDS9-SF (Pontes & Griffiths, 2015), IGDT-10 (Király, Sleczka, et al., 2017), and IGD-9 (Lemmens, Valkenburg, & Gentile, 2015) had the best evidential support for their psychometric properties (King, Chamberlain, et al., 2020). Of these three tools, only the IGDS9-SF and IGDT-10 cover the DSM-5 and ICD-11 criteria (King, Chamberlain, et al., 2020) because the GAS-7 was developed before IGD was defined.

H. DEFINING PROBLEMATIC VIDEO GAMING IN THE MILITARY ENVIRONMENT

Based on our review of the literature, we identified a consensus regarding how problematic video gaming should be assessed. Specifically, the characterization of problematic video gaming is based on how we understand addiction and the related functional and psychological impairments in everyday life. It is apparent, however, that video gaming behaviors must be examined as a continuum and that the criterion to classify video gaming as normal or problematic should depend on the context (e.g., when and where video games are being played). Thus, for the purposes of this review and study, we must assess problematic video gaming within the context of military environments, which differ significantly from environments regularly faced by most civilians. Specifically, the military operational environment is characterized by high levels of physical and psychological stress, sleep deprivation, and long periods away from home.

In terms of identifying the threshold for when video gaming should be considered "problematic", It has been proposed that problematic video gaming within the military environment is characterized by functional impairments. While individuals characterized as problematic gamers may spend excessive amounts of time playing video games, the amount of time spent gaming should not be considered solely as a reliable indicator of problematic video gaming (Király, Tóth, et al., 2017; Loton et al., 2016). In the military

context, this is an especially important caveat, as the time ADSMs can spend playing video games is limited by work duties and operational commitments.

There is an abundance of evidence that excessive video gaming interferes with obtaining good sleep in the military, which ultimately causes functional impairments in physical and psychological performance. Therefore, we propose that reduced sleep quality or quantity due to video gaming-related behaviors (e.g., playing video games or preoccupation with video games before bed) should be considered as a functional impairment caused by problematic video gaming. The relationship between video gaming and shortened sleep duration is evident in the actigrams (i.e., charts of activity readings collected by wrist-worn devices) of Sailors participating in field studies conducted on different ships. Several Sailors exhibited long bouts (up to several hours) of inactivity before sleep, which corresponded with the use of electronic devices before bedtime (see Figures 1 to 3). The Sailors' sleep duration was curtailed on nights when they used their devices before bedtime, even though some Sailors self-reported sleeping during the time. While using electronic devices did not necessarily involve video gaming, these data highlight the need to address sleep disturbances when discussing problematic video gaming and other related behaviors. The red boxes denote periods of inactivity due to the use of an electronic device. The light blue periods denote sleep.

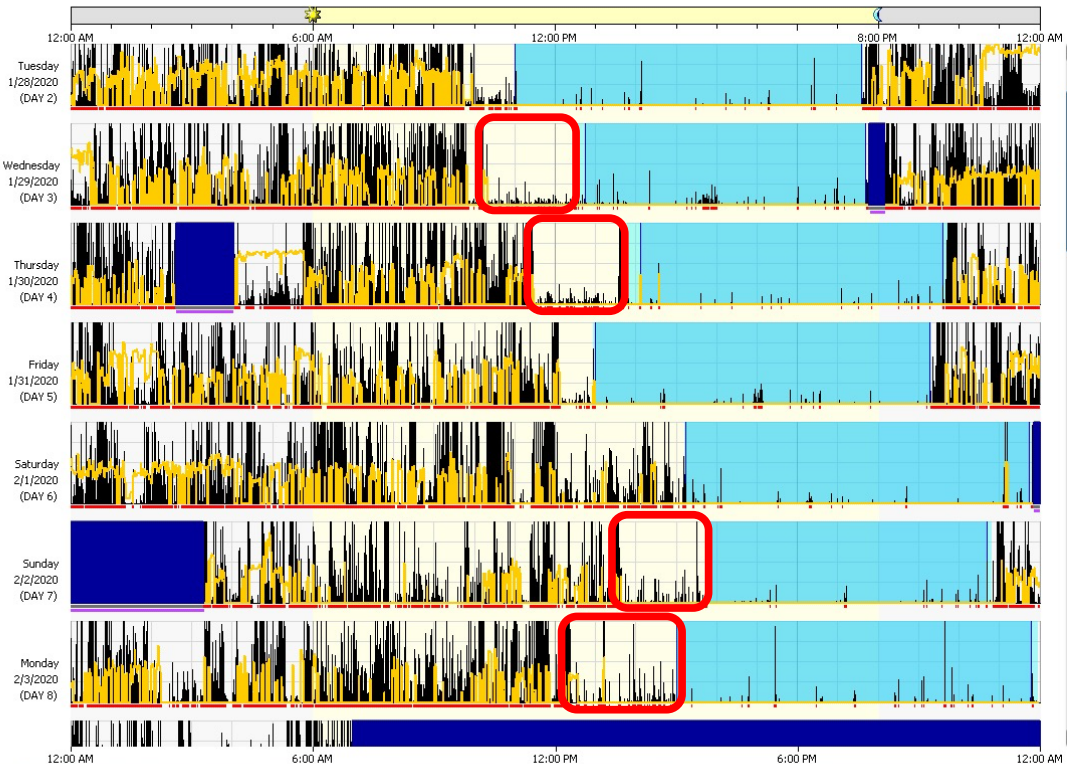

Figure 1. Actigram from a Sailor using electronic devices before sleep.

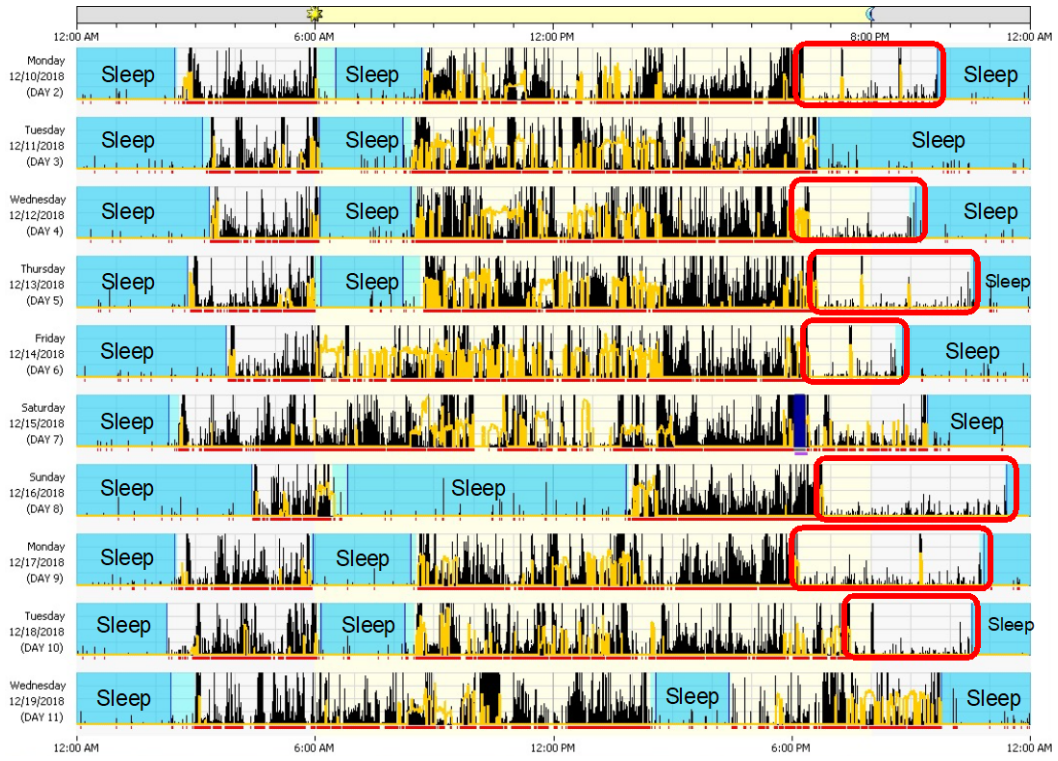

Figure 2. Actigram from a Sailor using electronic devices before sleep.

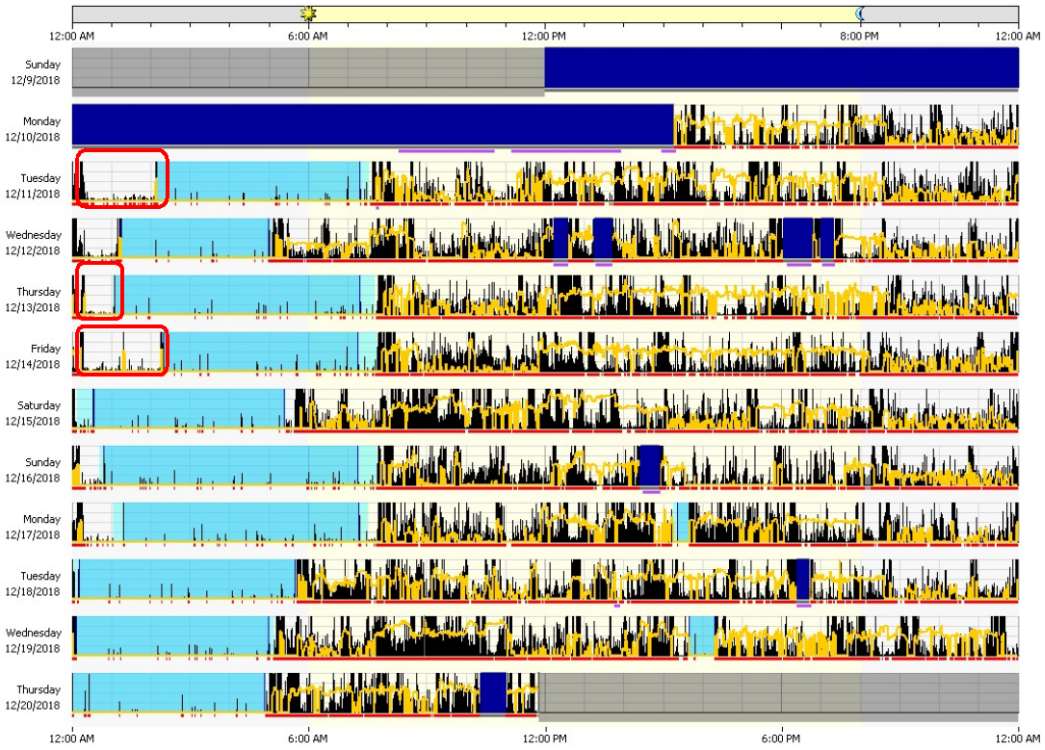

Figure 3. Actigram from a Sailor using methods

III. RESEARCH DESIGN

The study included two major components. The first component involved collecting data from Sailors on two surface ships of the United States Navy (USN). We contacted eight ships; two Ticonderoga-class cruisers (USS San Jacinto, CG-56; USS Cape St. George, CG-71) agreed to participate in the study (both in port). Sailors completed a printed cross-sectional survey and were asked to document their activities in a 10-day log completed online.

The second component involved collecting data from Marines in three commands assigned by the Marine Corps Headquarters (HQMC), i.e., the 2nd Combat Engineer Battalion (2d CEB), Camp Lejeune, NC, the 3rd Marine Logistics Group (3d MLG), Okinawa, and the 2nd Marine Air Wing (2d MAW), Cherry Point, NC. Marines completed an online cross-sectional survey and participated in semi-structured focus groups.

A. PARTICIPANTS

A total of 1,188 ADSM volunteered to participate in the survey, but 175 were dropped due to missing data or because they were Sailors in USMC commands (Figure 1). Therefore, 1,013 ADSMs, 927 Marines and 86 Sailors were used for the analysis. All Sailors assigned to the two ships and Marines assigned to the three commands were allowed to participate in the study. Given the number of Sailors onboard their ship during the recruitment and the number of Marines in the email distribution lists, the approximate average response rate for the USMC commands was 7.5% (2d CEB: ~9%; 3d MLG: ~8%; 2d MAW: ~5.5%) and 22.5% for the USN ships (CG-56: ~29%; CG-71: ~16%). Detailed information regarding participation in the survey portion of the study is shown in Figure 4.

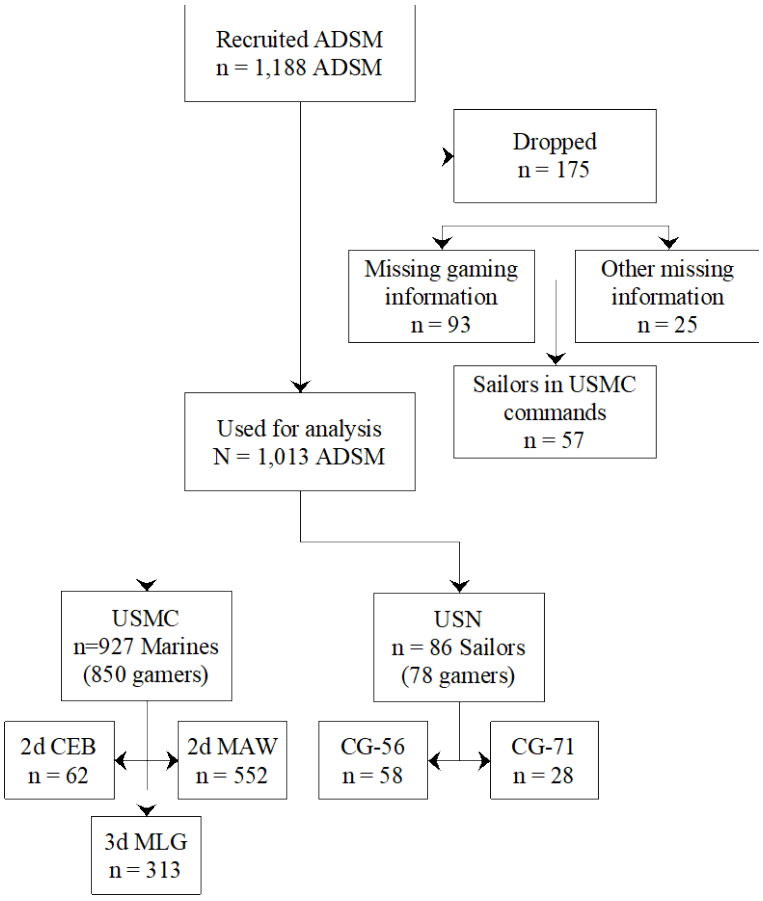

Figure 4. Survey consort diagram.

Four Sailors completed the activity logs and 43 Marines (42 males) volunteered to participate in 8 focus groups, i.e., 13 from the 2d CEB (all E4-E5) and 30 from the 3d MLG (14 E1-E3, 10 E4-E5, and 6 SNCO and Officers). Detailed information regarding the participation in the focus groups is shown in Table 1.

Table 1. Number of Marines in the focus groups.

Rank group	2d CEB	3d MLG	
		1st day	2nd day
E1-E3	-	8	6
E4-E5	13	6	4
SNCO and Officers	-	1	5

The study protocol was approved by the Naval Postgraduate School Institutional Review Board (IRB) (NPS.2021.0040), the USMC IRB, the USMC Survey Office (SCN USMC-HQ-21016)), and the USN Survey Office (RCS# NSP5223.07). Informed consent was obtained from all volunteers.

B. EQUIPMENT

1. The survey

In keeping with the focus of the project, the literature review led to the identification of the main topics of interest to be addressed in the survey. This result led to the identification of potential tools which could be used to effectively assess these topics of interest. We developed two surveys, one for the USMC and one for the USN. In both surveys, items were grouped into five sections, i.e., demographic and occupational characteristics, behavioral habits, video gaming habits, why ADSMs play video games, and functional effects. The two surveys included the same validated tools but differed in some questions in the demographic information/occupational characteristics and behavioral habits sections. The structure of the surveys is shown in Figure 5.

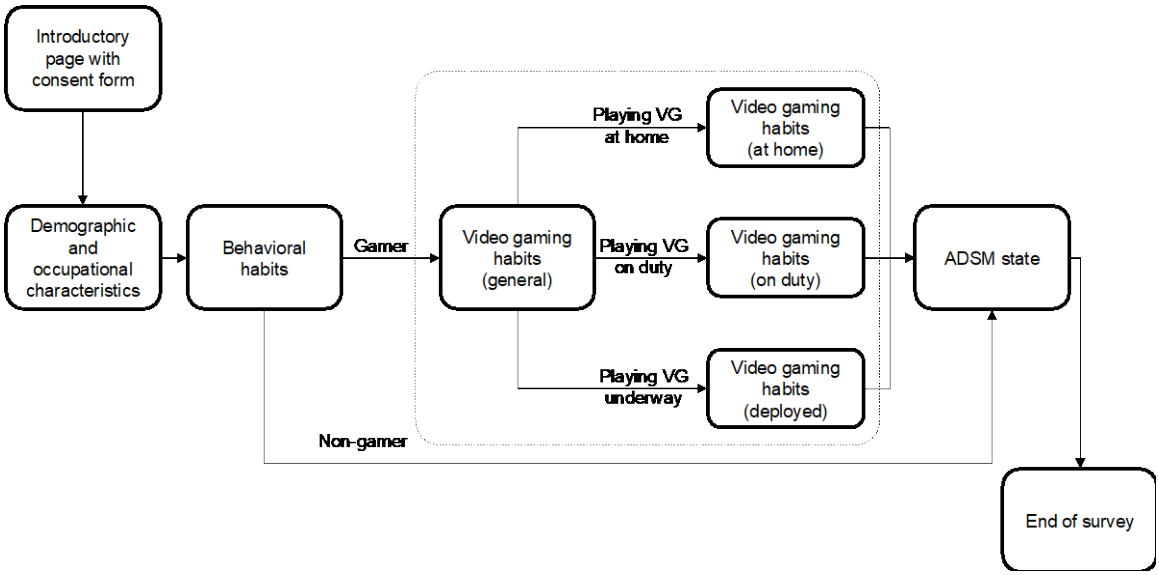

Figure 5. Structure of surveys.

a. Demographic information and occupational characteristics

Participants were asked to report their age, sex, rank, how many years they have served in the military, whether they had been deployed during their service and how many times, and whether their deployment experience involved combat. Marines were also asked their military occupational specialty – MOS (air, logistics, ground).

b. Behavioral habits

Participants were asked how many hours they slept in a typical day (at home/off duty, on duty/inport, when deployed/underway), and whether they were using nicotine products and caffeinated beverages. Sailors were asked whether they had an exercise routine when at home/off duty, when on duty/inport, and when deployed/underway. Marines were asked whether they had an exercise routine, the frequency and kind of this routine, and the duration of this routine. Lastly, all participants were asked whether they play video games either at home/off duty, on duty/inport, and/or when deployed/underway.

c. Video gaming habits

Items in this section were completed only by participants who reported playing video games. Gamers were asked how many years they had played video games. Also, gamers were asked which of 15 video game genres they play (action/ adventure, sports, role-playing, strategy, simulation, multiplayer, simulation, puzzle, shooter, racing, fighting, battle royal, platformer, music and dance, and card-based games, other). These genres are the most common in the video gaming literature and on gaming websites (Lemmens & Hendriks, 2016). Representative examples of each genre examples were provided.

The 9-item IGDS9-SF was used to assess the severity of gaming activity by examining both online and/or offline gaming activities occurring over a 12-month period (Pontes & Griffiths, 2015). The 12-month period is aligned with ICD-11 which notes that for the assessment of gaming disorder, the gaming behavior should be evident

over a period of at least 12 months (World Health Organization, 2019a). Items were answered using a 5-point scale: 1 ("Never"), 2 ("Rarely"), 3 ("Sometimes"), 4 ("Often"), and 5 ("Very often"). Each individual's score was calculated as the sum of all responses, ranging from 9 to 45. For research purposes, the authors proposed using the score of 36 as the criterion to distinguish between disordered and non-disordered gamers. Another criterion for the classification of a disordered gamer is to have a response of 5 ("Very often") in at least five of the nine items on the ICD-11.

Depending on the sample characteristics, however, the criterion score may differ. A recent study using a Chinese clinical sample (N = 131) and a normative sample (N = 3,742) found that a cut-off score of 32 was adequate to distinguish between disordered and non-disordered gamers in a Chinese population (Qin et al., 2020). In contrast, a study of Brazilian gamers (N = 610) identified a cut-off score of more than 16 for risky gaming and more than 21 to distinguish between a normative and clinically diagnosed sample of gamers (Severo et al., 2020).

Next, gamers were asked to provide detailed information regarding their video gaming habits at home/off duty, when they are on duty/in port, and when they are deployed/underway.

(1) Sailors

Sailors were asked to report their at home/off duty habits, specifically how many days in a typical week they were playing or watching others playing video games, how many hours per day they spent in these activities, and what electronic devices they use (desktop/laptop, smartphone, tablet, game console, virtual reality device, other). When they are on duty/in port, gamers reported how many hours in a typical day they were involved with playing or watching others playing video games, how many hours per day they spent in these activities, and what electronic devices they used (desktop/laptop, smartphone, tablet, game console, virtual reality device, other). When they are deployed/underway, gamers reported how many days in a typical week they were playing or watching others playing video games, how many hours per day they spent in these activities, what electronic devices they use (desktop/laptop, smartphone, tablet, game console, virtual reality device, other), when the played video games or watch others play video games (before going to work, during spare time at work, after work,

before bedtime, other), where (on the mess decks, in their rack, other), and how often they slept later because they were playing video games. Gamers were asked to rate how many of their shipmates play video games when deployed/underway. Also, gamers reported how their video gaming activities changed in the COVID-19 environment compared to their video gaming activities before COVID-19.

(2) Marines

Regarding their habits at home/off duty, Marines reported how many days in a typical week they were playing video games, how many hours per day they spent in this activity, and what electronic devices they used (desktop/laptop, smartphone, tablet, game console, virtual reality device, other). Marines also reported when they played video games (in the morning, in the afternoon, in the evening, before bedtime, other), and how often they slept later because they were playing video games.

Regarding their habits when they are on duty/in port/during the duty day, Marines reported how many hours in a typical week they were playing video games, on average how many hours per day they spent in this activity, what electronic devices they used (desktop/laptop, smartphone, tablet, game console, virtual reality device, other), when they play video games (before going to work, during spare time at work, after work, before bedtime, other), and how often they slept later because they were playing video games.

Regarding their habits when deployed/underway, Marines reported how many days in a typical week they were playing video games, how many hours per day they spent in this activity, what electronic devices they use (desktop/laptop, smartphone, tablet, game console, virtual reality device, other), when they play video games (before going to work, during spare time at work, after work, before bedtime, other), where (on the mess decks, in their rack, other), and how often they slept later because they were playing video games. Gamers were asked to rate how many of their fellow Marines play video games when deployed/underway. Also, gamers reported how their video gaming activities changed in the COVID-19 environments compared to their video gaming activities before COVID-19.

d. Why ADSMs play video games

Only gamers completed this section. Motivational factors for playing video games were assessed with the 27-item Motives for Online Gaming Questionnaire – MOGQ (Demetrovics et al., 2011). MOGQ assesses seven motivational dimensions, i.e., social (building and maintaining social relationships), escape (escaping from reality), competition (competing with others), coping (coping with stress and distress), skill development, fantasy (in-game identities and experience), and recreation (entertainment and enjoyment). The MOGQ uses a 5-point Likert scale from 1 "almost never/never" to 5 "almost always/always" with higher scores indicating a higher frequency of use. The instructions of the MOGQ were revised to focus on video games in general, not emphasizing online-only video games.

e. Functional effects/impairments in everyday life

All participants completed this section. The 4-item Perceived Stress Scale (PSS) was used to assess one's perception of how much stress he/she experienced over the past month (Cohen, Kamarck, & Mermelstein, 1983; Cohen & Williamson, 1988). Each item was scored on a 5-point Likert scale from "never (0)" to "very often (4)". Ranging from 0 to 16, the total score was calculated as the sum of all responses with two items being reverse scored. Higher scores indicate higher perceived stress.

The 5-item Satisfaction with Life Scale (SWLS) was used to assess one's satisfaction with life as a whole (Diener, Emmons, Larsen, & Griffin, 1985; Pavot & Diener, 1993). Each item was scored on a 7-point Likert scale from "strongly disagree (1)" to "strongly agree (7)". Responses were summed for a total score ranging from 5 to 35. Higher scores were associated with greater satisfaction with life. Based on their SWLS score, respondents can be classified into seven groups (5-9: extremely dissatisfied with life; 10-14: dissatisfied; 15-19: slightly dissatisfied; 20: neutral; 21-25: slightly satisfied; 26-30: satisfied; 31-35: extremely satisfied with life) (Pavot & Diener, 1993).

ADSM style of coping with problems was assessed with the 28-item brief COPE questionnaire (Carver, 1997). The brief COPE had 14 subscales. Subscale scores were obtained by summing the scores on the relevant items. Responses were entered with a four-point Likert scale ranging from 1 "I haven't been doing this at all" to 4 "I've been

doing this a lot". Based on the scheme developed by Rice and Liu (2016), coping styles were classified into three groups, i.e., emotion-focused, problem-focused, and dysfunctional. Emotion-focused coping styles include acceptance, seeking emotional social support, positive reframing/ reinterpretation, humor, and turning to religion. Problem-focused coping styles include active coping, planning, seeking instrumental social support. Dysfunctional styles include self-distraction, self-blame, denial, venting, behavioral disengagement, and substance use. We derived a score for each group by averaging the scores of the coping styles included in the group.

Functional effects and impairments in everyday life were assessed by using five standardized scales. The Patient Health Questionnaire (PHQ-8) is an 8-item scale for the assessment of depressive symptoms that is commonly used in research studies of non-clinical samples and the general population (Kroenke et al., 2009). The eight items asked about the presence of symptoms in the past 2 weeks. Items were scored from 0 to 3 with response options "not at all" (score 0), "several days" (score 1), "more than half the days" (score 2), and "nearly every day" (score 3). The maximum total score was 24. Higher scores represent increased severity of depressive symptoms, with possible depression defined by scores of equal to, or greater than, 10 on the summed PHQ-8 index (Kroenke et al., 2009). The PHQ-8 is a variant of the full PHQ-9 scale that does not include the self-harm item.

The 7-item Generalized Anxiety Disorder (GAD-7) questionnaire was used to assess the severity of symptoms of the generalized anxiety disorder (Löwe et al., 2008; Spitzer, Kroenke, Williams, & Löwe, 2006). The third version of the 20-item UCLA loneliness scale was used to assess one's subjective feelings of loneliness and social isolation (Russell, 1996). Participants responded using a 4-point Likert scale from 1 "never" to 4 "always". To calculate the total score for each participant, all responses are averaged for a score ranging from 1 to 4. Higher scores mean more reported loneliness.

The Epworth Sleepiness Scale (ESS) was used to assess average daytime sleepiness (Johns, 1991). Respondents used a 4-item Likert scale to rate the chance of dozing off or falling asleep in eight different everyday situations. Answers for the eight items ranged from 0 to 3, with 0 being "would never doze," 1 being "slight chance of dozing," 2 being "moderate chance of dozing," and 3 denoting a "high chance of dozing".

Respondents were instructed to rate each item according to his/her usual way of life in recent times. Responses were summed to obtain the total Epworth score. A sum of more than 10 reflects above normal daytime sleepiness and a need for further evaluation (Johns, 1992). Lastly, the 3-item Alcohol Use Disorders Identification Test for consumption (AUDIT-C) was used to assess heavy drinking and/or active alcohol abuse or dependence (Bush et al., 1998).

2. The activity log

Sailors who completed the survey were asked to complete an activity log for approximately 10 days, documenting their daily routine (meals, sleep or nap, work out, work/watch/on duty, play or watch video games, personal time not including video gaming). The activity logs covered a 24-hour period in 15-minute intervals. Participants were asked to document the duration and timing of exposure to sunlight, consumption of caffeinated beverages and energy drinks, and whether they worked out (including type and duration of workout). Sailors on the ships in port were asked to complete the online version of the log, which was implemented in the TimeUse 2.0 (ver.20210317100) web application developed by Pulsar Informatics.

3. Focus groups

Focus groups were conducted with USMC personnel a few weeks after surveys had been completed. Marines in each focus group session were of similar ranks (E1 – E3; E4 – E5; SNCO and officers) and the sessions were recorded to facilitate analysis afterward. The 60-minute focus groups employed a semi-structured format based on the following probe questions which were based, in part, on the preliminary results of the survey:

- What videogames do you like to play?
- How often/how long do you play them?
- What platforms do you use?

- Where do you play them?
- Why do you play them?
- What benefits do video games offer?
- Are there any drawbacks of playing video games frequently? If so, what are they?
- Did your video gaming habits change during COVID-19?
- How prevalent is video gaming in your unit?
- Have you noticed any performance decrements in yourself or your fellow Marines due to video gaming? If so, how did those decrements manifest themselves?

C. PROCEDURES

The study was divided into four phases. In the first phase ("Preparation"), we assessed the background literature on video gaming, gaming addiction, motivational factors for playing video games, and effects of video gaming on behavior, psychological health, and well-being. Based on the literature review and the specific needs of the sponsors, the survey tool was developed. The survey was refined and pilot tested with focus groups of Marines attending the Defense Language Institute, Monterey, CA.

The second phase of the study included fielding the survey to collect data and their analysis. All crewmembers of the USN ships and the USMC commands were eligible to participate in the study. Recruitment was conducted by members of the research team in person. Recruitment for the USMC commands was conducted by ombudspersons who forwarded emails to potential participants and made announcements. Marines were asked to complete a web-based survey and to participate in focus groups. The link to the survey was available to the Marines for 30 days. The following table shows the data collected in the study.

Table 2. Study components

Study component		Cross-sectional survey	Activity log	Focus groups
USMC	Three commands	Online	-	Yes
USN	Two ships in port	Printed	Online	-

The third phase of the study ("Focus groups") built on the findings of the survey. Based on the analysis of the survey data, we identified issues and trends of interest that were investigated further with the focus groups. The last phase of the study ("Reporting") is focused on presenting the study results. Figure 6 shows the study phases and the tasks completed within each phase.

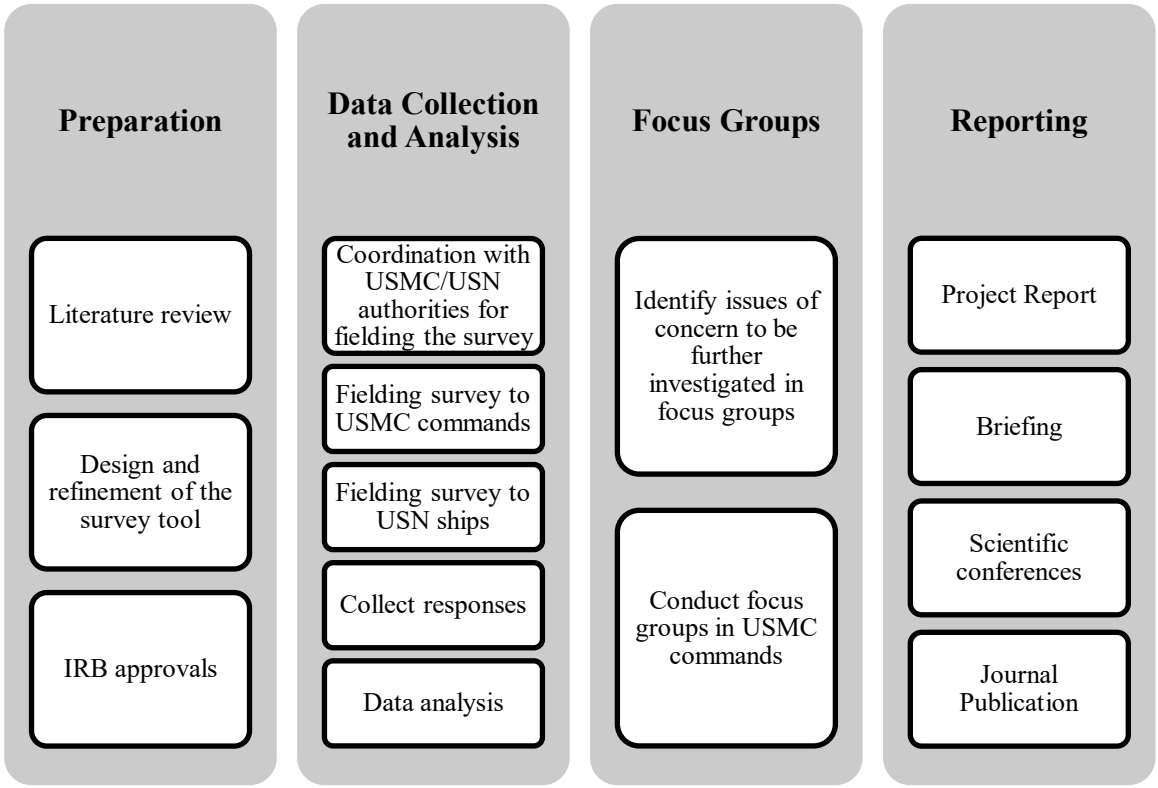

Figure 6. Study phases.

D. STATISTICAL ANALYSIS

First, analysis focused on Marines by describing their demographic and occupational characteristics. Next, we described the behavioral characteristics of gamers and their gaming habits. We assessed gamer well-being, explored the prevalence of

"Disordered" and "Problematic" video gamers, and identified the effect of COVID-19 on video gaming habits. Lastly, we presented our findings from the focus groups. The study sample of Marines included a small group of non-gamers, which allowed us to compare information between gamers and the *ad hoc* control group of non-gamers.

To assess the severity of video gaming, we classified ADSMs based on classification scheme that included three mutually exclusive groups (normal gamers, problematic gamers, and disordered gamers). "Disordered" gamers were identified based on existing criteria from the video gaming literature. "Problematic" gamers were classified as such based on whether they reported sleeping later due to video gaming (sometimes, frequently, or always) in at least one setting (at home/off duty, on duty, underway/deployed). Detailed information regarding the 3-group classification scheme and operational relevance is included in the Conclusions chapter.

In general, analysis of Sailor data followed the same steps. However, the sample of Sailors was smaller and did not include an adequate group of non-gamers. Therefore, analysis of Sailor data was more descriptive in nature. When appropriate, though, we compare the information of Sailors who reported playing video games with the corresponding group of Marines. Given that only four Sailors completed the activity app, these data were not included in our analysis.

Data normality was assessed with the Shapiro-Wilk W test. Parametric and non-parametric statistical methods were used as appropriately needed for normally and non-normally distributed data. General linear regression model analysis was used to adjust for confounding variables. Multiple comparisons were based on Dunn's method for joint ranking. Post-hoc statistical significance was assessed using the Benjamini–Hochberg False Discovery Rate (BH-FDR) controlling procedure (Benjamini & Hochberg, 1995; Groppe, Urbach, & Kutas, 2011) at the $q = 0.20$ level. Effect size calculations were based on the non-parametric effect size r for continuous variables and relative risk (95% confidence interval) for categorical variables. Correlation analysis was used to assess associations among study variables.

Exploratory factor analysis (EFA) was used to assess underlying latent constructs in the variables of interest (DeVellis, 2003, p. 103; Fabrigar, Wegener, MacCallum, & Strahan, 1999; Henson & Roberts, 2006). We identified the number of factors to retain

using Cattell's scree test (Cattell, 1966) and the Kaiser criterion, i.e., all factors with an eigenvalue greater than 1 were retained (Kaiser, 1960). We used the maximum likelihood factoring method (Fabrigar et al., 1999), and the promax (oblique) rotation method. Oblique rotations assume that the latent factors are correlated, which is an appropriate assumption when assessing human behavior (Costello & Osborne, 2005). Loadings of 0.30 or greater were used to interpret the results. Lastly, partition analysis was used to identify a new cut-off IGDS9-SF score based on the composite score we developed.

An alpha level of 0.05 was used to determine statistical significance. Statistical analysis was conducted with JMP Pro 16 statistical software (SAS Institute; Cary, NC). Normally distributed data are presented as mean ± standard deviation (M ± SD), whereas non-normally distributed data are presented as median – MD (interquartile range – IQR).

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IV. RESULTS

A. MARINES

1. Demographics, occupational characteristics, and behavioral habits

As shown in Table 3, the study sample included predominantly males (854, 92.3%) and enlisted personnel (771, 83.3%). Also, 850 (91.7%) Marines reported playing video games (799 [94.0%] males, 51 [6.0%] females). Compared to non-gamers, gamers were on average six years younger in age ($p < 0.001$), included more males ($p < 0.001$), and had more enlisted personnel ($p < 0.001$). We verified these results with a generalized linear model (model: $X^2(4) = 65.1$, $p < 0.001$; all $p < 0.001$).

Of note, however, the *ad hoc* control group of non-gamers is too small to be considered representative of the sample. Therefore, comparisons between gamers and non-gamers should be interpreted with caution. Results of the correlation analysis are shown in Appendix B. Also, we conducted pairwise correlation analysis among demographic, occupational variables, variables of well-being, and coping styles of Marines who played video games.

Table 3. Marines' demographic and occupational characteristics.

Demographic and occupational characteristics	All Marines (n=927)	Gamers (n=850)	Non-gamers (n=77)	Un-adjusted p-value
Age in years, MD (IQR)	24 (8)	23 (7)	29 (13.5)	< 0.001 [B,D]
Sex (males), # (%)	854 (92.3%)	797 (94.0%)	57 (74.0%)	< 0.001 [C,D]
Rank group, # (%)				
Enlisted	771 (83.4%)	724 (85.4%)	47 (61.0%)	< 0.001 [C,D]
E1-E3	258 (27.9%)	246 (29.1%)	12 (15.6%)	-
E4-E6	437 (47.2%)	416 (49.1%)	21 (27.3%)	-
E7-E9	76 (8.22%)	62 (7.31%)	14 (18.2%)	-
Officers	154 (16.7%)	124 (14.6%)	30 (39.0%)	-
CWO	14 (1.51%)	14 (1.65%)	0	-
O1-O3	98 (10.6%)	79 (9.32%)	19 (24.7%)	-
O4-O6	42 (4.54%)	31 (3.6%)	11 (14.3%)	-
MOS, # (%)				0.774 [C]
Air	497 (55.7%)	458 (55.0%)	39 (51.3%)	-
Ground	200 (22.0%)	183 (22.0%)	17 (22.4%)	-
Logistics	212 (23.3%)	192 (23.1%)	20 (26.3%)	-
Years in active duty, MD (IQR)	4 (5)	4 (5.5)	7 (12)	< 0.001 [B,D]
Deployed while in the military (Yes), # (%)	423 (45.7%)	379 (44.5%)	44 (57.1%)	0.042 [C,D]
Total months deployed, MD (IQR) [A]	10 (14)	9 (14)	12 (18)	0.384 [B]
Deployment(s) involved combat, # (%) [A]	142 (33.6%)	123 (32.5%)	19 (43.2%)	0.178 [C]

[A] Only for ADSM who had been deployed
[B] Wilcoxon rank sums test
[C] Fisher's exact test
[D] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

Next, we assessed the behavioral habits of Marines and compared these habits between gamers and non-gamers. Our results suggest that the use of nicotine products was more prevalent in gamers compared to non-gamers. In terms of exercising, more gamers reported having an exercise routine, but they exercised less frequently than non-gamers. These findings should be interpreted with caution, however, because the two groups were not equivalent in terms of age, the ratio of males/females, and the ratio of officer/enlisted personnel. Detailed results are shown in Table 4.

Table 4. Behavioral habits of gamers and non-gamers

Behavioral habits	All Marines (n=927)	Gamers (n=850)	Non-gamers (n=77)	Unadusted p-value
Marines using nicotine products, # (%)	386 (41.8%)	368 (43.5%)	17 (23.4%)	< 0.001 [A,D]
Marines smoking cigarettes, # (%)	88 (22.8%)	83 (22.6%)	5 (27.8%)	-
Number of cigarettes/day, MD (IQR)	4 (4.25)	4 (4)	1 (5)	-
Marines chewing tobacco/stuff, # (%)	117 (30.3%)	113 (30.7%)	4 (22.2%)	-
Times per day, MD (IQR)	3 (4)	3 (4)	3 (5.75)	-
Marines using nicotine gum/patches, # (%)	22 (5.70%)	22 (5.98%)	0	-
Number of nicotine gum/patches /day, MD (IQR)	2 (3.25)	2 (3.25)	-	-
Marines using electronic smoke, # (%)	267 (69.2%)	256 (69.6%)	11 (61.1%)	-
Marines drinking caffeinated beverages, # (%)	857 (92.7%)	787 (92.8%)	70 (90.9%)	0.496 [A]
Marines drinking tea, # (%)	352 (41.1%)	322 (41.0%)	30 (42.9%)	-
Servings/cups of tea/day, MD (IQR)	1 (1)	1 (1)	1 (0.25)	-
Marines drinking coffee, # (%)	566 (66.1%)	514 (65.3%)	52 (75.4%)	-
Servings/cups of coffee/day, MD (IQR)	1 (1)	1 (1)	1.5 (1)	-
Marines drinking sodas/pops/soft drinks, # (%)	379 (44.3%)	361 (45.9%)	18 (25.7%)	-
Number of sodas/pops/soft drinks/day, MD (IQR)	1 (1)	1 (1)	1 (0)	-
Marines drinking energy drinks, # (%)	532 (62.2%)	499 (63.4%)	33 (47.8%)	-
Number of energy drinks/day, MD (IQR)	1 (0)	1 (1)	1 (0)	-
Marines having an exercise routine, # (%)	801 (86.7%)	740 (87.4%)	61 (79.2%)	0.053 [A,D]
Times per week exercising, MD (IQR)	5 (2)	4.5 (2)	5 (2%)	0.035 [B,D]
Exercise duration (minutes), MD (IQR)	60 (30)	60 (30)	60 (42.5)	0.965 [B]
Reported daily sleep duration (hours)				
At home/off duty, M ± SD	6.74 ± 1.30	6.73 ± 1.31	6.90 ± 1.14	0.186 [C]
On duty/in port, MD (IQR)	1 (5)	1 (5)	0 (5)	0.324 [B]
When deployed/underway, MD (IQR)	6 (2)	6 (2)	6 (1.88)	0.952 [B]

[A] Fisher's exact test
[B] Wilcoxon rank sums test
[C] t-test
[D] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

Next, we assessed Marines' orientation to coping with problems. On a scale from 0 to 6 (higher frequency), the most frequently used problem-focused styles were active coping (3 [3]) and planning (3 [3]), whereas the most frequently used emotion-focused style was acceptance (3 [3]). From the dysfunctional styles associated with maladaptive coping with problems, self-distraction (2 [3]) and self-blame (2 [3]) were the most frequently used by Marines, but the corresponding scores were lower (less frequently used styles) than the active coping, planning, and acceptance. Also, we compared the group scores. On a scale from 0 (denoting not using the style at all) to 6 (using the style a lot), the problem-focused style was the most frequently used style (2.67 [2]), closely followed by emotion-focused styles (2.4 [1.8]; Wilcoxon Signed Rank test, S = 60373, p

< 0.001). Dysfunctional coping styles were used much less frequently (1.17 [1.33]; Wilcoxon Signed Rank test, all p < 0.001). Compared to non-gamers, gamers turn to religion much less frequently (p = 0.007).

In conclusion, our results show that Marines used both problem-focused and emotion-focused coping styles. Dysfunctional styles, self-distraction (2 [3]) and self-blame (2 [3]), are evident but much less frequent. Detailed results are shown in Table 5.

Table 5. Marines' coping styles.

Coping styles [C]	All Marines (n=830) MD (IQR)	Gamers (n=753) MD (IQR)	Non-gamers (n=77) MD (IQR)	Gamers vs. non-gamers p-value [A]
Problem-focused coping styles	2.67 (2)	2.67 (2)	2.67 (1.33)	0.978
Active coping	3 (3)	3 (3)	3 (2)	- [B]
Planning	3 (3)	3 (3)	3 (2)	0.996
Seeking instrumental social support	2 (3)	2 (3)	2 (2)	0.667
Emotion-focused coping styles	2.4 (1.8)	2.4 (1.8)	2.4 (1.5)	0.663
Acceptance	3 (2)	3 (3)	2 (2.5)	0.194
Seeking emotional social support	2 (4)	2 (4)	2 (3)	0.772
Positive reframing/reinterpretation	2 (3)	2 (3)	3 (2)	0.150
Humor	2 (4)	2 (4)	2 (3)	0.719
Turning to religion	0 (2)	0 (2)	2 (3)	0.043
Dysfunctional coping styles	1.17 (1.33)	1.17 (1.33)	1 (1.25)	0.571
Self-distraction	2 (3)	2 (3)	2 (2.5)	0.652
Self-blame	2 (3)	2 (3)	2 (3)	0.433
Venting	1 (2)	1 (2)	1 (2)	0.813
Denial	0 (0)	0 (0)	0 (0)	0.394
Behavioral disengagement	0 (1)	0 (1)	0 (1)	0.603
Substance use	0 (0)	0 (0)	0 (0.5)	- [B]

Note: None of the p-values are statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

[A] Adjusted by age (nested within occupational group), sex, and occupational group (Officers, Enlisted)

[B] Model not statistically significant

[C] Box-Cox transformation applied

2. Video gaming habits

Marines respondents who play video games reported playing mostly when at home/off duty (834, 90.0%), but report playing less when deployed/underway (338, 36.5%) or when they are on duty/in port (191, 20.5%). Focusing only on gamers, 50.1% of the Marines reported playing video games only at home/off duty, whereas 25.8%

reported playing video games both at home/off duty and when deployed/underway. Detailed results are shown in Figure 7.

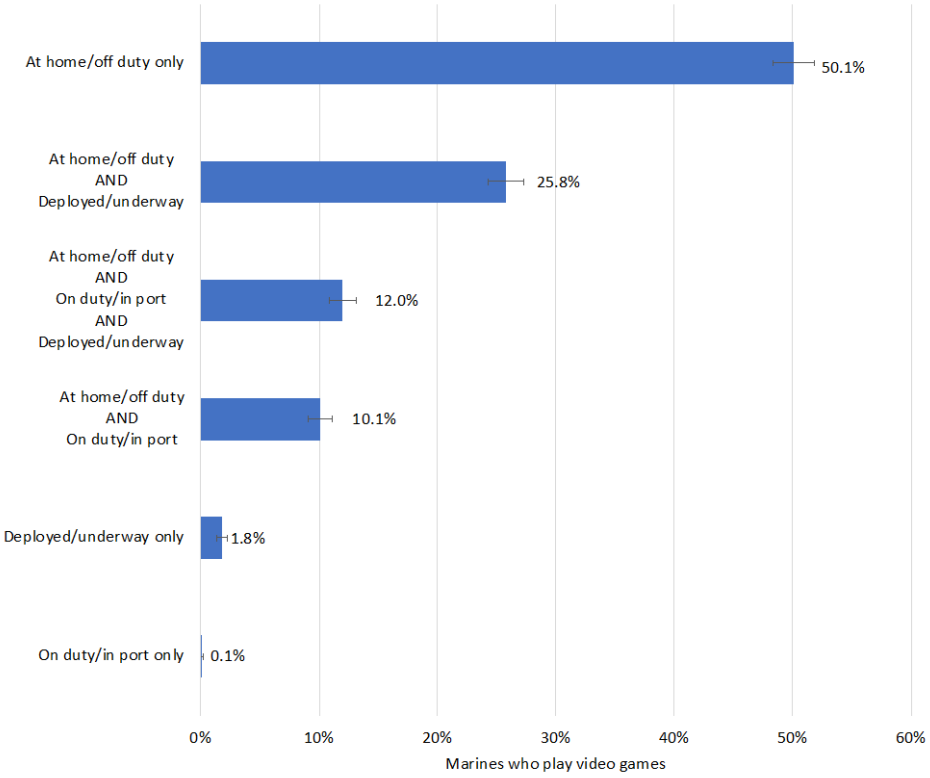

Figure 7. Patterns of video gaming among Marines who report playing video games. Horizontal lines denote the Standard Error of Proportion.

Marines reported that they had been playing video games on average 17.2 ± 6.71 years. Based on the years of playing video games and gamer's age, we calculated that video gaming started around the age of 8 (MD with IQR = 6). Of note, the age of starting video gaming seems to increase with respondents' age ($F[1,758] = 119$, $p < 0.001$). These findings indicate that compared to older Marines, younger Marines began playing video games at a younger age.

In terms of video game genres, the most popular types of video games played by Marines were shooter (777, 91.4%) and action/adventure games (763, 89.8%) followed by role-playing (645, 75.9%) and platformer games (515, 60.5%). Detailed results are shown in Table 6 and Figure 8. In addition, Marines reported using massively multiplayer online role-playing games (MMORPG; n = 26), horror games (n = 11), sandbox games (n

= 9), virtual reality games (n = 6), and board games (n = 6). The median number of days Marines reported playing video games in a typical week at home/off duty was 5 (IQR = 3) (3 [3] hours daily), 5 (5) days in a typical week on duty/in port/during the duty (3 [2] hours daily), and 6 (4) days in a typical week when deployed/underway (3 [2] hours daily).

Table 6. Video game genres played by Marines.

Genres	Marines (n=850)
Shooter (e.g., Call of Duty)	777 (91.4%)
Action/adventure (e.g., Tomb Raider, Assassin's Creed)	763 (89.8%)
Role-playing (e.g., The Witcher, Mass Effect)	645 (75.9%)
Platformer (e.g., Super Mario Bros.)	515 (60.6%)
Battle Royale (e.g., Fortnite)	475 (55.9%)
Strategy (e.g., Civilization, The Age of Empires)	470 (55.3%)
Fighting (e.g., Mortal Kombat, Street Fighter)	458 (53.9%)
Multiplayer online battle arenas (e.g., Smite, League of Legends)	457 (53.8%)
Racing (e.g., Gran Turismo, Forza)	429 (50.6%)
Sports (e.g., Madden NFL, FIFA)	307 (36.2%)
Simulation (e.g., SimCity)	292 (34.4%)
Card-based games (e.g., Hearthstone, Legends of Runeterra)	228 (26.8%)
Puzzle (e.g., Puzzle Quest, Match 3)	231 (27.2%)
Music & dance (e.g., Just Dance, Guitar Hero)	233 (27.4%)

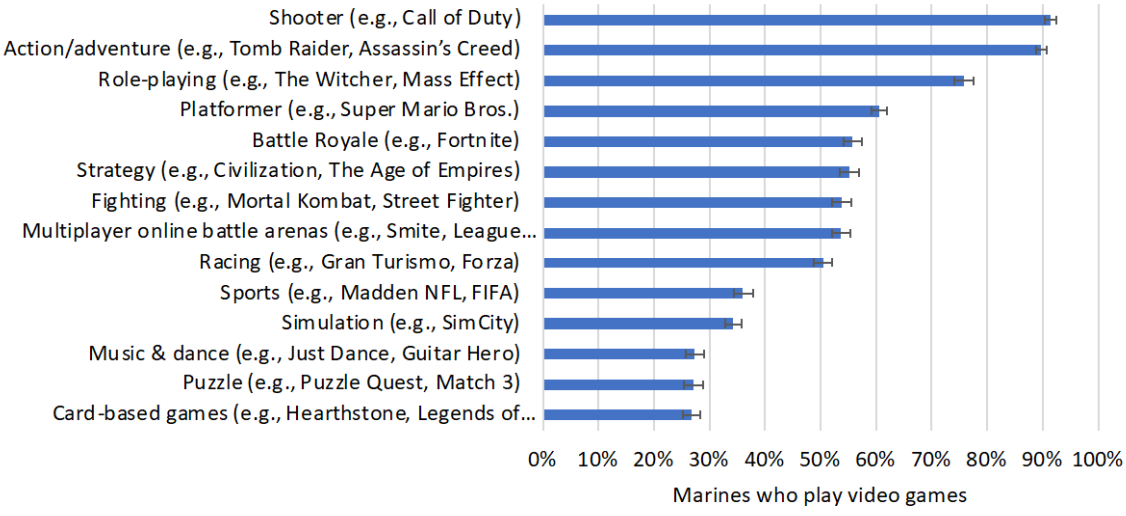

Figure 8. Video game genres played by Marines. Horizontal lines denote the Standard Error of Proportion.

In general, the most frequently reported devices for video gaming were game consoles and smartphones followed by computers (Figure 9). Less commonly used devices were tablets and more costly virtual reality devices.

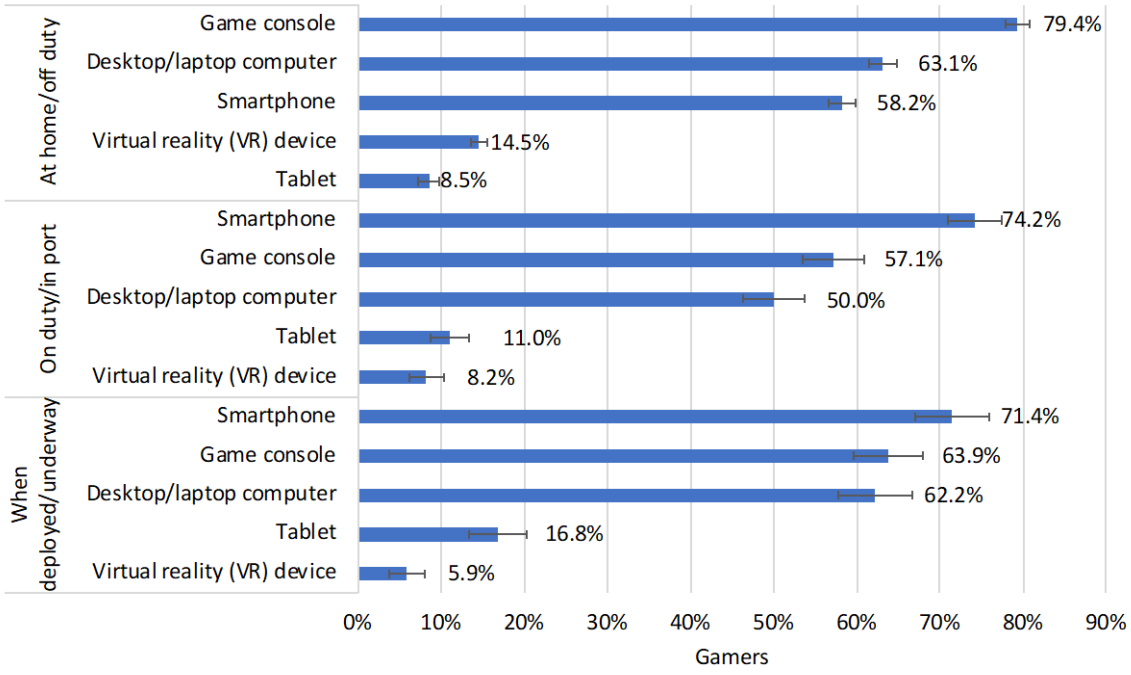

Figure 9. Use of gaming devices. Horizontal lines denote the Standard Error of Proportion.

In general, Marine gamers reported playing video games mainly later in the day, i.e., in the evening/before bedtime when at home/off duty, or after work/before bedtime when on duty/in port or when deployed/underway (Figure 10). It is worth mentioning some of the comments that Marines provided regarding the time they play video games: "*all day on weekends and weeknights after work*", "*midnight or later*", "*through the night*".

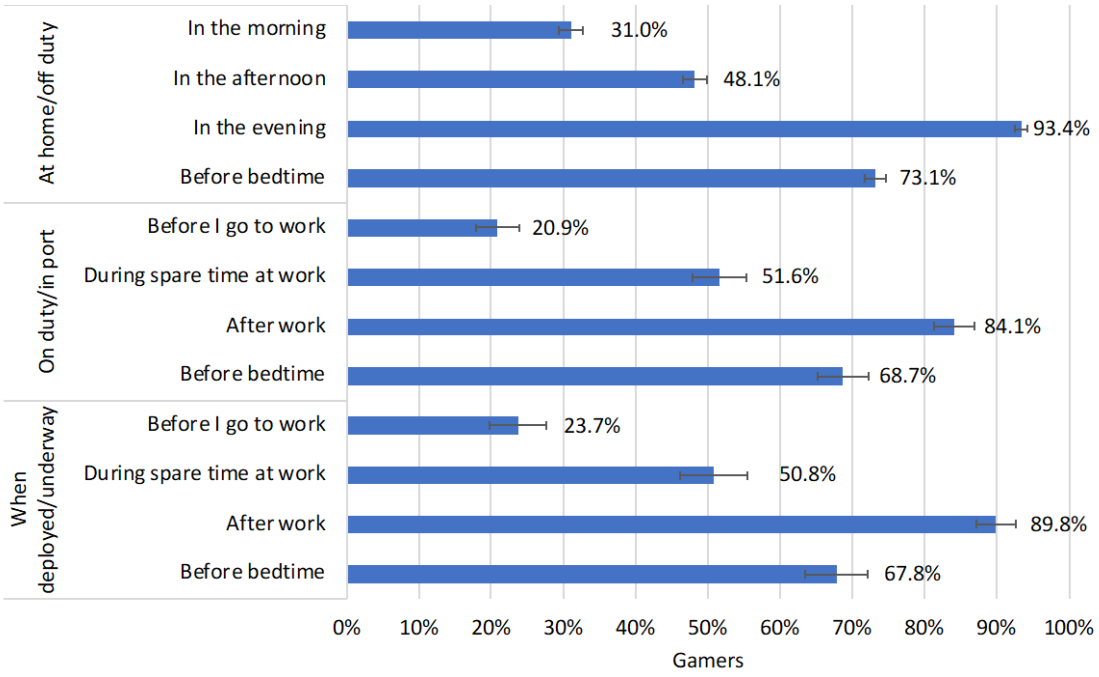

Figure 10. Marine gamers' responses to the question "When do you play video games?". Horizontal lines denote the Standard Error of Proportion.

Marines who reported playing video games before bedtime were asked whether they have slept later because of playing VGs. Responses showed that approximately 16% of gamers always/frequently sleep later because of playing video games on days at home/off duty, ~14% on days when on duty/in port, and 5% on days when deployed/underway (Figure 11).

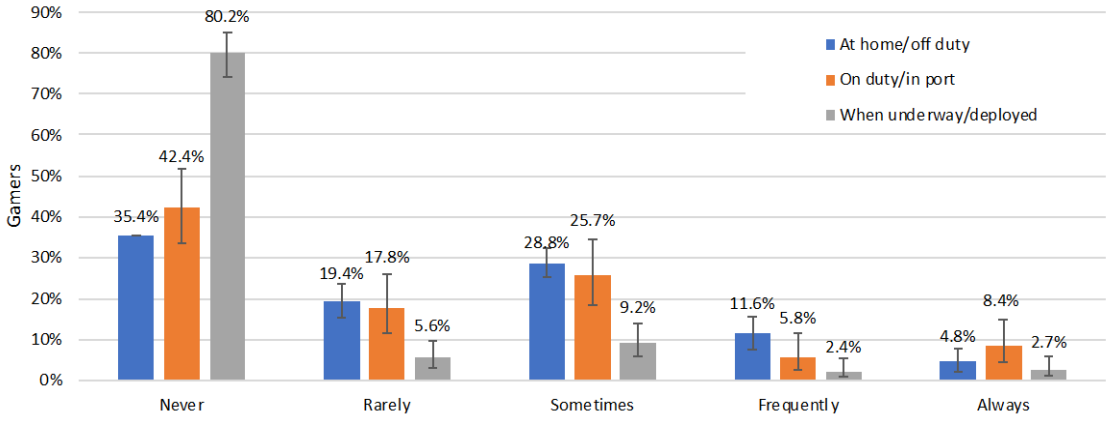

Figure 11. Marine gamers' responses to the question "If you play video games before bedtime, have you ever slept later because you played video games?". Vertical lines denote the Standard Error for Proportion.

Next, Marine gamers were asked where they played video games when deployed/underway. As shown in Figure 12, most Marine gamers reported playing video games in their rack (93.2%) and the mess decks/lounges/common areas (34.7%).

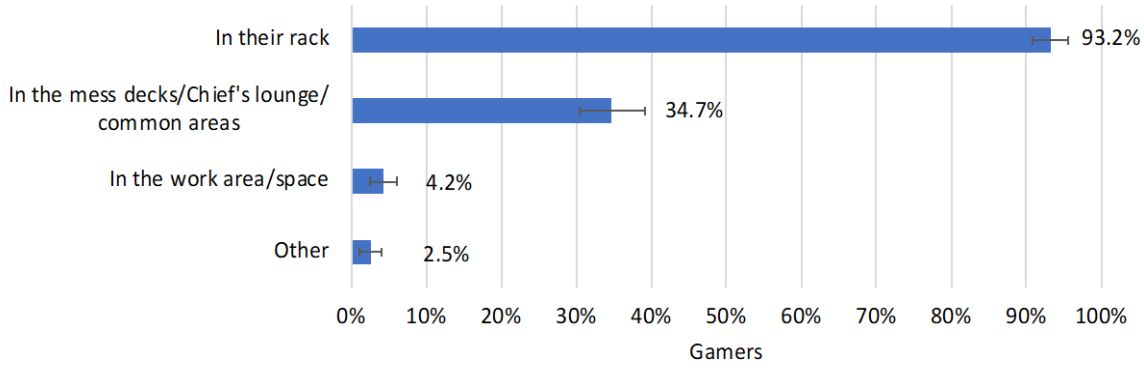

Figure 12. Marine gamers' responses to the question "Where do you play video games when deployed/underway?" Horizontal lines denote the Standard Error for Proportion.

Marines were asked to estimate how many of their fellow Marines or shipmates play video games when underway/deployed. As shown in Figure 13, approximately 84% of Marines responded that more than 40% of the fellow Marines or shipmates play video games when underway/deployed.

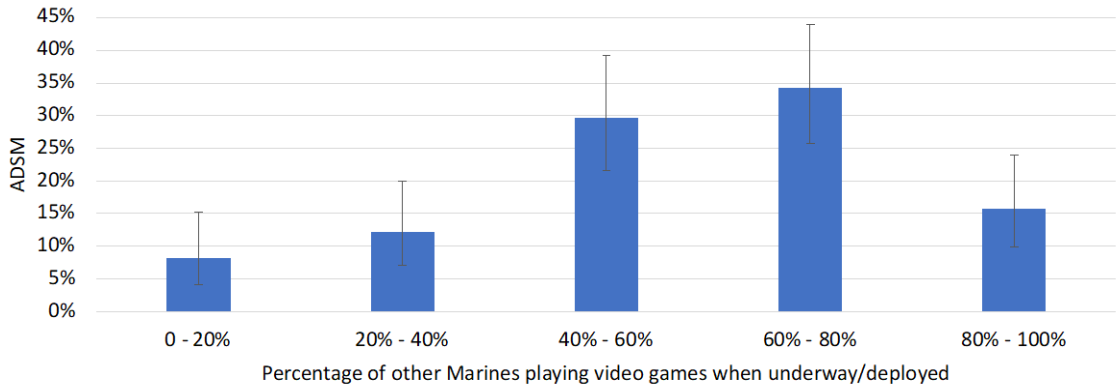

Figure 13. Responses of Marines to the question "Think of your fellow Marines/Shipmates. How many of them play video games when underway/deployed?"

3. Why do Marines play video games?

Using the Motives for Online Gaming Questionnaire (MOGQ), we assessed motivational factors for playing video games in terms of seven dimensions. The instructions of the MOGQ were revised to focus on video games in general, not emphasizing online video games. In terms of frequency, recreation was the most reported motivational factor (median score of 4.67) for playing video games followed by coping with stress (3.25). The categories of competing with others and skill development both followed with the same median score (2.75). Escaping from reality had a median score of 2.5. The social (building and maintaining social relationships) and fantasy factors were last in terms of their median score (2).

Further analysis showed that age, sex, and occupational group were statistically significant explanatory variables for MOGQ scores. Specifically, older Marine gamers had lower scores (i.e., reported less frequently) in the social, escape, competition, coping, skill development, and fantasy dimensions compared to younger Marine gamers. Enlisted Marine gamers had higher scores (reported more frequently) in the social, escape, competition, coping, skill development motivational dimensions than officers. Also, female gamers had lower scores than males in the social, escape, competition, coping, skill development, and recreation dimensions. Detailed results are shown in Table 7.

Table 7. MOGQ scores for Marine gamers.

Motivational factor	MOGQ score MD (IQR)	Model [A]		Age	Sex	Officer/ Enlisted
		R^2adj.	p-value			
Recreation	4.67 (1)	0.009	0.026	0.541	0.012	0.429
Coping with stress/distress	3.25 (1.5)	0.106	< 0.001	< 0.001	0.033	0.002
Compete with others	2.75 (1.75)	0.128	< 0.001	< 0.001	< 0.001	< 0.001
Skill development	2.75 (2.25)	0.075	< 0.001	< 0.001	0.010	0.011
Escape from reality [B]	2.5 (2.5)	0.134	< 0.001	< 0.001	0.158	0.001
Social (building and maintaining social relationships) [B]	2 (1.75)	0.168	< 0.001	< 0.001	0.002	< 0.001
Fantasy (in-game identities and experience) [B]	2 (2)	0.115	< 0.001	< 0.001	0.285	0.748

[A] General linear regression model analysis. Explanatory variables: Age nested within the occupational group (officers/enlisted), sex, and occupational group.

[B] Box-Cox transformation applied

4. Marine gamers' psychological state and sense of well-being

In terms of stress levels, Marine who played video games reported an average PSS-4 score of 7.77 ± 2.02 ranging from 0 to 13. In terms of satisfaction with life, the median SWLS score was 23 (10) ranging from 5 to 35. Based on their SWLS scores, 247 (31.0%) gamers were dissatisfied with their life. Detailed results are shown in Figure 14.

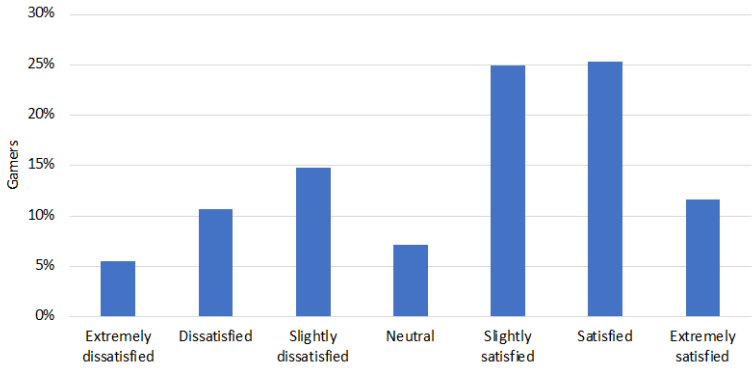

Figure 14. Satisfaction with life of Marine gamers.

The median PHQ-8 score was 4 (8) with 157 (21.5%) of the Marine gamers classified by these criteria as having major depression (10 ≤ PHQ-8 score < 20). The median GAD-7 score was 2 (7) with 124 (17.0%) of Marine gamers reporting symptoms of generalized anxiety disorder (GAD-7 scores ≥ 10). Detailed results regarding the anxiety groups are shown in Figure 15.

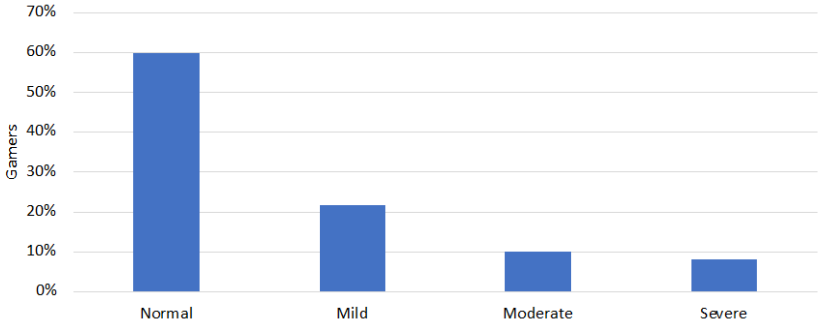

Figure 15. Severity of generalized anxiety disorder symptoms in Marine gamers.

In terms of feelings of loneliness and social isolation, the median score on the UCLA loneliness scale was 43 (20). The median ESS score was 8 (6) with 213 (30.5%) Marines reporting symptoms of excessive daytime sleepiness – EDS (ESS score > 10).

The median AUDIT-C score was 3(3) with 276 (39.3%) Marines reporting scores that were suggestive of heavy drinking and/or active alcohol abuse or dependence. Detailed results regarding Marines' well-being are shown in Table 8. Of note, gamers had higher (worse) AUDIT-C scores than non-gamers (p = 0.028).

Table 8. Marines' psychological state and sense of well-being.

Variable	All Marines	Gamers	Non-gamers	p-value [A]
PSS-4 score, M ± SD	7.81 ± 2.05	7.77 ± 2.02	8.25 ± 2.36	- [B]
SWLS score, MD (IQR) [C]	23 (10)	23 (10)	27 (10)	0.376
Satisfaction with life groups (SWLS)				-
Extremely dissatisfied	45 (5.14%)	44 (5.51%)	1 (1.30%)	-
Dissatisfied	91 (10.4%)	85 (10.7%)	6 (7.79%)	-
Slightly dissatisfied	129 (14.7%)	118 (14.8%)	11 (14.3%)	-
Neutral	60 (6.86%)	57 (7.14%)	3 (3.90%)	-
Slightly satisfied	213 (24.3%)	199 (24.9%)	14 (18.2%)	-
Satisfied	227 (25.9%)	202 (25.3%)	25 (32.5%)	-
Extremely satisfied	110 (12.6%)	93 (11.7%)	17 (22.1%)	-
PHQ-8 score, MD (IQR) [C]	4 (8)	4 (8)	3 (7)	0.300
Marines with major depression (10≤PHQ-8<20) , # (%)	167 (20.9%)	157 (21.5%)	10 (13.9%)	0.311
GAD-7, MD (IQR) [C]	2 (7)	2 (7)	2 (7.5)	0.578
Anxiety groups I (based on GAD-7), # (%)				0.569
Normal (GAD-7<5)	498 (62.1%)	454 (62.3%)	44 (60.3%)	-
Mild (5≤GAD-7<10)	166 (20.7%)	151 (20.7%)	15 (20.6%)	-
Moderate (10≤GAD-7<15)	76 (9.48%)	67 (9.19%)	9 (12.3%)	-
Severe (GAD-7≥15)	62 (7.73%)	57 (7.82%)	5 (6.85%)	-
Anxiety groups II (based on GAD-7), # (%)				
GAD (GAD-7≥10)	138 (17.2%)	124 (17.0%)	14 (19.2%)	0.554
UCLA loneliness score, MD (IQR) [C]	43 (19)	43 (20)	41 (19.3%)	0.537
ESS score, MD (IQR) [C]	8 (6)	8 (6)	8.5 (6)	- [B]
Marines with excessive daytime sleepiness (ESS>10), # (%)	233 (30.3%)	213 (30.5%)	20 (28.6%)	0.818
AUDIT-C score, MD (IQR) [C]	3 (3)	3 (3)	2 (4)	0.028 [E]
Marines with an AUDIT-C score suggestive of a problem, # (%) [D]	299 (38.8%)	276 (39.3%)	23 (33.3%)	- [B]

[A] Gamers versus non-gamers p-value adjusted by age (nested within the occupational group), sex, and occupational group (officers, enlisted)
[B] Model not statistically significant (p = 0.187)
[C] Box-Cox transformation applied
[D] AUDIT-C score criterion for alcohol problems: ≥4 for males; ≥3 for females
[E] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

5. Severity of gaming and Marines' sense of well-being

The results presented thus far were based on classifying Marine respondents as gamers or non-gamers. To further parse gaming behaviors, we assessed video gaming severity using the IGDS9-SF scores. The median IGDS9-SF score was 15 (7) ranging from 9 to 45 (45 is the maximum for this scale). Figure 16 shows the distribution of IGDS9-SF scores for Marines gamer. IGDS9-SF scores were calculated for 227 Marine gamers.

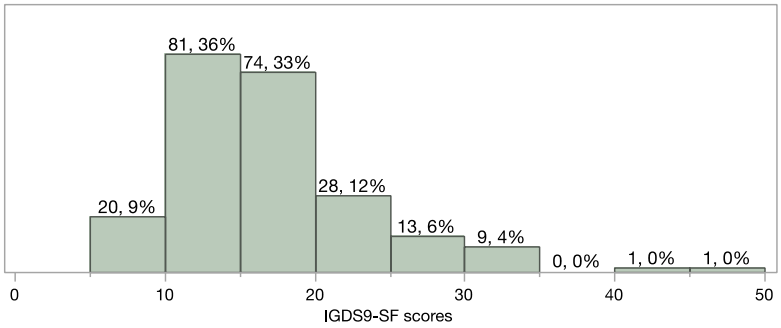

Figure 16. IGDS9-SF scores for Marine gamers.

To assess the effect of video gaming severity, we compared Marine gamers with an IGDS9-SF score in the first quartile (IGDS9-SF score <12) with gamers with an IGDS9-SF score in the fourth quartile (IGDS9-SF score > 19). Marine gamers in the 4th quartile were younger, employed dysfunctional and emotion-focused coping styles more frequently, and reported less satisfaction with their lives. The largest differences in dysfunctional coping styles were found in playing video games to escape from problems/reality and playing video games as a strategy to cope with stress/distress. Also, more Marine gamers in the 4th quartile reported playing video games while on duty/in port and when deployed/underway. Not surprisingly, Marine gamers in the 4th quartile were more likely to be identified with symptoms of major depression (3.34 times), generalized anxiety (3.02 times), and excessive daytime sleepiness (1.81 times).

Of note, however, the two groups did not differ in terms of stress, loneliness, problems with alcohol use, and performance-related behaviors (using nicotine products, drinking caffeinated beverages, and having an exercise routine) (all $p > 0.10$). Detailed results are shown in Table 9.

Table 9. Differences between Marine gamers in the 1st and the 4th quartile groups of IGDS9-SF scores.

Variable	Gamers in the 1st quartile group	Gamers in the 4th quartile group	Unadjusted p-value	Effect size
Age in years, MD (IQR)	25 (13)	23 (6)	0.090 [B,E]	0.169 [F]
Sex (males), # (%)	46 (93.9%)	50 (96.2%)	0.672 [A]	-
Enlisted, # (%)	44 (89.8%)	48 (92.3%)	0.736 [A]	-
Having been deployed, # (%)	28 (57.1%)	24 (46.2%)	0.321 [A]	-
Deployment involving combat, # (%)	9 (32.1%)	7 (29.2%)	0.990 [A]	-
Reported daily sleep duration				
At home/off duty, M ± SD	6.96 ± 1.22	6.97 ± 1.60	0.356 [C]	-
On duty/in port, MD (IQR)	3 (6)	5 (5)	0.242 [B]	-
When deployed/underway, M ± SD	5.82 ± 2.80	6.10 ± 1.82	0.660 [C]	-
Using nicotine products, # (%)	25 (51.0%)	26 (50.0%)	0.990 [A]	-
Drinking caffeinated beverages, # (%)	48 (98.0%)	49 (94.2%)	0.618 [A]	-
Having an exercise routine, # (%)	42 (85.7%)	43 (82.7%)	0.788 [A]	-
Why playing video games (MOGQ scores)				
Social, MD (IQR)	1.25 (1.25)	3 (2)	< 0.001 [B,E]	0.486 [F]
Escape, MD (IQR)	1.25 (1)	4 (2.75)	< 0.001 [B,E]	0.665 [F]
Competition, MD (IQR)	2 (1.5)	3.5 (2)	< 0.001 [B,E]	0.516 [F]
Coping, MD (IQR)	2.25 (1.75)	4.25 (1.75)	< 0.001 [B,E]	0.656 [F]
Skill development, MD (IQR)	2 (2.5)	4 (2.25)	< 0.001 [B,E]	0.453 [F]
Fantasy, MD (IQR)	1.5 (1)	2.75 (2.5)	< 0.001 [B,E]	0.428 [F]
Recreation, MD (IQR)	4.33 (1.33)	4.67 (1)	0.264	-
When playing video games, # (%)				
At home/off duty	48 (98.0%)	51 (98.1%)	0.990 [A]	
On duty/in port	34 (69.4%)	47 (90.4%)	0.012 [A,E]	1.30 (1.06-1.60) [G]
When deployed/underway	23 (46.9%)	34 (65.4%)	0.073 [A,E]	1.39 (0.97-1.99) [G]
Coping styles, MD (IQR)				
Problem-focused coping styles	2 (2.33)	2.67 (2.67)	0.136 [B]	-
Emotion-focused coping styles	1.8 (2.2)	2.5 (1.35)	0.014 [B,E]	0.250 [F]
Dysfunctional coping styles	0.67 (1)	1.75 (1.75)	< 0.001 [B,E]	0.430
PSS-4 score, MD (IQR)	8 (1)	8 (2.25)	0.370 [B]	-
SWLS score, MD (IQR)	24.5 (10.3)	20 (15)	0.034 [B,E]	0.216 [F]
PHQ-8 score, MD (IQR)	2 (5)	7 (13)	< 0.001 [B,E]	0.470 [F]
Major depression (10≤PHQ-8<20), # (%)	5 (12.8%)	24 (57.1%)	0.003 [A,E]	3.34 (1.37-8.14) [G]
GAD-7, MD (IQR)	0 (4)	6 (11)	< 0.001 [B,E]	0.398 [F]
GAD (GAD-7≥10), # (%)	4 (10.3%)	13 (31.0%)	0.029 [A,E]	3.02 (1.08-8.47) [G]
UCLA loneliness score, MD (IQR)	38.5 (15.8)	46 (22)	0.116 [B]	-
ESS score, MD (IQR)	6 (6.5)	10 (10.3)	0.003 [B,E]	0.332 [F]
EDS, # (%)	9 (23.7%)	18 (42.9%)	0.098 [A,E]	1.81 (0.93-3.53) [G]
AUDIT-C score, MD (IQR)	2.5 (4)	3 (4.25)	0.343 [B]	-
Suggestive of a problem, # (%) [D]	13 (34.2%)	21 (50.0%)	0.179 [A]	-

EDS: Excessive daytime sleepiness (ESS>10); GAD: Generalized anxiety disorder

[A] Fisher's exact test

[B] Wilcoxon rank sums test

[C] t-test

[D] AUDIT-C score criterion for alcohol problems: ≥4 for males; ≥3 for females

[E] Statistically significant based on the post-hoc BH-FDR controlling procedure

[F] Non-parametric effect size r

[G] Relative risk (95% confidence interval)

We also explored differences in video gaming habits by contrasting the video gaming patterns in these two groups of Marine gamers. Compared to 35% in the 1st quartile group, approximately 62% of the gamers in the 4th quartile group played video games in all three time periods, i.e., at home/off duty and on duty/in port and when deployed/underway. Detailed results are shown in Figure 17.

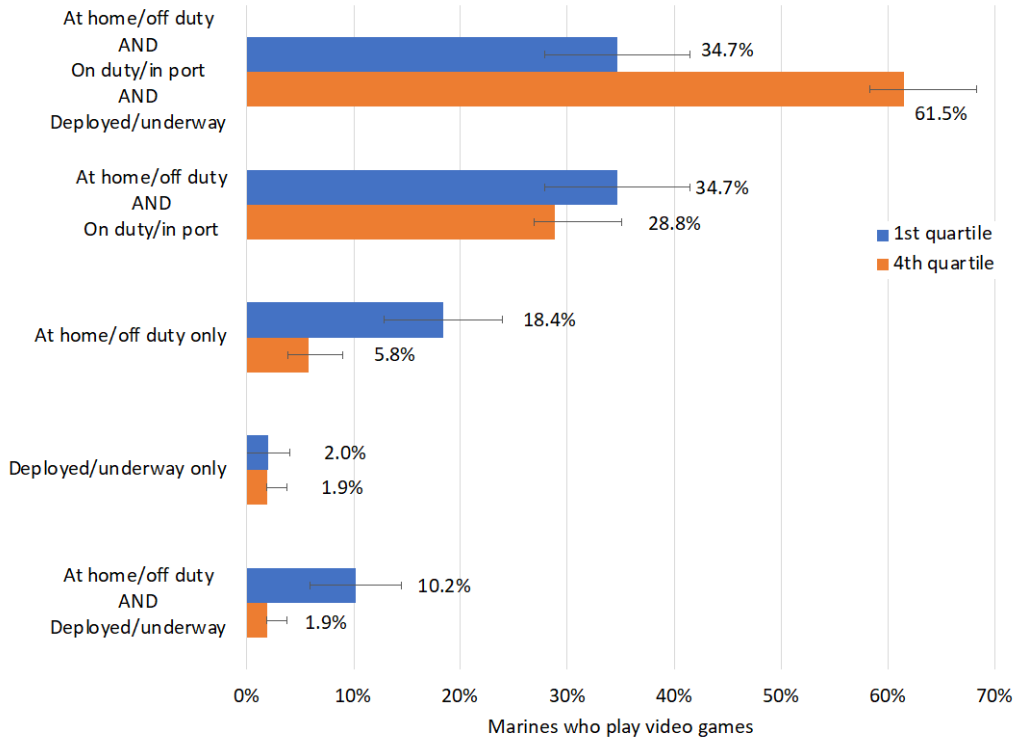

Figure 17. When Marine gamers play video games by IGDS9-SF score groups. Horizontal lines denote the Standard Error for Proportion.

The two severity groups differ only on their pattern of video gaming at home. Specifically, compared to Marine gamers in the lower severity group who play video games five days per week for a median duration of 3 hours/day, Marine gamers in the higher severity group play video games every day in a typical week at home/off duty for a median duration of 5 hours/day. Video gaming frequency or duration does not differ on a typical week on duty/in port or when underway/deployed. These results are shown in Table 10.

Table 10. Differences in frequency of video gaming between the 1st and the 4th quartile groups of Marine gamers based on IGDS9-SF scores.

Variable	Gamers in the 1st quartile group	Gamers in the 4th quartile group	Unadjusted p-value [A]	Effect size [C]
Number of days playing video games in a typical week, MD (IQR)				
At home/off duty	5 (4)	7 (2)	0.022 [B]	0.230
On duty/in port	5 (5)	5 (4.5)	0.293	-
When deployed/underway	6 (3)	7 (4)	0.511	-
Hours of video gaming, MD (IQR)				
At home/off duty	3 (3)	5 (4.5)	0.047 [B]	0.200
On duty/in port	2 (2)	4 (3)	0.250	-
When deployed/underway	3 (3)	3 (3)	0.768	-

[A] Wilcoxon rank sums test
[B] Statistically significant based on the post-hoc BH-FDR controlling procedure
[C] Non-parametric effect size r

Compared to Marine gamers in the 1st quartile group, more gamers in the 4th quartile tend to sleep later because they play video games. Depending on the setting (at home/off duty, on duty/in port, when deployed/underway), ~19% to ~31% of Marine gamers in the 4th quartile group reported that they frequently or always sleep later due to video gaming. In contrast, the percentage of Marine gamers who sleep later due to video gaming ranged from 0% to ~10% in the 1st quartile group. Detailed results are shown in Figures 18 to 20.

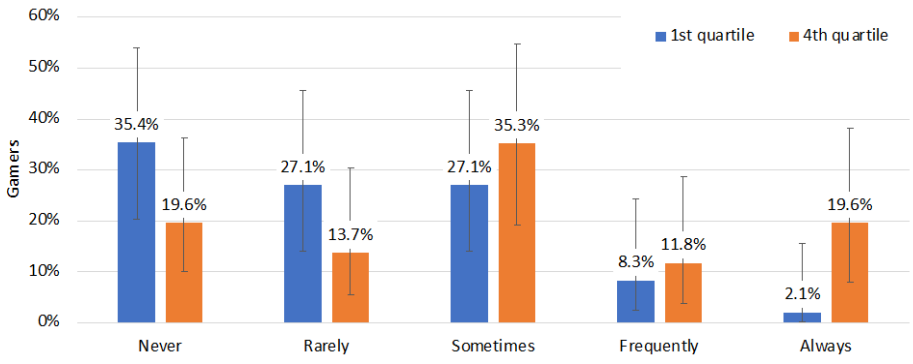

Figure 18. Responses of Marine gamers to the question "If you play video games before bedtime at home/off duty, have you ever slept later because you played video games?" Vertical lines denote the Standard Error of Proportion.

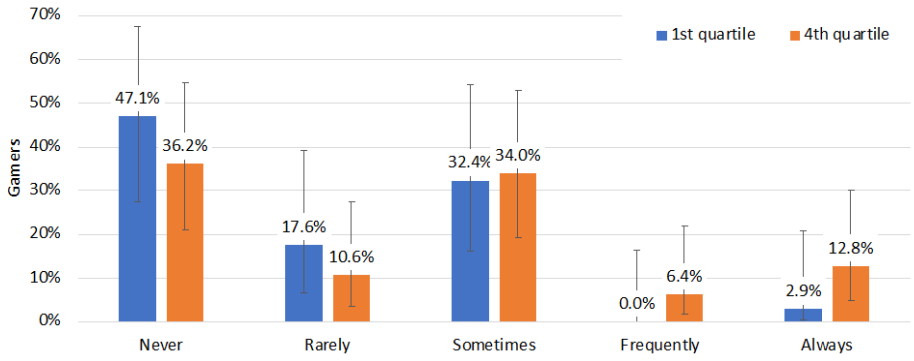

Figure 19. Responses of Marines gamers to the question "If you play video games before bedtime when on duty/in port, have you ever slept later because you played video games?" Vertical lines denote the Standard Error of Proportion.

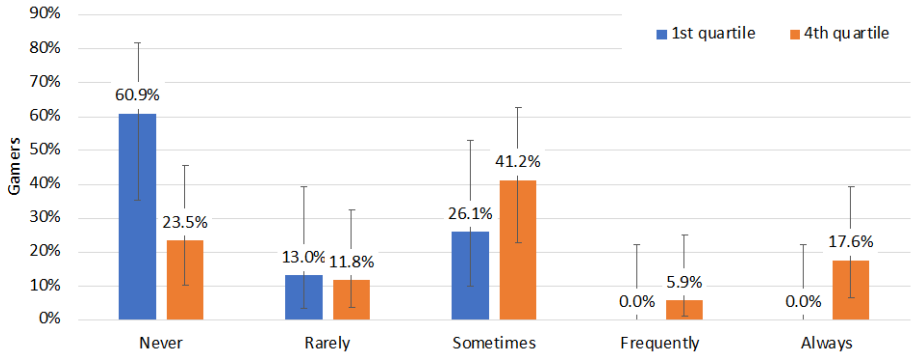

Figure 20. Responses of Marines gamers to the question "If you play video games before bedtime when underway/deployed, have you ever slept later because you played video games?". Vertical lines denote the Standard Error of Proportion.

6. Exploring the prevalence of "disordered" and "problematic" video gamers

The next step in our analysis was to explore the prevalence of "disordered" and "problematic" video gamers in the study sample. This analysis was based on the concept that gaming can be seen as a continuum with normal gaming at one end of the spectrum and "disordered" gamers at the other.

a. "Disordered" gaming

First, we used the two criteria from the video gaming literature to identify disordered gamers. Based on the "5 out of 9" criterion, 5 (2.20%) Marines (four E-3 to

E5 and one Officer) were classified as disordered gamers. Based on having a score of 36 or more, 2 (0.88%) Marines (E-5) were classified as "disordered gamers". In both cases, very few service members were identified as having serious problems with video gaming.

An issue of concern, however, is the applicability of existing criteria to assess video gaming severity in the military environment. In particular, the IGDS9-SF criteria are not tailored for military personnel. Consequently, we further explored what constitutes "disordered" gaming in the military using two approaches.

(1) Approach "A"

The first approach to classify Marine gamers was based on the factors identified in the literature on video gaming, i.e., ADSM psychological state and how they cope with stress. Using the data collected in the current study, under the general term "ADSM psychological state" we included depression, anxiety, loneliness, stress, and satisfaction with life.

We used exploratory factor analysis (EFA) to assess any underlying latent constructs. Based on a 3-factor model, latent Factor 1 included 10 components associated with negative aspects of ADSM well-being and psychological health, i.e., depression (PHQ-8 score), anxiety (GAD-8 score), loneliness (UCLA loneliness score), all dysfunctional coping styles of the Brief COPE questionnaire (behavioral disengagement, self-blame, denial, substance use, self-distraction, venting), and the inversely scored satisfaction with life (SWLS score). More information about the EFA is shown in Appendix C.

Based on these findings, we developed a crude unidimensional composite score to include the 10 components that were included in latent Factor 1 of the EFA. The composite score was calculated as the average of the normalized component scores. Hence, the composite score ranged from 0 to 100 with higher scores denoting better ADSM psychological state and less frequent use of dysfunctional coping styles. The median composite score for all Marines (n = 776) was 68.8 (24.4) ranging from 5.13 to 100. Gamers and non-gamers did not differ in terms of their composite score ($p = 0.574$; results adjusted for age, sex, officer or enlisted; Box-Cox transformation applied; Entire model: $F(5,770) = 19.5$, $p < 0.001$). The frequency plot of the composite score for all Marines is shown in Figure 21.

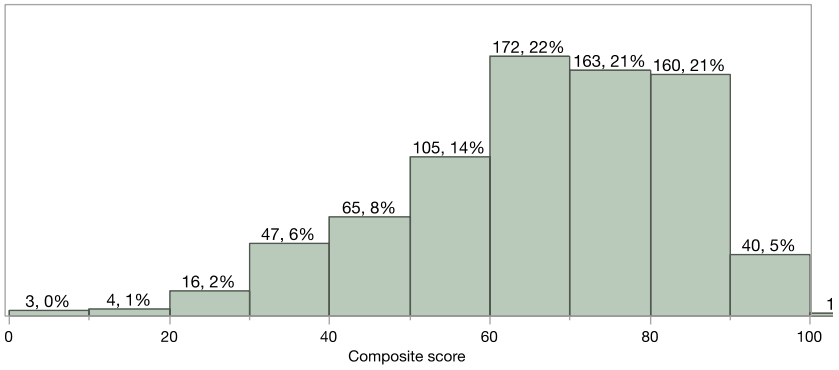

Figure 21. Distribution plot of the composite scores for all Marines.

Next, we focused on Marine gamers. The results from the partition analysis suggests that an IGDS9-SF score of 31 could be used as a cut-off criterion for classifying gamers into two groups based on their composite score (LogWorth = 4.79). Compared to Marines with an IGDS9-SF score of less than 31, Marines (n = 9, 3.97%) with an IGDS9-SF score of 31 or more employed dysfunctional coping styles more frequently, employed problem-focused coping styles less frequently, were less satisfied with their life, and scored higher (worse) in loneliness. Not surprisingly, Marines in the higher severity group were more likely to be identified with major depression (4.66 times), generalized anxiety (5.29 times), excessive daytime sleepiness (2.67 times), and have an AUDIT-C score suggestive of an alcohol use problem (2.1 times). Of note, however, the two groups did not differ in terms of performance-related behaviors (using nicotine products, drinking caffeinated beverages, and having an exercise routine) (all $p > 0.10$). Detailed results are shown in Table 11.

Table 11. Differences between Marine gamers with IGDS9-SF scores < 31 and gamers with IGDS9-SF scores ≥ 31.

Variable	IGDS9-SF scores<31 (n=218)	IGDS9-SF scores≥31 (n=9)	Unadjusted p-value	Effect size
Age in years, MD (IQR)	23 (7)	23 (7.5)	0.547 [B]	-
Sex (males), # (%)	211 (96.8%)	9 (100%)	0.990 [A]	-
Enlisted, # (%)	194 (89.0%)	9 (100%)	0.603 [A]	-
Having been deployed, # (%)	106 (48.6%)	5 (55.6%)	0.744 [A]	-
Deployment involving combat, # (%)	29 (27.4%)	1 (20.0%)	0.990 [A]	-
Reported daily sleep duration, MD (IQR)				
At home/off duty	7 (2)	6.5 (1.75)	0.351 [C]	-
On duty/in port	4 (6)	6 (4)	0.444 [B]	-
When deployed/underway	6 (2)	7 (3)	0.962 [C]	-
Using nicotine products, # (%)	113 (52.1%)	5 (55.6%)	0.990 [A]	-
Drinking caffeinated beverages, # (%)	202 (92.7%)	9 (100%)	0.990 [A]	-
Having an exercise routine, # (%)	189 (86.7%)	7 (77.8%)	0.354 [A]	-
Why playing video games (MOGQ scores)				
Social, MD (IQR)	2.25 (1.75)	3.5 (2)	0.004 [B,D]	0.193 [E]
Escape, MD (IQR)	2.5 (2.19)	4.5 (1.63)	0.001 [B,D]	0.215 [E]
Competition, MD (IQR)	4 (1.69)	5 (1.5)	0.001 [B,D]	0.222 [E]
Coping, MD (IQR)	3.13 (1.69)	4.75 (0.88)	< 0.001 [B,D]	0.231 [E]
Skill development, MD (IQR)	3 (2.25)	4.75 (3)	0.131 [B]	-
Fantasy, MD (IQR)	2 (1.75)	3.5 (2.13)	0.010 [B,D]	0.174 [E]
Recreation, MD (IQR)	4.67 (1)	5 (1.17)	0.565 [B]	-
Coping styles, MD (IQR)				
Problem-focused coping styles	2.67 (2)	1.33 (1.92)	0.068 [B,D]	0.129 [E]
Emotion-focused coping styles	2.4 (1.7)	1.9 (1.45)	0.273 [B]	-
Dysfunctional coping styles	1 (1.33)	2.67 (1.67)	< 0.001 [B,D]	0.246 [E]
PSS-4 score, MD (IQR)	8 (1)	8 (1.5)	0.035 [B,D]	0.142 [E]
SWLS score, MD (IQR)	23 (9)	11 (14)	0.007 [B,D]	0.183 [E]
PHQ-8 score, MD (IQR)	3 (7)	20 (14)	< 0.001 [B,D]	0.264 [E]
Major depression (10≤PHQ-8<20), # (%)	34 (18.4%)	6 (85.7%)	< 0.001 [A,D]	4.66 (3.04-7.16) [F]
GAD-7, MD (IQR)	2 (6)	19 (13)	< 0.001 [B,D]	0.279 [E]
GAD (GAD-7≥10), # (%)	25 (13.5%)	5 (71.4%)	0.001 [A,D]	5.29 (2.92-9.57) [F]
UCLA loneliness score, MD (IQR)	41 (16)	55 (23)	0.011 [B]	0.186 [E]
ESS score, MD (IQR)	8 (7)	14.5 (11.8)	0.008 [B,D]	0.194 [E]
EDS, # (%)	50 (28.1%)	6 (75.0%)	0.010 [A,D]	2.67 (1.68-4.25) [F]
AUDIT-C score, MD (IQR)	3 (3)	6.5 (8.25)	0.030 [B,D]	0.157 [E]
Suggestive of a problem, # (%) [C]	65 (35.7%)	6 (75.0%)	0.054 [A,D]	2.1 (1.35-3.28) [F]

EDS: Excessive daytime sleepiness (ESS>10); GAD: Generalized anxiety disorder

[A] Fisher's exact test

[B] Wilcoxon rank sums test

[C] AUDIT-C score criterion for alcohol problems: ≥4 for males; ≥3 for females

[D] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

[E] Non-parametric effect size r

[F] Relative risk (95% confidence interval)

(2) Approach "B"

The second approach to classify Marine gamers was based on the factors identified in the literature on video gaming, specifically, psychological state and how gamers cope with stress. However, we also included the important operational component of sleeping later due to video gaming. We developed a crude unidimensional composite score, calculated as the average of the normalized component scores. The composite score ranged from 0 to 100 with higher scores denoting better ADSM state, less frequent use of dysfunctional coping styles, and not sleeping later due to video gaming. The median composite score for all Marines (n=776) was 65.9 (23.4) ranging from 9.53 (worse) to 100 (best). Gamers had lower (worse) composite score than non-gamers ($p = 0.002$; results adjusted for age, sex, Officer or Enlisted; Box-Cox transformation applied; entire model: $F(5,770) = 26.2$, $p < 0.001$). The frequency plot of the composite score of all Marines is shown in Figure 22.

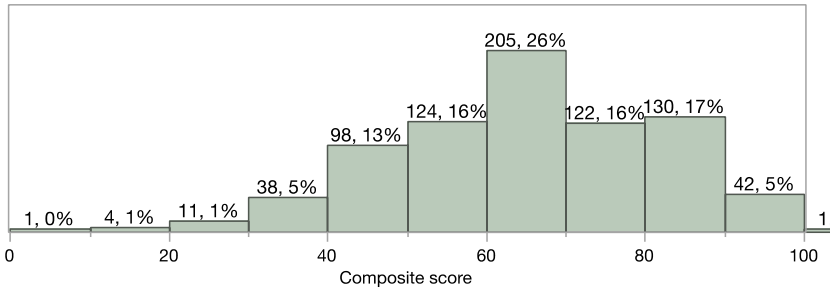

Figure 22. Distribution plot of the composite scores for all Marines.

The addition of the sleep components in the composite score reduced the IGDS9-SF cut-off score by 1 point. Specifically, partition analysis results suggest that an IGDS9-SF score of 30 could be used as a cut-off criterion for classifying "disordered" and "normal" Marine gamers (LogWorth = 5.78). Compared to Marines with an IGDS9-SF score < 30, Marines (n = 11, 4.85%) with an IGDS9-SF score ≥ 30 employed dysfunctional coping styles more frequently, were less satisfied with their life, and scored higher (worse) in loneliness. Also, Marines in the higher severity group were more likely to be identified with major depression (4.06 times), generalized anxiety (4.60 times), excessive daytime sleepiness (2.36 times), and have an AUDIT-C score suggestive of an alcohol use problem (1.86 times). The two groups did not differ in terms

of performance-related behaviors (using nicotine products, drinking caffeinated beverages, and having an exercise routine) and stress levels (all $p > 0.18$). Detailed results are shown in Table 12.

Table 12. Differences between Marine gamers with IGDS9-SF scores < 30 and gamers with IGDS9-SF scores ≥ 30.

Variable	IGDS9-SF scores<30 (n=216)	IGDS9-SF scores≥30 (n=11)	Unadjusted p-value	Effect size
Age in years, MD (IQR)	23 (7)	23 (7)	0.653 [B]	-
Sex (males), # (%)	209 (96.8%)	11 (100%)	0.990 [A]	-
Enlisted, # (%)	192 (88.9%)	11 (100%)	0.612 [A]	-
Having been deployed, # (%)	105 (48.6%)	6 (54.6%)	0.765 [A]	-
Deployment involving combat, # (%)	29 (27.6%)	1 (16.7%)	0.990 [A]	-
Reported daily sleep duration, MD (IQR)				
At home/off duty	7 (2)	6.5 (1.5)	0.481 [B]	-
On duty/in port	4 (6)	5 (4)	0.499 [B]	-
When deployed/underway	6 (2)	6.5 (2.5)	0.875 [B]	-
Using nicotine products, # (%)	113 (52.6%)	5 (45.6%)	0.671 [A]	-
Drinking caffeinated beverages, # (%)	200 (92.6%)	11 (100%)	0.990 [A]	-
Having an exercise routine, # (%)	188 (87.0%)	8 (72.7%)	0.177 [A]	-
Why playing video games (MOGQ scores)				
Social, MD (IQR)	2.25 (1.75)	3.5 (2.25)	0.005 [B,D]	0.188 [E]
Escape, MD (IQR)	2.5 (2.25)	4.5 (1)	0.002 [B,D]	0.251 [E]
Competition, MD (IQR)	2.88 (1.5)	5 (1)	< 0.001 [B,D]	0.257 [E]
Coping, MD (IQR)	3 (1.75)	4.75 (0.5)	< 0.001 [B,D]	0.268 [E]
Skill development, MD (IQR)	3 (2.25)	4.5 (3)	0.068 [B,D]	0.123 [E]
Fantasy, MD (IQR)	2 (1.75)	3.5 (2)	0.022 [B,D]	0.154 [E]
Recreation, MD (IQR)	4.67 (1)	5 (1.33)	0.637 [B]	-
Coping styles, MD (IQR)				
Problem-focused coping styles	2.67 (2)	1.67 (1.83)	0.065 [B,D]	0.130 [E]
Emotion-focused coping styles	2.4 (1.75)	2.2 (1.3)	0.279 [B]	-
Dysfunctional coping styles	1 (1.33)	2.5 (1.67)	< 0.001 [B,D]	0.252 [E]
PSS-4 score, MD (IQR)	8 (1)	8 (2)	0.163 [B]	-
SWLS score, MD (IQR)	23 (9)	12 (12)	0.003 [B,D]	0.204 [E]
PHQ-8 score, MD (IQR)	3 (7)	15 (15.5)	< 0.001 [B,D]	0.266 [E]
Major depression (10≤PHQ-8<20), # (%)	34 (18.5%)	6 (75.0%)	0.001 [A,D]	4.06 (2.46-6.71) [F]
GAD-7, MD (IQR)	2 (6)	15.5 (13.8)	< 0.001 [B,D]	0.281 [E]
GAD (GAD-7≥10), # (%)	25 (13.6%)	5 (62.5%)	0.003 [A,D]	4.60 (2.41-8.80) [F]
UCLA loneliness score, MD (IQR)	41 (16)	52 (20)	0.008 [B,D]	0.195 [E]
ESS score, MD (IQR)	8 (7)	13 (11)	0.007 [B,D]	0.198 [E]
EDS, # (%)	50 (28.2%)	6 (66.7%)	0.023 [A,D]	2.36 (1.41-3.96) [F]
AUDIT-C score, MD (IQR)	3 (3)	6 (7.5)	0.060 [B,D]	0.136 [E]
Suggestive of a problem, # (%) [C]	65 (35.9%)	6 (66.7%)	0.081 [A,D]	1.86 (1.13-3.07) [F]

EDS: Excessive daytime sleepiness (ESS>10); GAD: Generalized anxiety disorder

[A] Fisher's exact test

[B] Wilcoxon rank sums test

[C] AUDIT-C score criterion for alcohol problems: ≥4 for males; ≥3 for females

[D] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

[E] Non-parametric effect size r

[F] Relative risk (95% confidence interval)

We also explored differences in video gaming habits between the IGDS9-SF score < 30 and the IGDS9-SF score ≥ 30 groups by comparing the settings of playing video games in these two groups. Compared to 40% in the lower severity group, approximately 82% of the Marine gamers in the higher severity group played video games in all settings (at home/off duty and on duty/in port and when deployed/underway). Detailed results are shown in Figure 23.

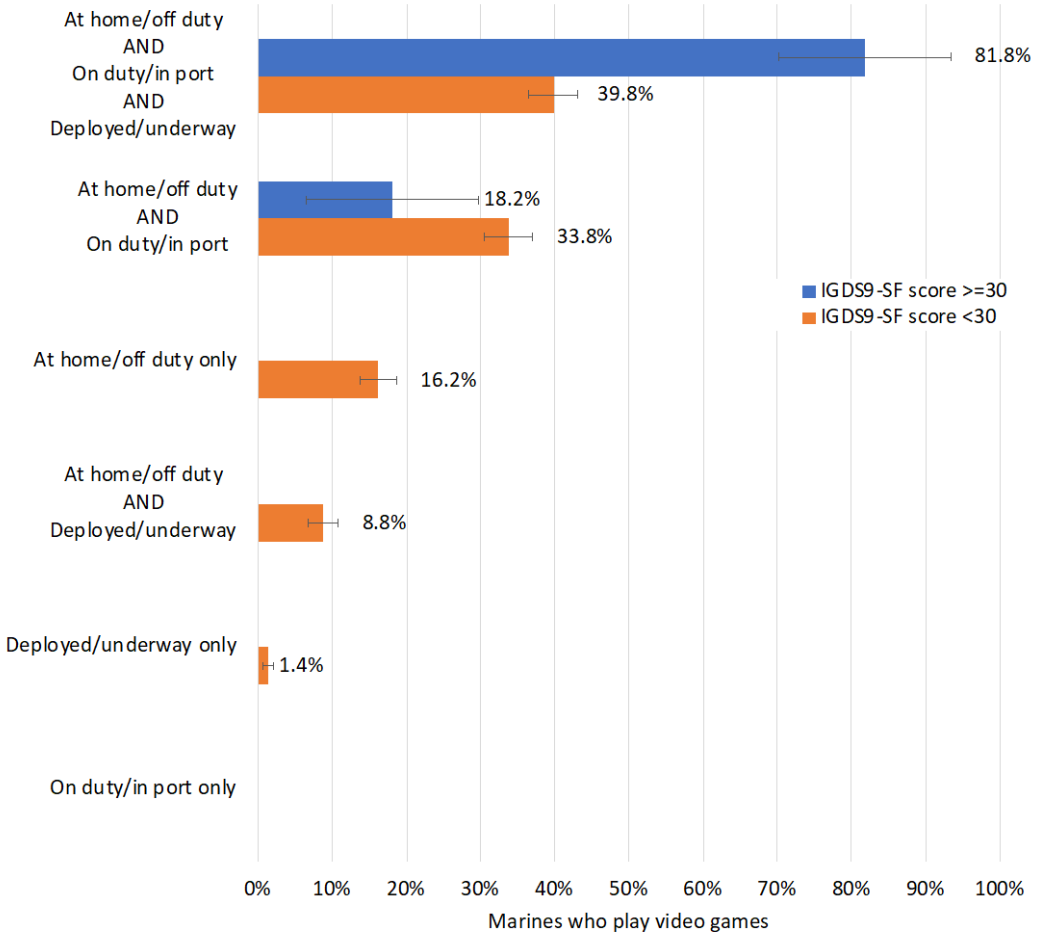

Figure 23. When Marine gamers play video games by IGDS9-SF score groups (<30 versus ≥30). Horizontal lines denote the Standard Error for Proportion.

Compared to Marine gamers with IGDS9-SF score <30, gamers with IGDS9-SF scores ≥ 30 play video games more days in a typical week at home/off duty and in a typical week on duty/in port, and more hours per day. Video gaming

frequency or duration did not differ in a typical week underway/deployed. These results are shown in Table 13.

Table 13. Differences in frequency of video gaming between Marine gamers with IGDS9-SF scores < 30 and gamers with IGDS9-SF scores ≥ 30.

Variable	IGDS9-SF scores<30 (n=216)	IGDS9-SF scores≥30 (n=11)	Unadjusted p-value [A]	Effect size [C]
Number of days playing video games in a typical week, MD (IQR)				
At home/off duty	6 (3)	7 (0)	0.041 [B]	0.137
On duty/in port	5 (5)	7 (2)	0.026 [B]	0.181
When deployed/underway	6 (4)	7 (5)	0.620	-
Hours of video gaming, MD (IQR)				
At home/off duty	3 (3)	5 (4)	0.007 [B]	0.173
On duty/in port	2 (2)	4 (3)	0.087 [B]	0.134
When deployed/underway	3 (2)	3 (7)	0.975	-

[A] Wilcoxon rank sums test
[B] Statistically significant based on the post-hoc BH-FDR controlling procedure
[C] Non-parametric effect size r

b. "Problematic" gaming

Given our findings on "disordered" gamers described in the previous section, we assessed the prevalence of "problematic" gamers based on the 3-group conceptual model to classify gamers based on their video gaming habits and effect of gaming on ADSM well-being (detailed information regarding this model is included in the Conclusions chapter). Analysis showed that 114 (50.2%) of the Marines were classified as problematic gamers. These results are shown in Figure 24.

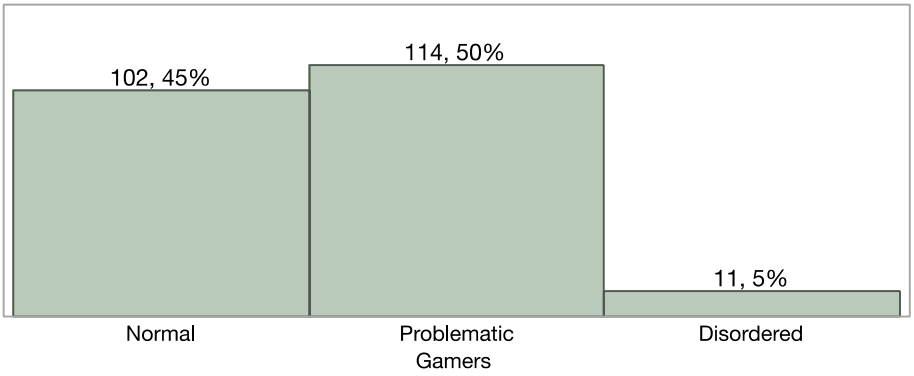

Figure 24. Marine gamers classified by their video gaming habits.

Between-group comparisons showed that the problematic and disordered Marine gamers were younger than normal gamers. In terms of the motivation to play VGs, all three groups scored high on the recreational dimension, suggesting that all Marine gamers frequently played VGs for entertainment and enjoyment. For all other dimensions (social, escaping from reality, competing with others, coping with stress and distress, skill development, and fantasy), the normal gamers scored the lowest and the disordered gamers scored the highest, with the problematic gamers' scores falling in-between.

Disordered gamers had the highest (worst) scores in using dysfunctional coping styles, quality of life (SWLS), depression (PHQ-8), generalized anxiety (GAD-7), and loneliness. The scores of problematic gamers, however, were comparable to normal gamers, which is expected given the conceptual basis of the 3-group video gaming severity model.

The IGDS9-SF scores differed between groups, which suggests that IGDS9-SF scores may be a good candidate for distinguishing between normal, problematic, and disordered gamers. Detailed results for the comparisons between normal, problematic, and disordered gamers are shown in Table 14.

Table 14. Differences between normal, problematic, and disordered gamers.

Variable	Normal gamers (n=102)	Problematic gamers (n=114)	Disordered gamers (n=11)
Age in years, MD (IQR)	25 (10)	22 (5) [B2]	23 (7)
Sex (males), # (%)	99 (97.1%)	110 (96.5%)	11 (100%)
Enlisted, # (%)	87 (85.3%)	105 (92.1%)	11 (100%)
Having been deployed, # (%)	49 (48.0%)	56 (49.1%)	6 (54.6%)
Deployment involving combat, # (%)	18 (36.7%)	11 (19.6%)	1 (16.7%)
Reported daily sleep duration, MD (IQR)			
At home/off duty	6.5 (1)	7 (2)	6.5 (1.5)
On duty/in port	3 (6)	4 (7)	5 (4)
When deployed/underway	6 (3)	6 (2)	6.5 (2.5)
Using nicotine products, # (%)	53 (52.5%)	60 (52.6%)	5 (45.6%)
Drinking caffeinated beverages, # (%)	96 (94.1%)	104 (91.2%)	11 (100%)
Having an exercise routine, # (%)	92 (90.2%)	96 (84.2%)	8 (72.7%)
IGDS9-SF score, MD (IQR)	13 (6.25)	16 (6.25) [A1]	32 (3) [B3,C3]
Why playing video games (MOGQ scores)			
Social, MD (IQR)	2 (2)	2.5 (1.5) [A1]	3.5 (2.25) [C2]
Escape, MD (IQR)	2 (2.25)	2.88 (2) [A2]	4.5 (1) [B3,C2]
Competition, MD (IQR)	2.75 (1.5)	3 (1.5)	5 (1) [B2,C3]
Coping, MD (IQR)	2.88 (1.5)	3.5 (1.56)	4.75 (0.5) [B3,C3]
Skill development, MD (IQR)	2.5 (2.69)	3.25 (2) [A1]	4.5 (3) [B1]
Fantasy, MD (IQR)	1.75 (1.75)	2.5 (1.75) [A3]	3.5 (2) [B2]
Recreation, MD (IQR)	4.67 (1)	4.67 (1)	5 (1.33)
Coping styles			
Problem-focused coping styles, MD (IQR)	3 (2)	2.5 (2.08)	1.67 (1.83)
Emotion-focused coping styles, MD (IQR)	2.5 (1.8)	2.2 (1.8)	2.2 (1.3)
Dysfunctional coping styles, MD (IQR)	1.08 (1.33)	1 (1.33)	2.5 (1.67) [B2,C2]
PSS-4 score, MD (IQR)	8 (2)	7 (2)	8 (2)
SWLS score, MD (IQR)	25 (9)	23 (10)	12 (12) [B1,C2]
PHQ-8 score, MD (IQR)	3 (7)	3 (9)	15 (15.5) [B3,C2]
Major depression (10≤PHQ-8<20), # (%)	14 (15.7%)	20 (21.1%)	6 (75.0%) [B2,C2]
GAD-7, MD (IQR)	2 (7)	2 (6)	15.5 (13.8) [B3,C3]
GAD (GAD-7≥10), # (%)	12 (13.5%)	13 (13.9%)	5 (62.5%) [B2,C2]
UCLA loneliness score, MD (IQR)	41 (19.3)	41 (14)	52 (20) [B1,C1]
ESS score, MD (IQR)	7 (6)	9 (8)	13 (11) [B2]
Excessive daytime sleepiness (ESS>10), # (%)	19 (22.4%)	31 (33.7%)	6 (66.7%) [B2,C1]
AUDIT-C score, MD (IQR)	3 (3)	3 (2)	6 (7.5)
Suggestive of a problem, # (%) [C]	27 (31.4%)	38 (40.0%)	6 (66.7%)

[A] Difference between Problematic and Normal gamers

[B] Difference between Disordered and Normal gamers

[C] Difference between Disordered and Problematic gamers

Statistical significance: "1" $p<0.05$; "2" $p<0.01$; "3" $p<0.001$;

Note 1: Nonparametric comparisons for all pairs of continuous variables using Dunn's method for joint ranking.

Note 2: Pairwise comparisons for categorical variables using Fisher's exact test with statistical significance based on post-hoc analysis with the BH-FDR controlling procedure

Note 3: AUDIT-C score criterion for alcohol problems: ≥4 for males; ≥3 for females

Lastly, we compared the three video gaming severity groups in terms of the number of days spent playing video games and hours of video gaming per day. Compared to normal Marine gamers, problematic and disordered gamers played video games more days in a typical week at home/off duty and in a typical week on duty/in port. Of note, both problematic and disordered gamers reported playing video games 7 days/week when at home and underway. These results are shown in Table 15.

Table 15. Differences in frequency of video gaming between gamers.

Variable	Normal gamers (n=102)	Problematic gamers (n=114)	Disordered gamers (n=11)
Number of days playing video games in a typical week, MD (IQR)			
At home/off duty	5 (4)	7 (2) [A2]	7 (0) [B1]
On duty/in port	5 (2)	5 (5) [A1]	7 (2) [B1]
When deployed/underway	5 (4.25)	7 (3)	7 (5)
Hours of video gaming, MD (IQR)			
At home/off duty	3 (2)	4 (2) [A1]	5 (4) [B2]
On duty/in port	2 (2)	3 (2)	4 (3)
When deployed/underway	3 (3)	4 (3) [B1]	3 (7)

[A] Difference between Problematic and Normal gamers
[B] Difference between Disordered and Normal gamers
[C] Difference between Disordered and Problematic gamers
Statistical significance: "1" $p<0.05$; "2" $p<0.01$; "3" $p<0.001$;
Note 1: Nonparametric comparisons for all pairs of continuous variables using Dunn's method for joint ranking.

7. Video gaming activities before and during the COVID-19 environment

Marines who played video games were asked to retrospectively compare their video gaming activities before and after the COVID-19 environment (March 2020). Most (56.4%) of the responses noted that the video gaming activities remained the same, 37.8% noted that video gaming increased somewhat or greatly, and 5.7% noted that video gaming activities decreased greatly or somewhat. These results are shown in Figure 25.

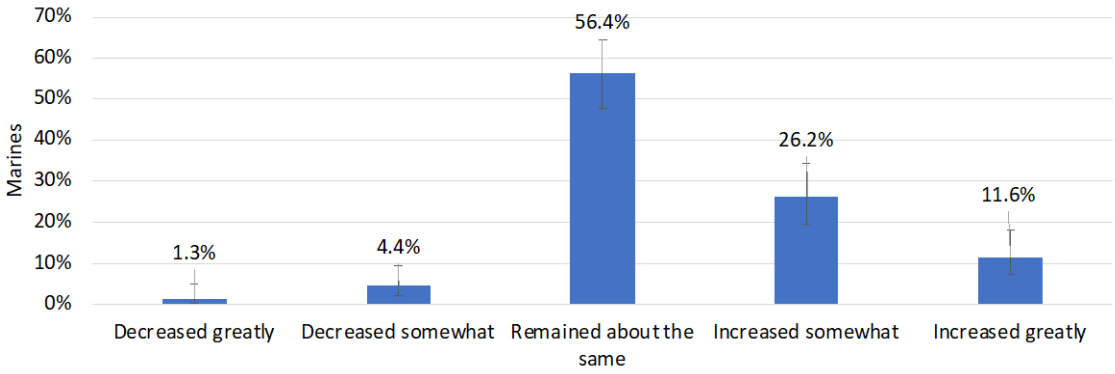

Figure 25. Responses to the question "Compared to your video gaming activities before COVID-19, your video gaming activities in the COVID-19 environment (March 2020 to present) have…". Vertical lines denote the Standard Error for Proportion.

Also, we assessed whether changes in video gaming activities due to COVID-19 were associated with gaming severity. Analysis showed that 90.9% of the disordered gamers responded that their video gaming activities increased compared to 40.7% of the problematic gamers and 29% of the normal gamers. Detailed results are shown in Figure 26.

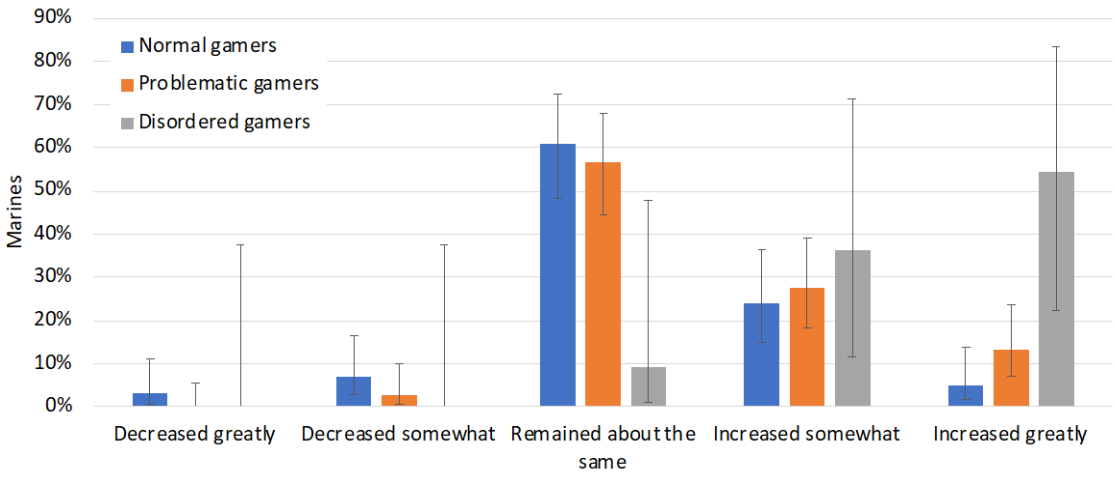

Figure 26. Responses to the question "Compared to your video gaming activities before COVID-19, your video gaming activities in the COVID-19 environment (March 2020 to present) have…" by gaming severity groups. Vertical lines denote the Standard Error of Proportion.

8. Focus groups

The information from the responses gathered in our Marine focus groups is clustered into 12 categories.

What videogames do you like to play?

Marines reported various games and genres that they enjoy playing, but we did not identify any specific pattern in terms of their preferences aside from noting that popular games included first-person shooters (FPS), tactical, survival, fighter, and role-playing games.

How often/how long do you play them?

In general, young Marines (E1-E3) reported playing typically 1 to 4 hours during weekdays (up to 8 hours was the maximum). Compared to junior Marines (E1-E3), senior Marines (E4-E5) and SNCO/Officers reported playing less frequently and for fewer hours because they are busy (duties, family, etc.). Specifically, SNCO/Officers reported playing 1 to 2 hours during weekdays. These results suggest that video gaming may decrease with age due to life commitments and responsibilities.

All rank groups noted that the amount of time spent playing video games increases on weekends. E1-E3 Marines reported playing from 3 to 12 hours daily or more during the week, with the amount doubling during weekends. Of note, some Marine gamers mentioned that they play much more when a new game comes out and some noticed that they are waiting for the new games to come out.

In general, E1-E3 Marines reported that they do not play video games when on duty. Lastly, involvement with video gaming does not only include playing, but also watching other people playing, either in the same location or online using real-time screen-sharing. Also, for some games, time is spent outside the game to learn about strategies to use, etc. As one Marine said:

> "*Some of them take so much strategy. Sometimes in downtime I will watch YouTube to learn more.*"

What platforms do you use?

Marines reported playing video games using personal computers, gaming consoles, and smartphones. Personal computers seemed to be their main preference.

Where do you play them?

Occasionally, Marines set up party games in the common lounge areas, but hours are limited in these areas. Also, oftentimes Marines have parties gathering to play video games.

Why do you play video games?

All rank groups reported that the major factors for playing video games were socializing and communicating with fellow Marines and friends, and to decompress from stress. Other factors for playing video games included satisfaction of winning and building connections with other players.

Marines from Okinawa noted that one of the main reasons for playing video games was to connect with friends back home (online chatting in the background while playing the video game). As one SNCO/Officer said:

> "*Now playing early in the morning for 1-2 hours to play with friends back home – not primarily to play the game, but to socialize with people back home. Catching up and mindlessly playing the game.*"

Also, senior NCOs and officers reported that they played video games to spend time with their children.

What benefits do video games offer?

All Marine gamers recognized that the benefits of video gaming include socializing and communicating with fellow Marines and friends, and that playing video gaming acts as a stress reliever and helps them decompress. As two enlisted Marines said:

Marine 1: "*[Video gaming] is always a great talking point. I've connected with a lot of Marines in real life talking about video games. Getting that shared experience, I think it really brings us together. I haven't seen much tearing apart. All I see is building up in a different way than we get at work.*"

Marine 2: "*You can be in a whole conversation with somebody. You are playing a game, but you are really just having something in the background to have an excuse to talk to somebody. To have a conversation with the game in the background.*"

Marine 3: "*Generally, my social abilities were stunted just because of how I was… people my age had such varying interests I couldn't really connect… and games were a different kind of bridge to fill that gap.*"

Marines also mentioned that playing video games can be beneficial in terms of expressing creativity and improving communications skills and hand-eye coordination. Senior enlisted Marines mentioned video gaming as beneficial in team building, and that some aspects of leading group efforts in video games may transfer to real life. Senior NCOs/Officers stated that playing video games can be a source of achievement/accomplishment and that critical thinking, decision making, and development of leadership skills may benefit from this activity. The following is a relevant comment from a senior enlisted Marine:

"*I could say there are parallels in my real life… I struggle leading Marines just like I struggle leading in video games… let me break it down to you, this is what is going to happen… if you explain it well enough, you are able to articulate it well enough, they will usually follow what you are saying and will give you better results. In both video gaming and with Marines.*"

Some Marines expressed that video gaming helps them manage criticism and defeat. The following comment addresses the social aspect of video gaming, making friends, developing leading people, and the issue of managing criticism:

> "*The social aspect of gaming is something that is not always taken into consideration. You can make friends in gaming that you have never met in person, but build connections and friendships over the years. Can be a healthy outlet to unwind. … [In] FPS [games] there can be intense focus and communication where everyone will play their role… rely and communicate with each other on a team. … Some aspects, being able to trust people, playing your role may translate into leading Marines. To hear criticism and be able to handle it from your own team and not take it personally.*"

Are there any drawbacks of playing video games frequently? If so, what are they?

Junior Marines noticed staying up late to play video games instead of sleeping. As one senior NCO/Officer said:

> "*[Gamers] are stuck playing in the barracks... they don't get a chance to explore or other activities; exercise or sports… more engaging activities. It could get addicting… obviously with anything, they could overdo it… stay up too late or spend their entire day thinking about video games.*"

Senior NCOs and Officers, however, described a different picture. Specifically, they said that video gaming does not affect their own sleep, but it may affect time spent with family or friends. In general, senior NCOs/Officers noted that video gaming is a secondary activity for them because they are busy with their families and their work duties.

Both junior (E1-E3) and senior (E4-E5) enlisted Marines noticed that sometimes they drink alcohol while playing video games. Also, some gamers use energy drinks to

stay alert when they feel drowsy due to video gaming. The following are relevant comments we received regarding video gaming and alcohol:

> Marine 1: "*Absolutely [I drink while playing], in some scenarios. It depends. If I'm trying to decompress or relax, I'll play low-stakes and I'll slowly drink with that as a sort of way to relax."*
> Marine 2: "*Some games having a couple of drinks can help, more to help you relax and not feel stress from the game. I don't do it often, but I've had some pretty fun times doing that with friends.*"

Another issue related to video gaming is "*getting sucked in*" the games and losing the sense of time. One relevant comment from a junior Marine was the following:

> "*I think about how I spend my time, could I have been doing something better? Should I have been doing something else with my time? What should I do next time? What should I do tomorrow?*"

Of note, Marines noted that they consider getting mad at the game (raging) a drawback of playing video games, a feeling that may transfer to real life. However, very few Marines we interviewed had experienced any cases of raging themselves or in their unit. As two Marines said:

> Marine 1: "*I know somebody I work with, whenever he plays games, he is like, raging… he'll be smashing the desk and just like going crazy. In PT, if there is something he struggles with, he will react in the same way. I don't know if that's personality or because he plays the game so much and now that rage reactions have spilled out into the rest of his life.*"
> Marine 2: "*I know one guy who bit himself because he was so mad… he got so mad during the games and then in real life. And I don't know if its personality or if the video games contributed to it.*"

Lastly, video gaming may have negatively affected some gamers' social interactions. As two Marines said:

> Marine 1: "*I am a shy, asocial introvert, and I believe that is because my social skills were stunted largely due to me focusing on video games rather than talking to people.*"
> Marine 2: "*Generally, my social abilities were stunted just because of how I was… But in the long run, [video gaming] isn't a good replacement for social interaction… grew to prefer gaming interaction than social events.*"

Did your video gaming habits change during COVID-19?

Most of the Marines who participated in the focus group, regardless of their rank, noted that video gaming increased during COVID-19.

How prevalent is video gaming in your unit?

There was a consensus among the Marines who participated in the focus groups that a very high prevalence of video gaming exists in their commands. Specifically, junior Marines (E1-E3) noted that the prevalence of video gaming reached 80 to 100% in their unit. For E4-E5 Marines, the prevalence was estimated at approximately between 85% to 90%. Senior NCOs/Officers estimated the prevalence of gamers in the junior ranks (E1-E3) to approximately 90%. One senior NCO/Officer noted that from the 16 Marines on his ship, 13 were gamers (all males), whereas both females Marines did not play video games.

In general, Marines expressed the opinion that females were much less interested in and engaged with video gaming. As two Marines said:

> Marine 1: "*[They are] not 'gamers' but can enjoy playing a game like a phone game or something like that.*"
> Marine 2: "*Females may not actually call themselves 'gamers', even though they do play some videogames.*"

Most Marines reported starting playing video games in childhood. We received a comment, however, which suggests that some Marines start playing video games after joining the military:

> "*[I started playing video games] when I joined the Marine Corps because I had a lot of downtime and a way to connect to people.*"

Have you noticed any performance decrements in yourself or your fellow Marines due to video gaming? If so, how did those decrements manifest themselves?

In general, the responses we received suggest that Marines do not report video gaming to affect their work life ("*Gaming doesn't seem to impact work that much*"). There are cases, however, of Marines who are sleepy at work due to late-night video gaming. As two Marines said:

> Marine 1: "*PT is every morning at 5:30… Some Marines show up exhausted or sleepy, and I ask about why. They say they were up late playing video games.*"
> Marines 2: "*There is one kid, it's not as bad anymore… he was going through a rough time… he would play games all night. Till 3 am and sometimes we PT at 4 or 5 am. He would show up late because he fell asleep because he was up all night on his game. He was drinking cases of monster a day to stay awake. Spent all his money on monsters and his work ethic just wasn't there because he was so tired all the time*."

Addiction to video gaming

A number of Marines self-identified as being addicted to video gaming. However, Marines reported that gaming addiction was not prevalent. Specifically, they reported that, in their experience, people tend to grow out of addiction over time. As two junior Marines said:

Marine 1: "[I was] *maybe [addicted to video games] as a teen… but a lot of people grow out of it.*"
Marine 2: "*Most gamers have likely felt addicted at some point in their lives.*"

Marines noted that some individuals with extreme social problems seem drawn to video gaming. However, the Marines who expressed this opinion mentioned that they are not sure whether the social problems preexisted or were developed due to extreme gaming.

Recommendations

Because there is such a high prevalence of video gaming in the Corps, one E4-E5 Marine suggested that the USMC could consider leveraging competitive video games for recruiting purposes or to compete with other services. Senior NCOs/officers also expressed the opinion that video games could be a useful tool for recruitment and professional military education and leadership training. They also commented that the USMC could consider developing a recommended gaming list for training for tactics, etc.

Other findings of interest

Some Marines have participated in gaming tournaments competing for prizes. Also, several Marines reported spending $300-$400 per year on games. One Marine reported that one year he spent $3000-$4000 for a gaming system.

B. US NAVY SAILORS

Due to the small number of non-gamers in our sample of USN Sailors, this analysis will be based only on gamers. When appropriate, results from Sailors will be compared with Marines who play video games.

1. Demographics, occupational characteristics, and behavioral habits

As shown in Table 16, the sample of Sailors who were gamers were predominantly males (76, 97.5%) and enlisted (73, 93.6%). Compared to Marines, the

sample of Sailor gamers had less time in service. Also, in contrast to Marines, more Sailors had been deployed while in the military, but fewer Sailors had experienced combat during deployment.

Table 16. Gamers' demographic and occupational characteristics.

Demographic and occupational characteristics	Sailors (n=78)	Marines (n=850)	Unadjusted p-value
Age in years, MD (IQR)	24.5 (11)	23 (7)	0.813 [B]
Sex (males), # (%)	76 (97.5%)	799 (94.0%)	0.307 [C]
Rank group, # (%)			
Enlisted	73 (93.6%)	726 (85.4%)	0.058 [C,D]
E1-E3	26 (33.3%)	246 (28.9%)	-
E4-E6	42 (53.9%)	418 (49.2%)	-
E7-E9	5 (6.41%)	62 (7.29%)	-
Officers	5 (6.41%)	124 (14.6%)	-
CWO	1 (1.28%)	14 (1.65%)	-
O1-O3	4 (5.13%)	79 (9.29%)	-
O4-O6	-	31 (3.65%)	-
Years in active duty, MD (IQR)	3 (5.75)	4 (5.5)	0.002 [B,D]
Deployed while in the military, # (%)	46 (59.0%)	381 (55.2%)	0.018 [C,D]
Total months deployed, MD (IQR) [A]	10 (12.5)	9 (14)	0.187 [B]
Deployment(s) involving combat, # (%) [A]	6 (13.0%)	125 (32.8%)	0.006 [C,D]

[A] Only for ADSM who had been deployed
[B] Wilcoxon rank sums test
[C] Fisher's exact test
[D] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

Approximately 40% of the Sailors who reported video gaming use nicotine products, 84.6% drank caffeinated beverages, and 85.9% had an exercise routine. A higher percentage of Sailors reported exercising when they were at home/off duty and underway/deployed. The median reported daily sleep duration in a typical day at home/off duty was 6.5 hours compared to 6 hours in a typical day on duty/inport and 6 hours while underway/deployed. Compared to Marines, fewer Sailor video gamers reported drinking caffeinated beverages. Detailed results are shown in Table 17.

Table 17. Behavioral habits of gamers.

Behavioral habits	Sailors (n=78)	Marines (n=850)	Unadusted p-value
Gamers using nicotine products, # (%)	31 (39.7%)	369 (43.5%)	0.552 [A]
Gamers smoking cigarettes, # (%)	11 (35.5%)	84 (22.8%)	0.125 [A]
Number of cigarettes/day, MD (IQR)	3 (8)	4 (4)	0.749 [B]
Gamers chewing tobacco/stuff, # (%)	8 (27.6%)	114 (30.9%)	0.836 [A]
Times per day, MD (IQR)	3 (3)	3 (4)	0.301 [B]
Gamers using nicotine gum/patches, # (%)	4 (14.3%)	22 (5.96%)	0.100 [A]
Number of nicotine gum/patches /day, MD (IQR)	4 (4.13)	2 (3.25)	0.218 [B]
Gamers using electronic smoke, # (%)	18 (58.1%)	256 (69.4%)	0.227 [A]
Gamers drinking caffeinated beverages, # (%)	66 (84.6%)	789 (92.8%)	0.016 [A,C]
Gamers drinking tea, # (%)	24 (36.9%)	322 (40.8%)	0.600 [A]
Servings/cups of tea/day, MD (IQR)	1 (0.5)	1 (1)	0.760 [B]
Gamers drinking coffee, # (%)	35 (53.0%)	516 (65.4%)	0.060 [A]
Servings/cups of coffee/day, MD (IQR)	2 (1)	1 (1)	0.642 [B]
Gamers drinking sodas/pops/soft drinks, # (%)	37 (59.7%)	361 (45.8%)	0.047 [A]
Number of sodas/pops/soft drinks/day, MD (IQR)	1.5 (1)	1 (1)	0.078 [B]
Gamers drinking energy drinks, # (%)	33 (52.4%)	501 (63.5%)	0.104 [A]
Number of energy drinks/day, MD (IQR)	1 (0.5)	1 (1)	0.710 [B]
Gamers having an exercise routine, # (%)	67 (85.9%)	741 (87.3%)	0.724 [A]
At home/off duty	60 (89.6%)	N/A	-
On duty/in port	24 (35.8%)	N/A	-
When deployed/underway	50 (74.6%)	N/A	-
Times per week exercising, MD (IQR)		5 (2)	-
At home/off duty	3 (2.5)	N/A	-
On duty/in port	2 (2.38)	N/A	-
When deployed/underway	5 (3)	N/A	-
Reported daily sleep duration in hours, MD (IQR)			
At home/off duty	6.5 (2)	7 (2)	0.425 [B]
On duty/in port	6 (2)	1 (5)	< 0.001 [B,C]
When deployed/underway	6 (2)	6 (2)	0.027 [B,C]

[A] Fisher's exact test
[B] Wilcoxon rank sums test
[C] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

Next, we assessed how Sailors cope with problems. On a scale from 0 to 6 (higher frequency), the most frequently used problem-focused styles were active coping (4 [3]) and planning (3 [3]), and the most frequently used emotion-focused style was acceptance (4 [3]). From the dysfunctional styles associated with maladaptive coping, self-distraction (3 [3]) and self-blame (2 [4]) were the most frequently used by Sailors video gamers. Also, we compared the aggregated group scores. On a scale from 0 (denoting not using the style at all) to 6 (using the style a lot - higher frequency), problem-focused was the most frequently used style (3.33 [2.33]) followed by emotion-focused styles (2.4 [2.1];

Wilcoxon Signed Rank test, S = 850.5, p < 0.001). Dysfunctional coping styles were used much less frequently (1.33 [1.33]; Wilcoxon Signed Rank test, all p < 0.001). Compared to Marines, Sailor gamers more frequently use a positive reframing/reinterpretation coping style (p = 0.017).

In conclusion, our results show that Sailor gamers more frequently use problem-focused coping styles and rely less on emotion-focused coping styles. Detailed results are shown in Table 18.

Table 18. Gamers' coping styles.

Coping styles [C]	Sailors (n=77)	Marines (n=753)	Unadjusted p-value [A]
Problem-focused coping styles	3.33 (2.33)	2.67 (2)	- [B]
Active coping	4 (3)	3 (3)	- [B]
Planning	3 (3)	3 (3)	- [B]
Seeking instrumental social support	2 (3)	2 (3)	0.009 [D]
Emotion-focused coping styles	2.4 (2.1)	2.4 (1.8)	- [B]
Acceptance	4 (3)	3 (3)	- [B]
Seeking emotional social support	2 (3)	2 (4)	0.014 [D]
Positive reframing/reinterpretation	3 (3)	2 (3)	0.017 [D]
Humor	2 (3)	2 (4)	- [B]
Turning to religion	0 (2)	0 (2)	- [B]
Dysfunctional coping styles	1.33 (1.33)	1.17 (1.33)	0.399
Self-distraction	3 (3)	2 (3)	0.793
Self-blame	2 (4)	2 (3)	0.813
Venting	1 (2)	1 (2)	- [B]
Denial	0 (1)	0 (0)	0.412
Behavioral disengagement	0 (1.5)	0 (1)	0.446
Substance use	0 (0)	0 (0)	- [B]

[A] Adjusted by occupational group (Officers, Enlisted)
[B] Model not statistically significant
[C] Box-Cox transformation applied
[D] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

2. Video gaming habits

Most Sailors (73, 84.9%) reported playing video games at home/ off duty, but fewer Sailors reported video gaming when deployed/underway (61, 70.9%) or on duty/in port (52, 60.5%). When contrasting the video gaming habits of Sailors to those of

Marines, we observed two points of interest. First, there is a consistent pattern in both groups that video gaming takes place mostly at home/when off duty and less so while on duty. The second point of interest is that Sailors seem more consistent in their video gaming habits. These results are shown in Figure 27.

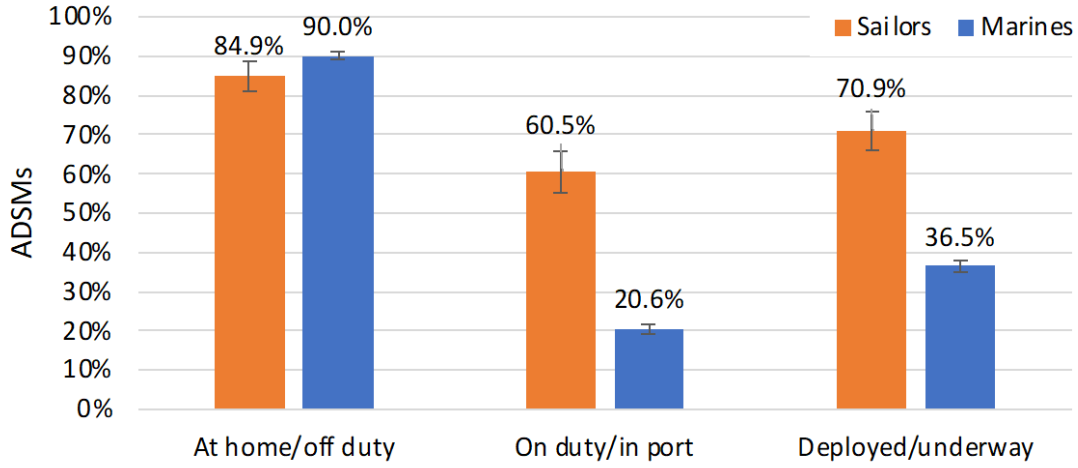

Figure 27. Percentage of ADSMs playing video games. Vertical lines denote the Standard Error of Proportion.

We investigated when Sailors play video games by classifying them into six groups. Focusing only on Sailor gamers, 51.3% of Sailors reported playing video games all three settings (at home/off duty, on duty/in port, when deployed/underway), whereas 21.8% reported video gaming both at home/off duty and when deployed/underway. In contrast, approximately 50% of Marines reported video gaming only at home/off duty. Detailed results are shown in Figure 28.

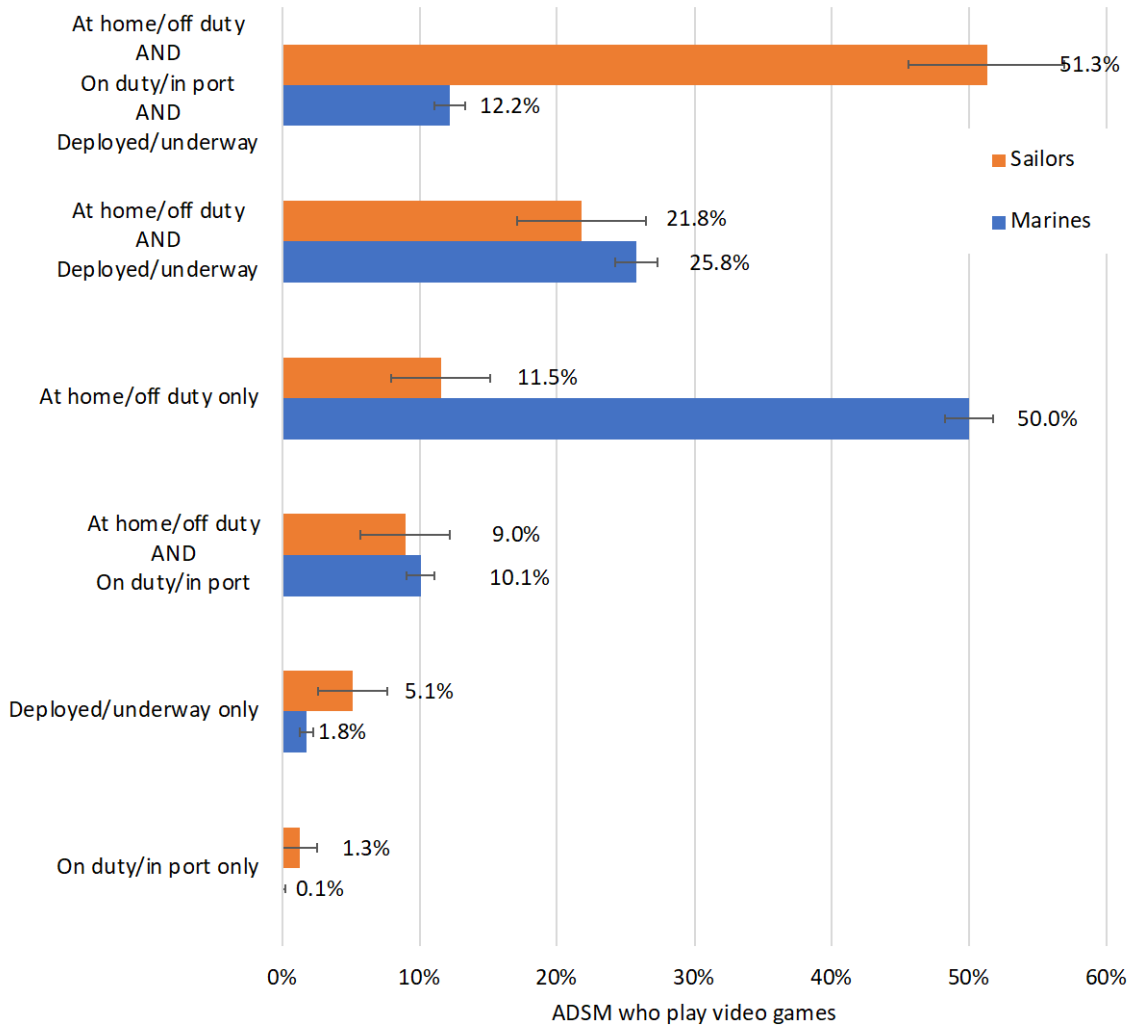

Figure 28. When do ADSMs play video games? Horizontal lines denote the Standard Error of Proportion.

Sailors reported playing video games for an average of 18.7 ± 8.12 years compared to 17.2 ± 6.71 years for Marines, ($t[84.3] = 1.56$, $p = 0.123$). Based on the number of years video gaming and gamers' ages, we estimated that Sailors started playing video games approximately at the median age of 7 years (IQR = 5). Of note, older Sailors and Marines reported that they started playing video games later in childhood than younger service members ($F[2,831] = 40.7$, $p < 0.001$). That is, younger ADSMs started playing at a younger age than older ADSMs.

In terms of game genres, Sailor gamers most often reported playing shooter (68, 88.3%) and action/adventure games (62, 80.5%) followed by platformer games (58,

75.3%) and role-playing (53, 68.8%). Detailed results are shown in Table 19 and Figure 29. For Sailors and Marine gamers, the two most frequently reported genres for both groups were shooter and action/adventure games followed by role-playing and platformer games. Compared to Marines, fewer Sailor gamers reported playing shooter games ($p = 0.004$). More Sailors, though, reported playing platformer games ($p = 0.010$), fighting games ($p = 0.042$), and sport games ($p = 0.048$).

Table 19. Video game genres by occupational group.

Genres	Sailors (n=86)	Marines (n=850)	Unadjusted p-value [A]
Action/adventure (e.g., Tomb Raider, Assassin's Creed)	68 (88.3%)	763 (89.8%)	0.695
Shooter (e.g., Call of Duty)	62 (80.5%)	777 (91.4%)	0.004 [B]
Platformer (e.g., Super Mario Bros.)	58 (75.3%)	515 (60.6%)	0.010 [B]
Role-playing (e.g., The Witcher, Mass Effect)	53 (68.8%)	645 (75.9%)	0.170
Fighting (e.g., Mortal Kombat, Street Fighter)	51 (66.2%)	458 (53.9%)	0.042 [B]
Racing (e.g., Gran Turismo, Forza)	44 (57.1%)	429 (50.6%)	0.285
Battle Royale (e.g., Fortnite)	38 (49.4%)	475 (55.9%)	0.283
Sports (e.g., Madden NFL, FIFA)	37 (48.1%)	307 (36.2%)	0.048 [B]
Strategy (e.g., Civilization, The Age of Empires)	36 (46.8%)	470 (55.3%)	0.154
Multiplayer online battle arenas (e.g., Smite, League of Legends)	36 (46.8%)	457 (53.8%)	0.283
Card-based games (e.g., Hearthstone, Legends of Runeterra)	27 (35.1%)	228 (26.8%)	0.083
Puzzle (e.g., Puzzle Quest, Match 3)	27 (35.1%)	231 (27.2%)	0.145
Simulation (e.g., SimCity)	25 (32.5%)	292 (34.4%)	0.803
Music & dance (e.g., Just Dance, Guitar Hero)	20 (26.0%)	233 (27.4%)	0.894

[A] Fisher's exact test

[B] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

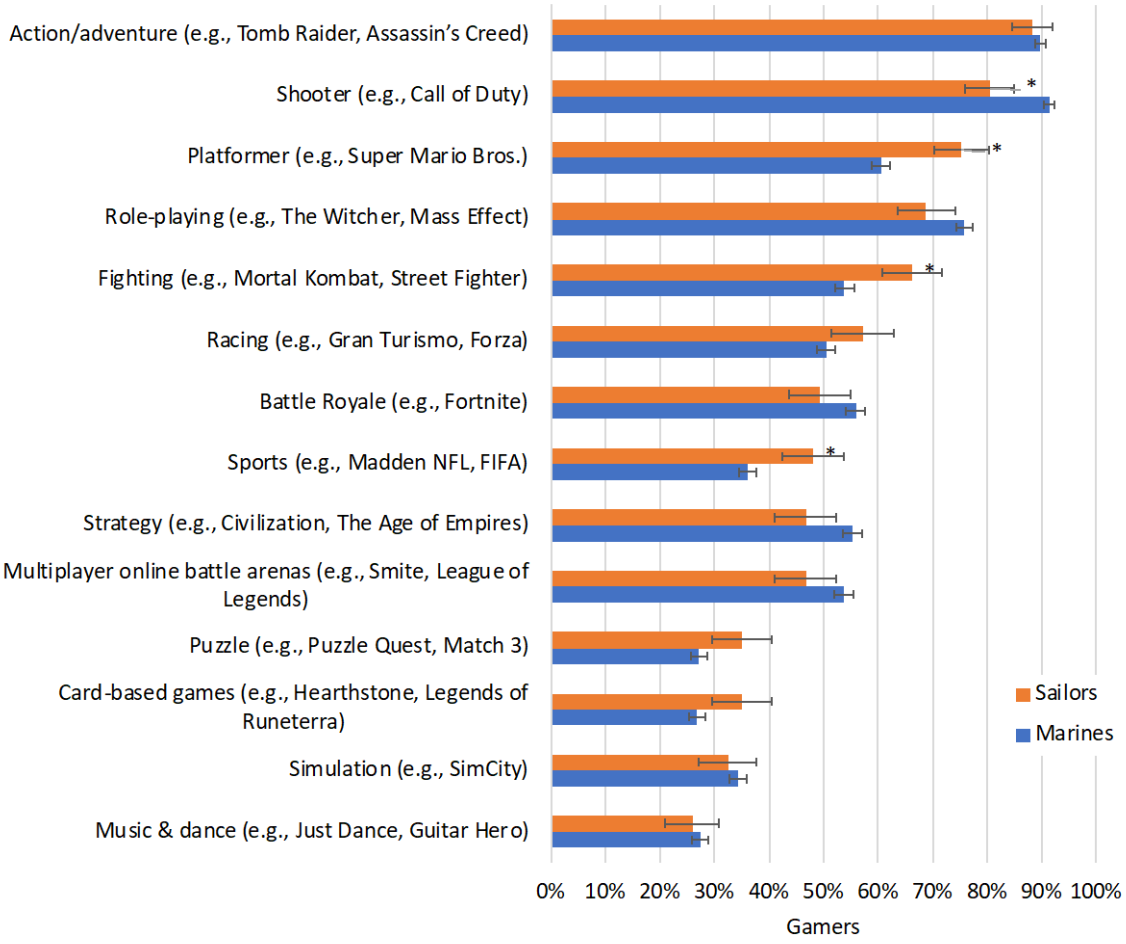

Figure 29. Video game genres by occupational group. Horizontal lines denote the Standard Error of Proportion. The asterisks denote statistically significant differences.

The median number of days that Sailor gamers reported gaming in a typical week at home/off duty was 5 (IQR = 3) for 3 [2.5] hours daily; and 3.75 (IQR = 4.75) days in a typical week when deployed/underway for 2 [1.63] hours daily. The median number of hours of gaming on a typical **day** on duty/in port was 2 (2).

In general, the most frequently reported devices used to play video games were game consoles and smartphones followed by personal computers (Figure 30). This pattern was consistent in all settings, i.e., at home/off duty, on duty/in port, and when deployed/underway. However, some differences existed between Sailors and Marine gamers. At home/off duty, more Sailor gamers (78.1%) used smartphones to play video games compared to Marine gamers (58.2%). Twice as many Marine gamers (50.0%) used

personal computers to play video games on duty/in port compared to Sailor gamers (25.0%). Lastly, while deployed/underway, more Sailor gamers used a game console (83.9%) compared to Marine gamers (63.9%), but more Marine gamers (62.2%) used a personal computer compared to Sailor gamers (29.0%). We postulate that the differences between groups while on duty/in port and when deployed/underway may be attributed to differences in the respective operational environments and duties.

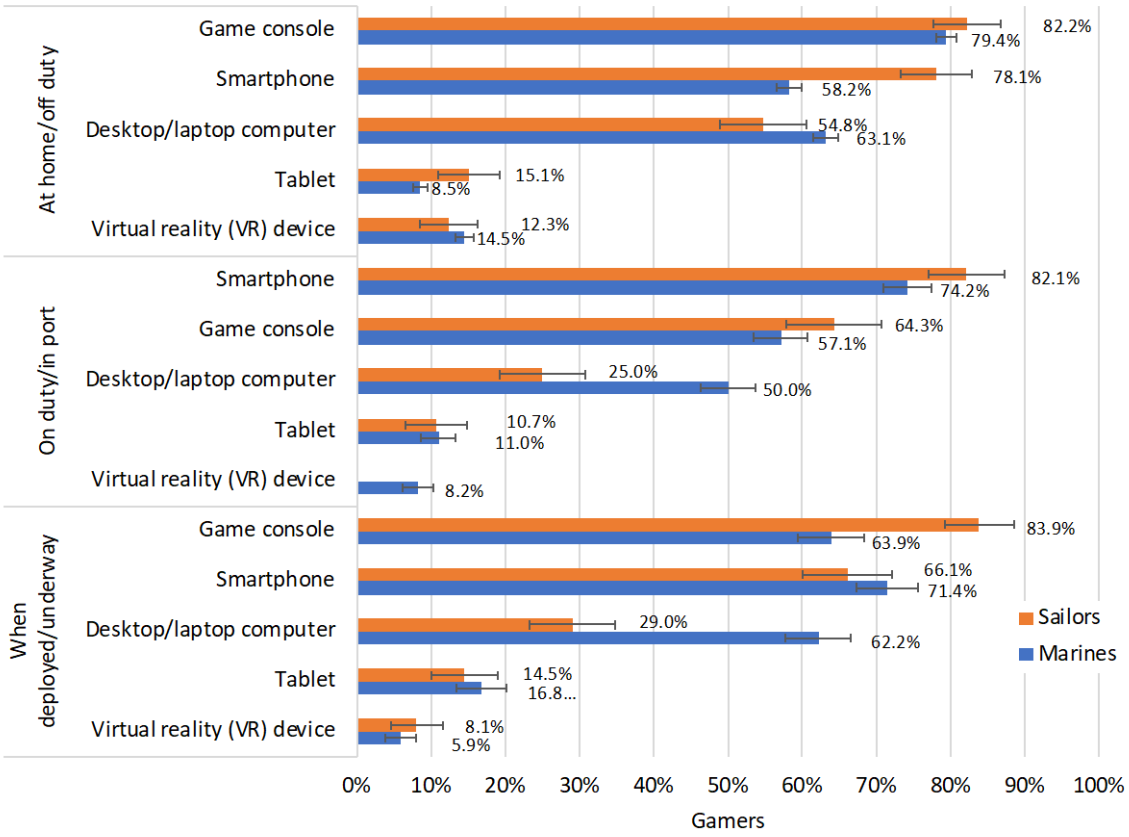

Figure 30. Use of gaming devices for Sailors and Marine gamers. Horizontal lines denote the Standard Error of Proportion.

When underway/deployed, Sailor gamers reported playing video games mainly later in the day, i.e., after work and before bedtime (Figure 31). Approximately 42% of the Sailor gamers, however, also played video games during their spare time at work. These patterns are in line with responses from Marine gamers.

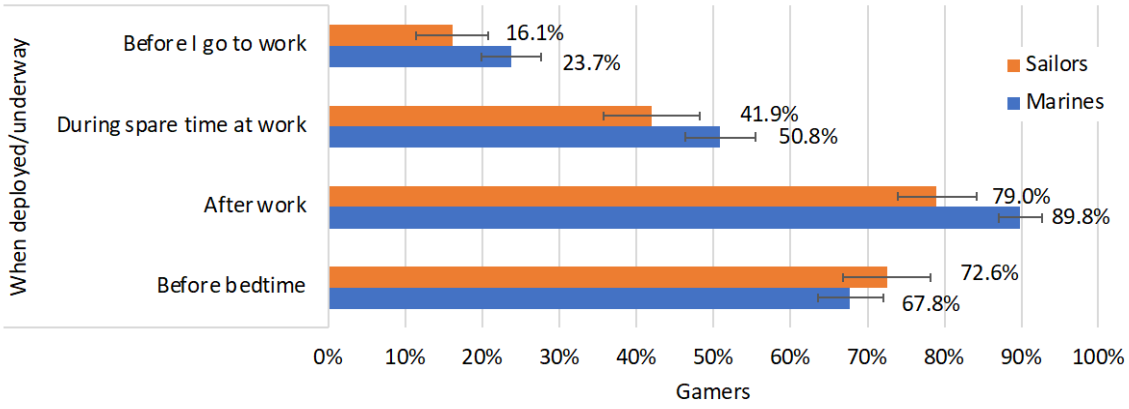

Figure 31. Sailor gamer responses to the question "When do you play video games?" Horizontal lines denote the Standard Error of Proportion.

Sailors who reported playing VGs before bedtime when underway/deployed, were asked whether they have slept later because of playing VGs. When underway/deployed, approximately 18% of the Sailor gamers responded that they slept later sometimes or more frequently because of VGs. In contrast, approximately 14% of the Marine gamers reported sleeping later because of VGs (Figure 32).

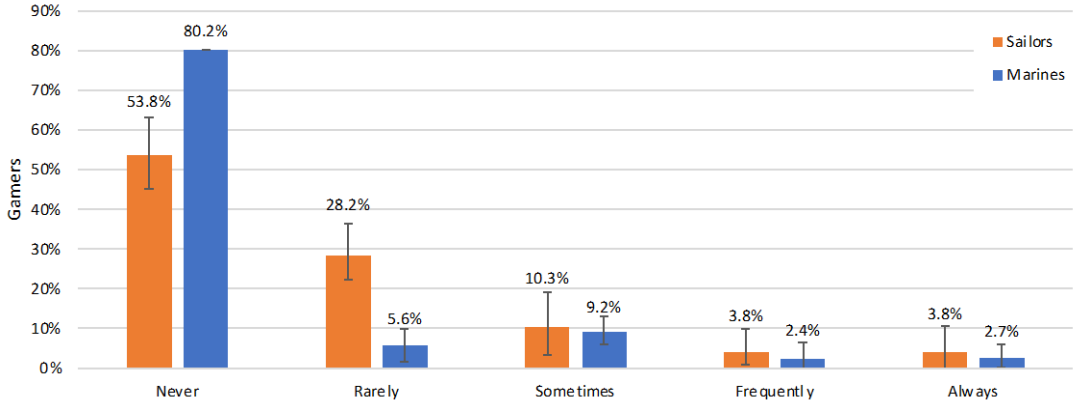

Figure 32. Gamers' responses to the question "If you play video games before bedtime, have you ever slept later because you played video games?" Vertical lines denote the Standard Error for Proportion.

Next, Sailor gamers were asked where they played video games when deployed/underway. As shown in Figure 33, most Sailor gamers reported playing video games in their rack (63.9%) and the mess decks/lounges/common areas (60.7%). Also, several Sailor gamers reported playing video games in their work area (27.9%) and the

common area of their berthing compartment (16.4%). In contrast, almost all Marine gamers played video games in their rack (93.2%) and 34.8% in the mess decks/common areas.

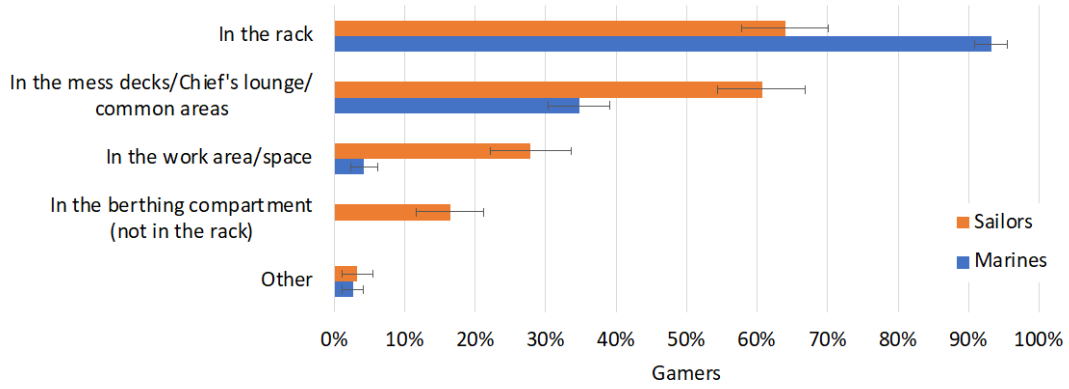

Figure 33. Gamers' responses to the question "Where do you play video games when deployed/underway?" Horizontal lines denote the Standard Error for Proportion.

Sailors were asked how many of their shipmates play video games when underway/deployed. As shown in Figure 34, approximately 64% of Sailors responded that more than 60% of their shipmates play video games when underway/deployed. The same pattern was evident in the responses from Marines with ~50% of them estimating that at least 60% of their fellow Marines play video games when underway/deployed.

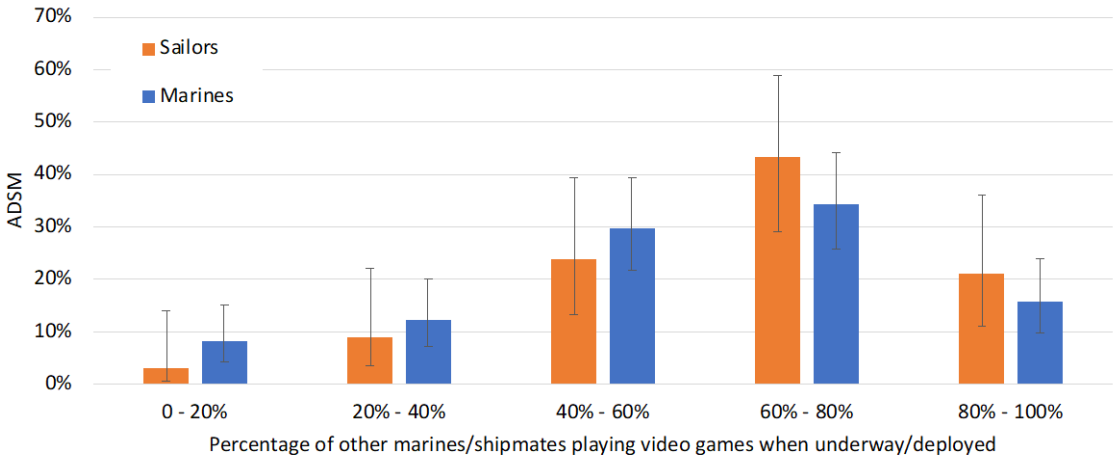

Figure 34. ADSM responses to the question "Think of your fellow Marines/Shipmates. How many of them play video games when underway/deployed?" Vertical lines denote the Standard Error of Proportion.

3. Why Sailors play video games

Using the MOGQ, we assessed the motivational factors for playing video games in terms of seven dimensions that are scored from 1 (had never or almost never played video games for this reason) to 5 (had always or almost always played video games for this reason). Sailor gamers reported that they play video games mostly for recreation (4.33 [1.33]) followed by coping with stress (3.25 [1.38]). Skill development and competing with others followed with median scores of 2.75 (2.13) and 2.5 (1.75), respectively. Escaping from reality had a median score of 2.25 (1.88). The social (building and maintaining social relationships) and fantasy dimensions were last in terms of their median score (2 [2] and 2 [1.5] respectively). The same pattern of results was evident in Marine gamers.

4. Gamers' sense of well-being

In terms of stress levels, Sailor gamers had an average perceived level of stress (PSS-4) score of 7.45 ± 2.31 ranging from 0 to 16. In terms of satisfaction with life, the median SWLS score was 23 (8) ranging from 6 to 35. Based on their SWLS scores, 26 (33.3%) Sailor gamers reported some level of dissatisfaction with their life. Detailed results are shown in Figure 35.

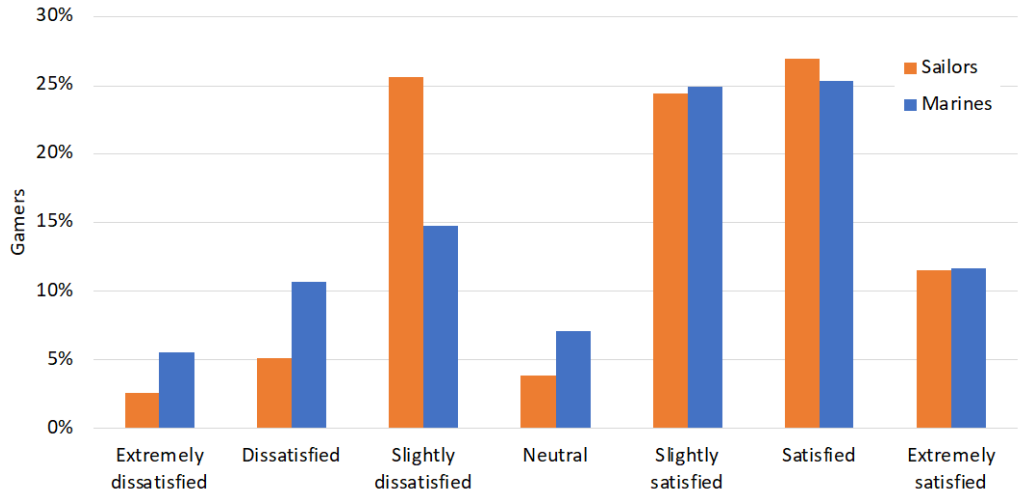

Figure 35. Gamers' satisfaction with life.

The median PHQ-8 score was 6 (6.5), with 16 (20.8%) gamers classified with major depression (10 ≤ PHQ-8 score < 20) and 3 (3.90%) classified with severe major depression (20 ≤ PHQ-8 score). The median GAD-7 score was 5 (8), with 17 (22.1%) gamers classified with symptoms of generalized anxiety disorder (GAD-7 scores ≥ 10). Detailed results regarding the anxiety groups are shown in Figure 36.

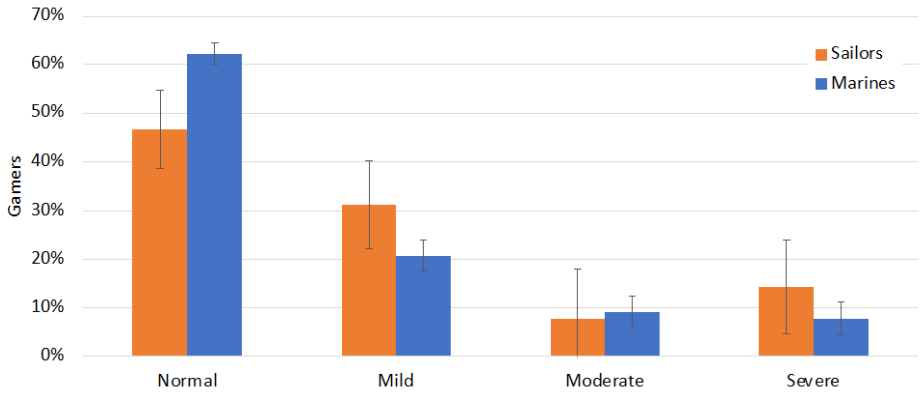

Figure 36. Severity of generalized anxiety disorder symptoms.

In terms of Sailors' feelings of loneliness and social isolation, the median score on the UCLA loneliness scale was 42.5 (16.3). The median ESS score was 9 (6), with 28 (35.9%) Sailors having symptoms of excessive daytime sleepiness – EDS (ESS score > 10). The median AUDIT-C score was 3(4), with 30 (38.5%) Sailors having scores suggestive of heavy drinking and/or active alcohol abuse or dependence. Detailed results regarding Sailors' well-being are shown in Table 20. Compared to Marines, Sailor gamers were characterized by higher PHQ-8 scores (more severe depression symptoms; p = 0.029) and higher GAD-7 scores (more severe symptoms of generalized anxiety; p = 0.006). However, the median values on both scales, were relatively low.

Table 20. Sailors' psychological well-being

Variable	Sailors	Marines	p-value [A]
PSS-4 score, M ± SD	7.45 ± 2.31	7.77 ± 2.02	- [B]
SWLS score, MD (IQR) [C]	23 (8)	23 (10)	0.477
Satisfaction with life groups (SWLS)			
Extremely dissatisfied	2 (2.56%)	44 (5.51%)	-
Dissatisfied	4 (5.13%)	85 (10.7%)	-
Slightly dissatisfied	20 (25.6%)	118 (14.8%)	-
Neutral	3 (3.85%)	57 (7.14%)	-
Slightly satisfied	213 (24.3%)	199 (24.9%)	-
Satisfied	21 (26.9%)	202 (25.3%)	-
Extremely satisfied	9 (11.5%)	93 (11.7%)	-
PHQ-8 score, MD (IQR) [C]	6 (6.5)	4 (8)	0.029 [E]
ADSM with major depression (10≤PHQ-8<20), # (%)	16 (20.8%)	157 (21.5%)	-
ADSM with severe major depression (20≤PHQ-8) , # (%)	3 (3.90%)	0	-
GAD-7, MD (IQR) [C]	5 (8)	2 (7)	0.006 [E]
Anxiety groups I (based on GAD-7), # (%)			
Normal (GAD-7<5)	36 (46.8%)	454 (62.3%)	-
Mild (5≤GAD-7<10)	24 (31.2%)	151 (20.7%)	-
Moderate (10≤GAD-7<15)	6 (7.79%)	67 (9.19%)	-
Severe (GAD-7≥15)	11 (1.43%)	57 (7.82%)	-
Anxiety groups II (based on GAD-7), # (%)			
GAD (GAD-7≥10)	17 (22.1%)	124 (17.0%)	0.304
UCLA loneliness score, MD (IQR) [C]	42.5 (16.3)	43 (20)	0.688
ESS score, MD (IQR) [C]	9 (6)	8 (6)	- [B]
Excessive daytime sleepiness (ESS>10) , # (%)	28 (35.9%)	213 (30.5%)	0.442
AUDIT-C score, MD (IQR) [C]	3 (4)	3 (3)	0.464
ADSM with an AUDIT-C score suggestive of a problem, # (%) [D]	30 (38.5%)	276 (39.3%)	- [B]

[A] Adjusted by age (nested within the occupational group) and occupational group (officers, enlisted)
[B] Model not statistically significant
[C] Box-Cox transformation applied
[D] AUDIT-C score criterion for alcohol problems: ≥4 for males; ≥3 for females
[E] Statistically significant based on post-hoc analysis with the BH-FDR controlling procedure

5. Severity of gaming and Sailor well-being

In terms of severity of gaming, the median IGDS9-SF score for Sailors was 14 (7.5) ranging from 9 to 31 (45 is the maximum for this scale). Figure 37 shows the distribution of IGDS9-SF scores of Sailor gamers. Sailor gamers did not differ from Marines in terms of severity of gaming as assessed by the IGDS9-SF scores (Wilcoxon rank sums test, $Z = 1.49$, $p = 0.137$).

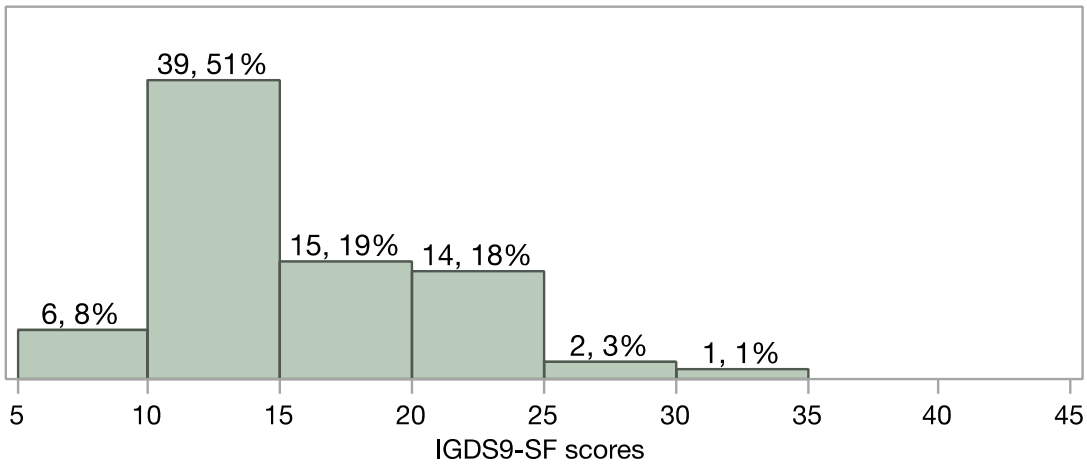

Figure 37. IGDS9-SF scores of Sailor gamers.

We used the IGDS9-SF scores to assess differences between high and low severity Sailor gamers. High and low severity gamers were identified as those that fell within the upper and lower quartile of IGDS9-SF scores. The low severity group included 10 Sailor gamers with IGDS9-SF scores in the first quartile (IGDS9-SF score <11), whereas the high severity group included 19 gamers with an IGDS9-SF score in the fourth quartile (IGDS9-SF score > 18.5). Sailors in the 4th quartile group had higher stress levels as assessed by PSS-4 scores, more severe symptoms of depression (PHQ-8 scores) and generalized anxiety (GAD-7 scores) and felt more lonely (on UCLA loneliness scores). Detailed results are shown in Table 21.

Table 21. Differences between Sailors in the 1st and the 4th quartile group of IGDS9-SF scores.

Variable	1st quartile group	4th quartile group	Unadjusted p-value	Effect size
Age in years, MD (IQR)	24 (12.5)	22 (8)	0.872 [B]	-
Sex (males), # (%)	10 (100%)	17 (89.5%)	0.532 [A]	-
Enlisted, # (%)	10 (100%)	17 (89.5%)	0.532 [A]	-
Having been deployed, # (%)	6 (60.0%)	10 (52.6%)	0.990 [A]	-
Deployment involving combat, # (%)	1 (16.7%)	1 (10.0%)	0.990 [A]	-
Reported daily sleep duration, MD (IQR)				
At home/off duty	7.75 (2.25)	6 (2)	0.230 [C]	-
On duty/in port	5.5 (3.63)	5.5 (2.5)	0.908 [B]	-
When deployed	6.5 (3.5)	5 (2.38)	0.323 [C]	-
Using nicotine products, # (%)	3 (30.0%)	8 (42.1%)	0.694 [A]	-
Drinking caffeinated beverages, # (%)	10 (100%)	16 (84.2%)	0.532 [A]	-
Having an exercise routine, # (%)	9 (90.0%)	15 (79.0%)	0.633 [A]	-
Why playing video games (MOGQ scores)				
Social, MD (IQR)	1.5 (0.63)	2.5 (1.75)	0.014 [B,E]	0.459 [F]
Escape, MD (IQR)	1.75 (1.75)	3.5 (1.5)	< 0.001 [B,E]	0.624 [F]
Competition, MD (IQR)	1.5 (1.56)	3.25 (2.25)	0.007 [B,E]	0.500 [F]
Coping, MD (IQR)	1.88 (1.69)	3.5 (1)	0.002 [B,E]	0.683 [F]
Skill development, MD (IQR)	1.75 (2.1)	3.25 (1.5)	0.018 [B,E]	0.441 [F]
Fantasy, MD (IQR)	1.38 (1.25)	2.25 (2.5)	0.041 [B,E]	0.380 [F]
Recreation, MD (IQR)	3.33 (1.08)	4.67 (1.33)	0.004 [B,E]	0.529 [F]
When playing video games, # (%)				
At home/off duty	8 (80.0%)	18 (94.7%)	0.267 [A]	-
On duty/in port	6 (60.0%)	14 (73.9%)	0.675 [A]	-
When deployed/underway	8 (80.0%)	15 (79.0%)	0.990 [A]	-
Coping styles				
Problem-focused coping styles, MD (IQR)	1.67 (3)	3 (2.33)	0.080 [B,E]	0.325 [F]
Emotion-focused coping styles, MD (IQR)	1.5 (1.45)	2.4 (1.6)	0.066 [B,E]	0.342 [F]
Dysfunctional coping styles, MD (IQR)	0.5 (1.25)	1.67 (0.83)	0.038 [B,E]	0.384 [F]
PSS-4 score, MD (IQR)	6 (4.25)	8 (2)	0.017 [B,E]	0.443 [F]
SWLS score, MD (IQR)	22.5 (10.3)	21 (9)	0.475 [B]	-
PHQ-8 score, MD (IQR)	2 (4.25)	8 (7)	0.002 [B,E]	0.574 [F]
Major depression (10≤PHQ-8<20) , # (%)	0	7 (36.9%)	0.030 [A,E]	N/A
Severe major depression (20≤PHQ-8) , # (%)	0	1 (5.26%)		
GAD-7, MD (IQR)	1 (5.25)	9 (10)	0.001 [B,E]	0.609 [F]
GAD (GAD-7≥10), # (%)	0	7 (36.8%)	0.063 [A,E]	N/A
UCLA loneliness score, MD (IQR)	35 (12)	50 (16)	0.008 [B,E]	0.490 [F]
ESS score, MD (IQR)	6 (7.5)	9 (8)	0.147 [B]	-
Excessive daytime sleepiness (ESS>10), # (%)	2 (20.0%)	7 (36.8%)	0.431 [A]	-
AUDIT-C score, MD (IQR)	1.5 (4.25)	3 (5)	0.591 [B]	-
Suggestive of a problem, # (%) [D]	3 (30.0%)	9 (47.4%)	0.450 [A]	-

[A] Fisher's exact test
[B] Wilcoxon rank sums test
[C] t-test
[D] AUDIT-C score criterion for alcohol problems: ≥4 for males; ≥3 for females
[E] Statistically significant based on the post-hoc BH-FDR controlling procedure
[F] Non-parametric effect size r
[G] Relative risk (95% confidence interval)

We also explored differences in Sailor video gaming habits between the 1st and 4th quartile groups by contrasting when gamers in these two groups reported playing video games. Compared to 40% in the 1st quartile group, approximately 58% of the gamers in the 4th quartile group played video games in all three settings (at home/off duty, on duty/in port, when deployed/underway). Detailed results are shown in Figure 38.

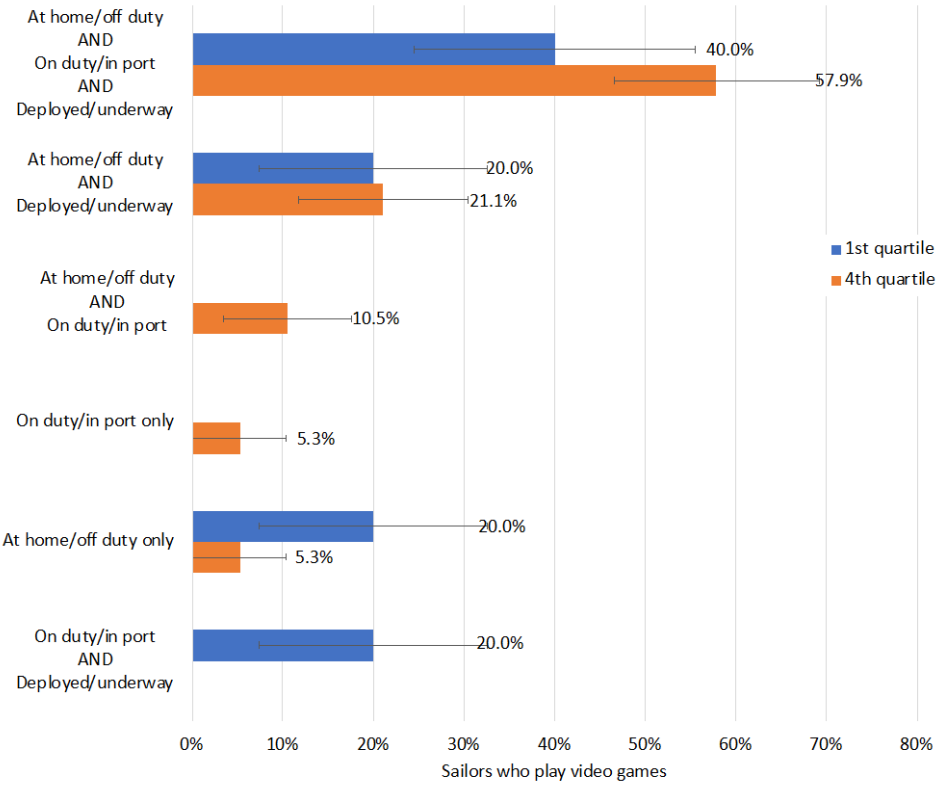

Figure 38. When Sailors play video games by IGDS9-SF score quartiles. Horizontal lines denote the Standard Error for Proportion.

The two severity groups differed only on video gaming at home. Specifically, compared to gamers in the 1st quartile group who play video games two days per week (median duration = 1 hour/day), Sailor gamers in the 4th quartile group played video games six days in a typical week at home/off duty (median duration = 3.5 hours/day). Video gaming frequency or duration did not differ in a typical day on duty/in port or when underway/deployed. These results are shown in Table 22.

Table 22. Differences in frequency and duration of video gaming between the 1st and the 4th quartile groups of IGDS9-SF scores (Sailors).

Variable	1st quartile group	4th quartile group	Unadjusted p-value [A]	Effect size [C]
Number of days playing video games in a typical week, MD (IQR)				
At home/off duty	2 (1.75)	6 (2)	< 0.001 [B]	0.706
When deployed/underway	3 (2.5)	2 (6)	0.817	-
Hours of video gaming, MD (IQR)				
At home/off duty	1 (1)	3.5 (4)	0.005 [B]	0.549
On duty/in port	2 (1.5)	2.25 (2.25)	0.990	-
When deployed/underway	2 (3)	3 (3)	0.369	-

[A] Wilcoxon rank sums test
[B] Statistically significant based on the post-hoc BH-FDR controlling procedure
[C] Non-parametric effect size r

Compared to Sailor gamers in the 1st quartile group (0%), ~24% of gamers in the 4th quartile group reported sleeping later frequently or always when underway or deployed due to playing video games. Detailed results are shown in Figure 39.

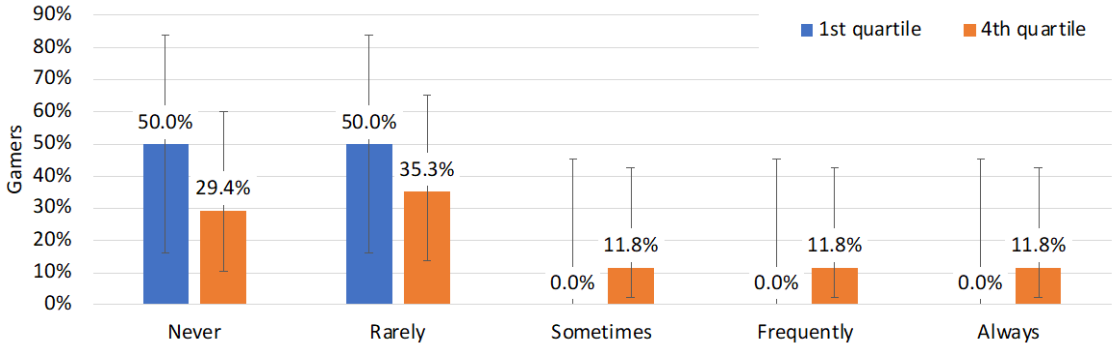

Figure 39. Responses of Sailor gamers to the question "If you play video games before bedtime when underway/deployed, have you ever slept later because you played video games?" Vertical lines denote the Standard Error of Proportion.

6. Prevalence of "disordered" video gamers

We used the two criteria from the video gaming literature to identify disordered gamers. Based on the "5 out of 9" criterion and having an IGDS9-SF score of 36 or more, none of the 78 Sailors who were gamers were classified as "disordered gamers".

We repeated this analysis based on the 3-group classification scheme for gaming severity. For this purpose, we used our IGDS9-SF cut-off score of 30 developed for Marines to identify disordered gamers. Results showed that 1 (1.30%) Sailor was

identified as a disordered gamer, 19 (24.7%) were problematic gamers, and 57 (74.0%) were normal gamers. These results are shown in Figure 40.

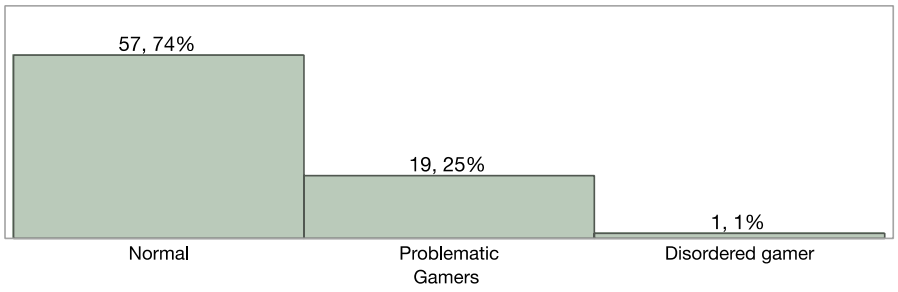

Figure 40. Sailor gamers classified by their video gaming habits.

7. Sailors' video gaming activities before and during the COVID-19 environment

Sailor gamers were asked to compare their video gaming activities before and after the COVID-19 pandemic lockdown began in March 2020. Focusing on gamers, approximately 47% of Sailors reported that their video gaming activities remained the same, 39.4% reported that their video gaming increased somewhat or greatly, and 13.1% reported that their video gaming activities decreased greatly or somewhat. Results did not differ substantively between Sailors and Marines. These results are shown in Figure 41.

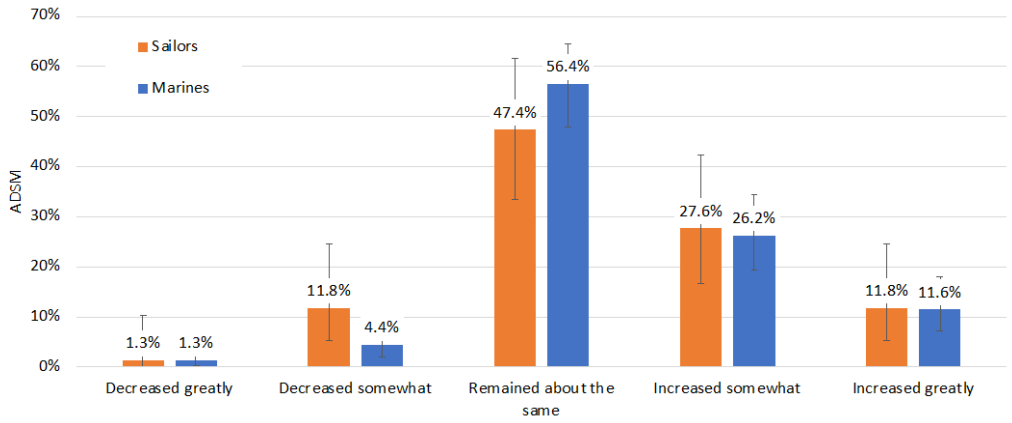

Figure 41. Responses to the question "Compared to your video gaming activities before COVID-19, your video gaming activities in the COVID-19 environment (March 2020 to present) have…". Vertical lines denote the Standard Error for Proportion.

V. CONCLUSIONS

Our study sample included 86 Sailors and 927 Marines (median age of 24 years, 92.4% males, 84.2% enlisted). From the 1,013 ADSMs, 91.6% self-identified as video gamers (median age of 23 years, 94.3% males, 86.1% enlisted). The information provided in the Marine focus groups along with the survey data of both Marines and Sailors suggest that video gaming is highly prevalent in the military. However, our study cannot provide conclusive answers regarding the prevalence of video gaming in the USN and the USMC for two reasons. The first reason is the low participation rate in the survey. The second reason is that females and non-gamers were underrepresented in the study sample. Therefore, future studies should further explore the prevalence of video gaming in the military, the demographic characteristics of gamers, and sex-related differences in video gaming habits.

Also, our data suggest that many service members start playing video games by the age of 7 or 8 years. This finding agrees with other studies of college-age students who report starting gaming at a young age (Phan, Jardina, Hoyle, & Chaparro, 2012). Of note, however, there is an ongoing debate regarding the effects of video games in this age group and the long-term effects on children's psychosocial development (Blumberg et al., 2019; Lobel, Engels, Stone, Burk, & Granic, 2017; Vieira & Krcmar, 2011).

Another question that remains to be answered is whether and how video gaming habits change after individuals join the military. For example, it is unclear what percentage of gamers start playing video games after joining the military or how many service members stop playing video games due to lack of free time or other reasons. Results from a recent study on Norwegian conscripts showed that gaming addiction scores worsened for 17.1% of individuals while serving in the military whereas for 8.3% scores improved (Olsen, Pallesen, & Myrseth, 2021).

Problem-focused and emotion-focused coping styles were more frequently used by both Marines and Sailor gamers than dysfunctional coping styles. From the dysfunctional coping styles category, self-distraction and self-blame were more common. Generally, ADSMs did not report using four coping styles, i.e., turning to religion, denial, behavioral disengagement, and substance use.

Recreation was the most frequently reported motivation for playing video games followed by coping with stress. In general, more ADSMs reported playing video games at home/off duty than when on duty or when underway/deployed. Sailor gamers, however, seem to be more consistent in their video gaming habits, i.e., the percentage of Sailors playing video games at home is 84.9% as compared to 60.5% on duty and 70.9% when deployed/underway. In keeping with results seen in Sailor gamers, 90% of the Marines reported playing video games at home. In contrast to Sailors, though, only 20.6% of the Marines play video games on duty and 36.5% when deployed/underway. Consequently, 51.3% of Sailor gamers play video games in all three settings (i.e., at home, on duty, when underway/deployed) compared to only 12.2% of Marine gamers. However, 50% of Marine gamers reported playing video games only at home compared to only 11.5% of Sailor gamers.

Depending on the setting (at home/off duty, when deployed/underway), gamers reported playing video games on average 3.75 to 6 days in a typical week for approximately 2 to 3 hours per day. The most frequently reported devices used for playing video games were game consoles and smartphones. In general, gamers tend to play video games later in the day (i.e., after work and before bedtime) and depending on the setting (at home/off duty, on duty/in port, underway/deployed) 5% to 18% of gamers sleep later due to video gaming. Most gamers reported playing video games in their racks or the mess decks/common areas when deployed/underway.

Gamers (both Sailors and Marines) reported symptoms of depression (~23% of ADSMs), generalized anxiety disorder (~19%), excessive daytime sleepiness (~33%), and AUDIT-C scores suggestive of heavy drinking (39%). Also, ~32% of gamers reported dissatisfaction with their life. More excessive gamers tended to be younger, used dysfunctional coping styles more frequently, and played video games more frequently and for more hours. Also, more excessive gamers were more likely to report sleeping later because of playing video games, and exhibited more symptoms of major depression, generalized anxiety, and excessive daytime sleepiness.

A. EXPLORING PROBLEMATIC AND DISORDERED GAMING IN THE MILITARY

One of the main goals of our study was to assess the severity of video gaming in the sample of ADSMs and propose a classification scheme that is tailored more closely to the needs of the US military. Our analysis was based on the concept that gaming severity is a continuum with normal gaming at one end of the spectrum and "disordered" gamers at the other. Based on the data from Marines, we developed a classification scheme regarding the video gaming continuum that included three mutually exclusive groups (normal gamers, problematic gamers, and disordered gamers).

In general, "disordered" gamers can be classified based on existing criteria from the video gaming literature. For this reason, we used several different approaches to define disordered gamers. Initially, we focused on two sets of validated criteria from the video gaming literature to identify disordered gamers. The first set of criteria comes from the DSM-5 while the second set of criteria is based on the IGDS9-SF scores. Next, we identified new IGDS9-SF criterion scores for the identification of disordered gamers. The first method led to a criterion score of 31 and was based on ADSM psychological status and health (depression, anxiety, loneliness, stress, and satisfaction with life) and how ADSMs cope with stress. The second method, with a criterion score of 30, included three components, i.e., ADSM psychological status and health, styles of coping with stress, and sleeping later due to video gaming.

The next step was to focus on "problematic" gamers. Our definition of "problematic" gamers included criteria that were operationally relevant. We identified the "problematic" group based on how they manage their spare time, specifically, on whether the service member sleep later due to video gaming. Based on this syllogism, gamers were classified as problematic if they responded that in a typical week at home or on duty or when deployed/underway they sleep later (sometimes, frequently, always) due to video gaming. The "problematic" aspect of such video gaming habits is that ADSMs do not have a healthy and operationally appropriate management of their "free" time. Their video gaming habits directly interfere with their sleep, and indirectly interfere with their operational performance. From an operational perspective, "problematic" gamers fail to recognize the importance of sleep and do not prioritize sleep as a critical component of

optimal operational performance. Conceptually, problematic gaming is based on a more operationally-focused and militarily-oriented definition. Even though mental health is an important factor to consider in problematic video gaming, other effects of video gaming (e.g., on sleep, physical health, and performance) may be equally important in the military.

In brief, the difference between "disordered" and "problematic" groups is that the "disordered" classification is based on three components: psychological status and health, styles of coping with stress, and time management reflected in sleeping later due to video gaming. In contrast, the "problematic" classification is based solely on time management and assumes that gamers do not have issues related to their psychological status/health and styles of coping with stress. An overview of the 3-group classification scheme to group gamers based on their video gaming habits is shown in Figure 42.

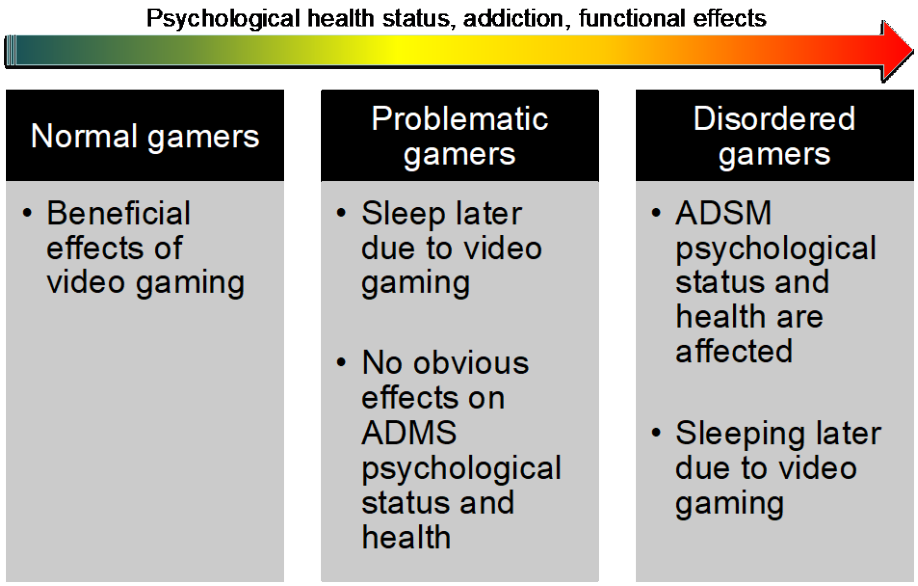

Figure 42. Gaming severity classification scheme.

B. WHY IS THE PREVALENCE OF DISORDERED GAMING NOT HIGHER?

The application of the 3-group model of video gaming severity described earlier led to the conclusion that approximately 50% of Marines and 25% of Sailors who play video games can be identified as "problematic" gamers.

Also, depending on the validated criterion used, the prevalence of disordered gamers in the study samples ranged from 0 to 2.20%. Even with the criteria we developed, the estimated prevalence of disordered gamers ranged between 1.3% and 4.85%. These findings do not differ from the prevalence of addicted gamers in civilian populations, both in the US and worldwide (Desai et al., 2010; Ferguson et al., 2011; Gentile, 2009; Przybylski et al., 2017; Stevens, Dorstyn, Delfabbro, & King, 2021).

Our results suggest that the military profession seems to partially shield individuals from the excessive use of video games. One potential explanation for this finding may be that some of the otherwise negative attributes of military life (long work hours, high levels of stress, high operational tempo) distract ADMS from the deleterious effects of video gaming. Military duties and video gaming battle for the same rare commodity, time. Compared to their civilian peers, the lack of free time may protect some service members from the potentially ill effects of video gaming.

C. THE EFFECT OF COVID-19 ON VIDEO GAMING

COVID-19 seems to have led to higher involvement with video games, a pattern consistent in both Marine and Sailor gamers. Specifically, our results show that 38%-39% of gamers increased their video gaming activities in the COVID-19 environment (March 2020) and thereafter. This phenomenon seems to be more pronounced in more severe gamers. In general, our findings agree with other recent studies that have shown that the COVID-19 pandemic has increased the number of players and online gaming activities (King, Delfabbro, et al., 2020; Nicola et al., 2020).

D. OPERATIONALIZING OUR FINDINGS

If we should summarize the findings and conclusions of our study is that video gaming should be addressed in the military. Given the widespread use of video games, we believe that there is a need for DoD policy focused on two important issues. The first issue is to increase awareness on the positive and negative effects of video gaming on active-duty service members. The second issue is to provide general guidelines for the identification of signs of problematic video gaming. Such a policy, however, can also

address the more general issue of personal technology use (PTU) and its effects on the military operational environment and, more broadly, on ADSMs lives.

E. STUDY LIMITATIONS

In terms of the response rate, the online survey had an average response rate of 7.5% for the online survey from the three USMC units. Even though the response rate in our study was low, it was a bit higher than the response rate of a large-scale survey study conducted in the USMC (6.6%) and the USN (6.7%) (Meadows et al., 2018). These low participation rates suggest that survey fatigue should be addressed in future studies with ADSMs.

On the other hand, the size of the survey did not seem to affect the completion rate. Approximately 90% of the Marines who connected to the online system completed an average of 85% of the survey. Also, only one of the Sailors failed to complete the entire survey in the face-to-face recruitment. These results agree with earlier observations that face-to-face recruitment is better in terms of completion of survey tools, but the tradeoff of this approach is the low number of individuals that can be recruited in this manner.

Our results regarding the prevalence of video gaming in the USN and the USMC should be generalized with caution due to two reasons. First, the low response rate, especially in the USMC commands, makes generalizing the results worrisome. Second, it was obvious from the face-to-face recruiting on the USN ships that more gamers volunteered and were attracted to participating in the study.

The main method to collect data was a survey tool with all the strengths and weaknesses that such a method entails. In particular, our findings cannot be used to determine causal relations between video gaming and the dependent variables of interest (e.g., ADSM state). Also, self-reported estimates of daily sleep duration are known to be affected by multiple factors, and therefore are considered unreliable. Follow-on studies should assess gamers' sleep patterns using more reliable and objective methods rather that self-reports.

Lastly, even though we had an *ad hoc* control group of Marines who were non-gamers which we used compare with gamers, there are two issues of concern. First, the

control group is too small to be considered representative. Second, results from the comparison between gamers and non-gamers should be interpreted with caution because the two groups were not equivalent in terms of age, the ratio of males/females, and the ratio of officer/enlisted personnel.

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VI. RECOMMENDATIONS

- Develop video gaming awareness training for leadership and ADSMs. Specifically, ADSMs should be educated about the potentially negative effects of video gaming as a time waster and sleep "thief", the impact video gaming has on social interactions, and the risk of addiction.
- Conduct a sleep study using objective methods to reliably assess sleep/wake patterns and sleep attributes of gamers (e.g., sleep duration, timing, quality).
- Conduct a follow-on study to validate the current findings and to assess the prevalence of video gaming in the United States Navy and United States Marine Corps. Some of this study could be accomplished by adding a few questions related to video gaming to a more general survey such as the Navy's command climate surveys.
- Even though tools like the IGDS9-SF (Severo et al., 2020) are extensively validated and used by researchers, existing criteria are not tailored for military personnel or for the unique demands of military operational settings. The criteria for "problematic" and "disordered" video gaming need to be further refined and tailored for the military.
- Assess whether and how video gaming behaviors change after individuals join the military.
- Assess the effect of other "time wasters," such as Internet and social media use (Edwards-Stewart et al., 2016). Even though technology use is often a means of relaxing from the stress of military life, the overuse of technologies can perpetuate sleep disturbances by increasing arousal right before bedtime (Troxel et al., 2015). As one of Troxel and colleagues' interviewee noted "*[Servicemembers] have such access now to the Internet, . . . video games, or their music… There are just so many things out there they use to stimulate themselves and try and get their minds off the mission and try and relax. They could do that for hours on end, [and] they end up waking up for the mission exhausted.*"

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APPENDIX A. DETAILED GROUP CHARACTERISTICS

Table 1. Detailed demographic and occupational characteristics by ADSM group and ship/command.

Demographic and occupational characteristics	USMC Commands			USN ships	
	2d CEB (n=62)	2d MAW (n=552)	3d MLG (n=313)	CG-56 (n=58)	CG-71 (n=28)
Age in years, MD (IQR)	26 (12)	24 (9)	23 (7)	25 (9)	21.5 (13.8)
Sex (males), # (%)	58 (93.5%)	515 (93.4%)	283 (89.8%)	56 (96.6%)	24 (85.7%)
Rank group, # (%)					
Enlisted	44 (71.0%)	457 (83.1%)	271 (86.0%)	52 (89.7%)	28 (100%)
E1-E3	7 (11.3%)	155 (28.2%)	96 (30.5%)	18 (31.0%)	11 (39.3%)
E4-E6	32 (51.6%)	256 (46.6%)	150 (47.6%)	31 (53.5%)	15 (53.6%)
E7-E9	5 (8.07%)	46 (8.36%)	25 (7.94%)	3 (5.17%)	2 (7.14%)
Officers	18 (29.0%)	93 (16.9%)	44 (14.0%)	6 (10.3%)	-
CWO	-	10 (1.82%)	4 (1.27%)	1 (1.72%)	-
O1-O3	13 (21.0%)	55 (10.0%)	31 (9.84%)	4 (6.90%)	-
O4-O6	5 (8.07%)	28 (5.09%)	9 (2.86%)	1 (1.72%)	-
MOS, # (%) [A]					
Air	1 (1.64%)	384 (71.0%)	113 (36.6%)	-	-
Ground	26 (42.6%)	90 (16.6%)	84 (27.2%)	-	-
Logistics	34 (55.7%)	67 (12.4%)	112 (36.3%)	-	-
Years in active duty, MD (IQR)	6 (8.25)	4 (6)	3.5 (5)	3.25 (3.75)	1.7 (10.8)
Deployed while in the military (Yes), # (%)	38 (61.3%)	261 (47.5%)	124 (39.4%)	40 (70.0%)	10 (35.7%)
Total months deployed, MD (IQR) [B]	9 (12.3)	10 (15)	9 (13)	9.5 (11.9)	19 (15.5)
Deployment(s) involved combat, # (%) [B]	14 (36.8%)	88 (33.7%)	40 (32.3%)	4 (10.0%)	2 (20.0%)

[A] Only for Marines

[B] Only for ADSM who had been deployed while in the military.

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APPENDIX B. PAIRWISE CORRELATIONS BETWEEN STUDY VARIABLES

We conducted pairwise correlation analysis among demographic, occupational variables, variables of well-being, and coping styles of Marines who reported playing video games. Correlations ranged from -0.56 to 0.80. In terms of magnitude, approximately 66% of the correlations were ≤ 0.20, 21 correlations ≥ 0.5, while only 7 correlations exceeded 0.6.

As assessed by IGDS9-SF scores, higher severity of video gaming was associated with worse MOGQ scores in escapism (higher frequency of using video gaming to escape from reality, rho = 0.54), in coping with stress (higher frequency of using video gaming to cope with stress, rho = 0.49), and competition (rho = 0.40). Also, Marines who scored higher in the severity of video gaming employed more frequently dysfunctional coping styles (rho = 0.36) and less so emotion-focused styles (rho = 0.20). As expected, Marines who frequently employed dysfunctional coping styles scored higher in depression (rho = 0.66), anxiety (rho = 0.65), loneliness (rho = 0.53), and were less satisfied with their life (rho = -0.53). Detailed results are shown in Table 23.

Table 23. Pairwise correlations among study variables

Study variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
(1) Age																							
(2) Sex	0.04																						
(3) Officer or enlisted	**0.42**	-0.04																					
(4) Use nicotine products	**-0.18**	**0.09**	**-0.19**																				
(5) Use caffeinated beverages	**0.10**	-0.01	0.06	0.03																			
(6) Have an exercise routine	0.06	0.07	**0.10**	**-0.09**	0.04																		
(7) IGDS9-SF	-0.11	0.07	-0.04	0.05	-0.08	-0.01																	
(8) MOGQ social	**-0.37**	**0.09**	**-0.30**	**0.09**	**-0.09**	-0.01	**0.34**																
(9) MOGQ escape from reality	**-0.33**	0.04	**-0.24**	**0.10**	**-0.08**	**-0.13**	**0.54**	**0.47**															
(10) MOGQ competition	**-0.29**	**0.13**	**-0.26**	**0.17**	-0.04	-0.02	**0.40**	**0.50**	**0.39**														
(11) MOGQ coping with stress	**-0.25**	0.07	**-0.25**	**0.11**	-0.02	-0.07	**0.49**	**0.52**	**0.71**	**0.51**													
(12) MOGQ skill development	**-0.22**	**0.09**	**-0.22**	**0.11**	-0.05	-0.02	**0.31**	**0.55**	**0.40**	**0.52**	**0.61**												
(13) MOGQ fantasy	**-0.33**	0.03	**-0.14**	**0.07**	**-0.08**	-0.07	**0.34**	**0.45**	**0.70**	**0.31**	**0.55**	**0.42**											
(14) MOGQ recreation	0.02	**0.09**	**-0.07**	-0.01	-0.05	0.01	**0.15**	**0.23**	**0.19**	**0.20**	**0.35**	**0.30**	**0.22**										
(15) PSS-4	-0.04	-0.02	0.05	0.01	-0.01	0.05	**0.14**	0.04	**0.22**	**0.11**	**0.19**	**0.08**	**0.18**	**0.12**									
(16) SWLS	**0.31**	0.02	**0.28**	**-0.11**	0.06	**0.16**	**-0.15**	**-0.16**	**-0.42**	**-0.11**	**-0.22**	-0.02	**-0.30**	0.07	**-0.09**								
(17) Problem-focused coping	**-0.10**	**-0.09**	0.02	0.01	-0.04	**0.08**	0.11	**0.11**	**0.17**	**0.09**	**0.19**	**0.18**	**0.21**	**0.10**	**0.25**	-0.06							
(18) Emotion-focused coping	**-0.19**	-0.07	0.03	0.04	0.01	**0.08**	**0.20**	**0.17**	**0.25**	**0.11**	**0.21**	**0.15**	**0.28**	0.04	**0.23**	-0.06	**0.73**						
(19) Dysfunctional coping	**-0.26**	**-0.08**	**-0.14**	0.07	0.01	-0.07	**0.36**	**0.25**	**0.55**	**0.21**	**0.39**	**0.16**	**0.47**	0.01	**0.31**	**-0.53**	**0.49**	**0.57**					
(20) PHQ-8	**-0.13**	**-0.11**	**-0.12**	0.07	0.01	**-0.14**	**0.36**	**0.12**	**0.42**	**0.09**	**0.22**	0.03	**0.32**	-0.03	**0.25**	**-0.55**	**0.18**	**0.26**	**0.66**				
(21) GAD-7	**-0.09**	**-0.12**	-0.05	0.02	0.05	**-0.12**	**0.33**	**0.11**	**0.39**	**0.11**	**0.25**	0.05	**0.28**	-0.01	**0.27**	**-0.45**	**0.22**	**0.28**	**0.65**	**0.80**			
(22) UCLA loneliness	**-0.12**	**-0.10**	**-0.09**	-0.03	-0.05	**-0.11**	0.14	0.05	**0.35**	0.01	**0.14**	-0.02	**0.28**	**-0.09**	**0.12**	**-0.56**	0.06	**0.11**	**0.53**	**0.58**	**0.54**		
(23) ESS	-0.09	-0.05	**-0.09**	-0.04	-0.02	-0.04	**0.24**	**0.16**	**0.27**	0.13	**0.20**	**0.12**	**0.20**	**0.09**	**0.10**	**-0.16**	0.07	**0.12**	**0.24**	**0.24**	**0.22**	**0.18**	
(24) AUDIT-C	**0.16**	0.06	**0.12**	**0.28**	**0.10**	-0.03	**0.09**	**-0.08**	0.03	-0.02	0.03	**-0.10**	0.01	0.02	**0.11**	**-0.09**	-0.02	0.02	**0.13**	**0.14**	**0.17**	0.05	0.04

Note 1: All pairwise correlations are based on Spearman's rho.

Note 2: Correlations in bold have an unadjusted p-value < 0.05 and are statistically significant based on the post-hoc BH-FDR procedure.

Note 3: Correlations above 0.5 are shown are highlighted in grey color.

APPENDIX C. EXPLORATORY FACTOR ANALYSIS (EFA)

Based on Cattell's scree test, we identified the point at which the data curve flattened out which led to a 3-factor model. All factors had an eigenvalue greater than 1 (Kaiser criterion) (Kaiser, 1960). The three latent factors had eigenvalues of 6.22, 3.33, 1.19. Analysis of factor intercorrelations showed that Factor 2 was correlated with Factor 1 (rho = 0.077, p = 0.032) and 3 (rho = 0.165, p < 0.001).

Factor 1 included 10 components associated with negative aspects of ADSM well-being and psychological health, i.e., depression (PHQ-8 score), anxiety (GAD-8 score), loneliness (UCLA loneliness score), all dysfunctional coping styles of the Brief COPE questionnaire (behavioral disengagement, self-blame, denial, substance use, self-distraction, venting), and the satisfaction with life (SWLS score) inversely scored. Of note, the self-distraction coping style had a loading of greater than 0.30 both in Factors 1 and 2. Conceptually, however, we believe that this component is a better fit to the first factor.

Factor 2 included components of problem- and emotion-focused coping styles, i.e., planning, acceptance, active coping, positive reframing, and humor. Factor 3 included three components of support from Brief COPE, i.e., emotional support, instrumental support, and turning to religion. One component did not have a factor loading of 0.30 or more, i.e., perceived stress (PSS-4 scores). These results are shown in Table 24.

Table 24. EFA loadings for the three first order factors after PROMAX oblique rotation.

Measure	Factor 1	Factor 2	Factor 3	Communalities
Factor 1: Negative aspects of well-being and psychological health				
Depression (PHQ-8)	**0.921**	-0.040	-0.055	0.819
Generalized anxiety (GAD-7)	**0.874**	-0.074	0.051	0.732
Behavioral disengagement (Brief COPE)	**0.732**	-0.140	0.085	0.490
Loneliness	**0.677**	0.093	-0.224	0.507
Self-blame (Brief COPE)	**0.599**	0.277	0.034	0.566
Denial (Brief COPE)	**0.480**	-0.061	0.135	0.235
Substance use (Brief COPE)	**0.441**	0.021	0.010	0.203
Venting (Brief COPE)	**0.402**	0.200	0.293	0.432
Self-distraction (Brief COPE)	**0.362**	**0.442**	0.053	0.470
Satisfaction with life (SWLS)	**-0.636**	-0.047	0.152	0.424
Factor 2: Problem- and emotion-focused coping styles				
Planning (Brief COPE)	-0.017	**0.775**	0.070	0.660
Active coping (Brief COPE)	-0.140	**0.758**	0.009	0.529
Acceptance (Brief COPE)	0.040	**0.744**	-0.001	0.575
Positive reframing (Brief COPE)	-0.038	**0.555**	0.256	0.521
Humor (Brief COPE)	0.199	**0.461**	0.037	0.338
Factor 3: Support				
Seeking emotional support (Brief COPE)	-0.010	0.071	**0.812**	0.729
Seeking instrumental support (Brief COPE)	0.020	0.117	**0.777**	0.709
Turning to religion (Brief COPE)	-0.117	0.158	**0.301**	0.164
Components with factor loading < 0.30				
Perceived stress (PSS-4)	0.215	0.177	0.007	0.106

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