



NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

**AN EXPLORATION OF SLEEP INERTIA AND CREW
REST FACILITIES IN U.S. COAST GUARD
ALERT-DUTY WATCHSTANDER PERFORMANCE**

by

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September 2019

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REPORT DOCUMENTATION PAGE			<i>Form Approved OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE September 2019		3. REPORT TYPE AND DATES COVERED Master's thesis
4. TITLE AND SUBTITLE AN EXPLORATION OF SLEEP INERTIA AND CREW REST FACILITIES IN U.S. COAST GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE				5. FUNDING NUMBERS
6. AUTHOR(S) Brendan A. Blain				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000				8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A				10. SPONSORING / MONITORING AGENCY REPORT NUMBER
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release. Distribution is unlimited.				12b. DISTRIBUTION CODE A
13. ABSTRACT (maximum 200 words) U.S. Coast Guard (USCG) alert-duty pilots are allowed to sleep during their 24-hour rotation, but may be awakened unexpectedly and required to perform complex tasking in a short period of time. Upon waking, these pilots may experience sleep inertia, a state of lowered arousal associated with decreased performance. Factors contributing to sleep inertia include heredity, age, sex, fitness, diet, and sleep history. Evidence suggests there may be viable methods to mitigate sleep inertia, including personal strategies for use by individuals as well as methods for optimizing the sleeping environment. This study investigates the prevalence and severity of sleep inertia among USCG pilots, determines factors that may contribute to the sleep inertia, and discusses the mitigation strategies that pilots have reported using in the past. The results of the study will be used to determine potential areas of improvement in accordance with the best practices of human systems integration.				
14. SUBJECT TERMS sleep inertia, sleep inertia reduction, alert duty standers, watch officers, commanding officers, Coast Guard, aviators, fatigue, safety, system safety, personnel, manpower, health hazards, occupational health, human systems integration, performance, human factors, human factors engineering, high-energy visible light, circadian rhythm, habitability, duty spaces, duty rooms, first responders				15. NUMBER OF PAGES 215
				16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU	

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**AN EXPLORATION OF SLEEP INERTIA AND CREW REST FACILITIES IN
U.S. COAST GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE**

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN HUMAN SYSTEMS INTEGRATION

from the

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ABSTRACT

U.S. Coast Guard (USCG) alert-duty pilots are allowed to sleep during their 24-hour rotation, but may be awakened unexpectedly and required to perform complex tasking in a short period of time. Upon waking, these pilots may experience sleep inertia, a state of lowered arousal associated with decreased performance. Factors contributing to sleep inertia include heredity, age, sex, fitness, diet, and sleep history. Evidence suggests there may be viable methods to mitigate sleep inertia, including personal strategies for use by individuals as well as methods for optimizing the sleeping environment. This study investigates the prevalence and severity of sleep inertia among USCG pilots, determines factors that may contribute to the sleep inertia, and discusses the mitigation strategies that pilots have reported using in the past. The results of the study will be used to determine potential areas of improvement in accordance with the best practices of human systems integration.

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LIST OF ACRONYMS AND ABBREVIATIONS

AC	Aircraft Commander
ALPAT	Alaska Patrol
ASTB	Aviation Selection Test Battery
ASTM	American Society for Testing and Materials
ASVAB	Armed Services Vocation Aptitude Battery
B-0	Bravo Zero Alert Status
BA	Basic Aircrew Member
BAC	Blood-Alcohol Content
CP	Co-pilot
DAG	Defense Acquisition Guidebook
DLS	Dynamic Lighting System
DM	Drop Master
DoD	Department of Defense
FE	Flight Examiner
FM	Flight Mechanic
FW	Fixed-Wing
HARDMAN	Hardware/Manpower Integration (Legacy Term for Navy and USMC HSI Program)
HFE	Human Factors Engineering
HITRON	Helicopter Interdiction Tactical Squadron
HSI	Human Systems Integration
HVAC	Heating Ventilation and Air Conditioning
IMPACTS	Integration, Manpower, Personnel, and Comprehensive Training and Safety (Legacy Term for USAF HSI Program)
IP	Instructor Pilot
IRB	Institutional Review Board
ISS	International Space Station
KSA	Knowledge, Skills and Abilities
MANPRINT	Manpower and Personnel Integration (Legacy Term for U.S. Army HSI Program)
NASA	National Aeronautics and Space Administration
NCR	National Capital Region
NEEMO	Nasa Extreme Environment Mission Operations

NPS	Naval Postgraduate School
NREM	Non-Rapid Eye Movement
NVG	Night Vision Goggle
ODO	Operations Duty Officer
PVT	Psychomotor Vigilance Test
REM	Rapid Eye Movement
RS	Rescue Swimmer
RW	Rotary-Wing
RWAI	Rotary-Wing Air Intercept
SAR	Search and Rescue
SWS	Slow Wave Sleep
USAF	United States Air Force
USCG	United States Coast Guard
USMC	United States Marine Corps
USNORTHCOM	United States Northern Command

EXECUTIVE SUMMARY

United States Coast Guard (USCG) pilots and aircrew maintain a 24-hour readiness across the continental United States, Alaska, and Hawaii. This readiness status is known as Bravo-Zero (B-0), which is a requirement to become airborne (or underway in a vessel) within 30 minutes of being notified of an immediate alert. These alerts could be for any one of the Coast Guard's 11 statutory missions, to include search and rescue (SAR) or law enforcement (LE). As a result of these alerts, there are times when duty crews must make critical decisions and complete important tasks while experiencing sleep inertia, which is a state of physical and cognitive impairment that occurs immediately after awakening (Tassi & Muzet, 2000). The effects that sleep inertia has on USCG pilots may vary with respect to various habitability factors such as napping, repeated nights of poor sleep, lighting, sound, and temperature (Hilditch, Centofanti, Dorrian, & Banks, 2016; Horne, 2004; Kräuchi, Cajochen, Werth, & Wirz-Justice, 2000; Santhi et al., 2013; Tassi et al., 2010). The primary basis for this thesis is to evaluate the habitability of sleeping quarters and subsequent sleep inertia effects from current USCG duty facilities.

This study was separated into two distinct parts in order to gain insights into both sleep inertia experiences of USCG aviators as well as investigating the habitability of the sleeping quarters for these personnel. The first part of this study was a seven-part, 42-question survey that addressed the prevalence, severity, and duration of sleep inertia currently impacting USCG pilots. The survey was sent via email to all 607 USCG aviators currently standing B-0 duty. In addition to basic demographic information, the survey compared the habitability arrangements of USCG pilots while on duty to the same arrangements at their off-duty residence. The survey further captured how these members were affected by sleep inertia while standing duty and how they coped through various mitigation strategies. Last, the survey contained several open-ended questions to capture insights and recommendations in this problem space. For the second part of this study, the research team sampled light, sound, and temperature data in the quarters where B-0 watchstanders typically resided during their duty. Due to time and travel constraints, the

data were collected at the two air stations closest to the Naval Postgraduate School: Air Station Sacramento and Air Station San Francisco.

Analysis from the survey portion of the study showed that sleep inertia may degrade performance among USCG B-0 watchstanders due to its high reported prevalence ($p < .0001$), duration ($p < .0267$), and severity/intensity ($p < .0001$). Respondents ($n = 169$; 27.8% response rate) indicated that the habitability factors of their duty room may explain part of the reasons for sleep inertia while standing B-0 duty. According to their feedback, the overall comfort in their duty space was less than while off duty ($p < .0001$); their overall sleep quality on duty was worse than off duty ($p < .0001$); and the levels of sound, light, and temperature were also further from their ideal than off duty (all $p < .0001$). Nearly 1M data points from the habitability portion of this study corroborated these findings with respect to the sub-optimal light, temperature, and sound conditions in the B-0 sleeping quarters.

Results from this study will be used to inform the USCG and any other organizations that stand similar duties. The findings may inform efforts to optimize the sleeping habits and environmental conditions of watchstanders in order to mitigate the impact of sleep inertia. Based on feedback from the open-ended responses, future research should include a similar study designed for investigating sleep inertia in all aircrew members, instead of only pilots. There are two additional USCG missions which may benefit the same sort of research: Rotary-Wing Air Intercept (RWAI) missions and shipboard deploying units. Both of these mission sets entail fatigue, sleep inertia, and crew endurance issues that should be further investigated.

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ACKNOWLEDGMENTS

Dedicated to

My parents

My wife

My sons

The men and women who bravely guard our coasts

... so others may live

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I. INTRODUCTION

United States Coast Guard (USCG) pilots and aircrew maintain a 24-hour readiness across the continental United States, Alaska, and Hawaii. This readiness status is known as Bravo-Zero (B-0), which is a requirement to become airborne (or underway in a vessel) within 30 minutes of being notified of an immediate alert. These duties are scheduled on a monthly basis and, depending on the size of the unit, are stood an average of one to two times per week. B-0 alerts could be for any one of the Coast Guard's 11 statutory missions, to include search and rescue (SAR) or law enforcement (LE). Because the duty period covers 24 hours, the assigned aircrew are allowed to sleep as needed in designated spaces (e.g., duty bedrooms). For all USCG missions, the requirements to become airborne involve several critical decisions about mission planning, pre-flight checking, starting, taxiing, and flying. However, for B-0 aircrew who may be asleep when the alert comes in, these requirements may be performed while experiencing sleep inertia. Sleep inertia is the groggy period experienced after rousing, manifesting in both physical and cognitive impairment, and lasting up to an hour or more (Tassi & Muzet, 2000).

A. PURPOSE

It is possible that personal sleep habits, as well as environmental factors, influence how well a USCG alert-duty watchstander will react to and perform after an abrupt awakening event, such as a no-notice SAR launch. This study investigates the prevalence, duration, and severity of sleep inertia among USCG pilots; factors contributing to sleep inertia; and mitigation strategies used by pilots. The goal of this thesis is to explore human systems integration (HSI) strategies that could be implemented to improve the performance of USCG aircrew who experience sleep inertia.

B. WATCHSTANDING

1. USCG Alert-Duty Watchstanders

USCG alert-duty aircrew hold to a B-0 alert status in which, under ideal conditions, they are required to become airborne within 30 minutes of being notified, regardless of

whether or not they are sleeping when they receive the call (USCG, 2018). The term “Bravo Zero” suggests that these aircrews could be making critical decisions about the mission, pre-flight checking, starting, taxiing, and flying of their aircraft, not only in harsh weather conditions, but also with a reduction in their cognitive and physiologic performance. Research has shown that individuals standing alert duty, and who also sleep during their duty cycle, will experience the effects of sleep inertia for approximately 30 minutes upon awakening (Bruck & Pisani, 1999). Other studies have shown that these effects could last for an hour or more, depending on various individual and environmental factors (Dement & Vaughan, 1999; T. H. Monk, 1991; Naitoh, Kelly, & Babkoff, 1992; Walker, 2017).

The effects of sleep inertia not only apply to USCG aircrew and first responders, but could also extend to commanders and their staff (e.g., 24-hour commanding officers and operations officers) at USCG SAR stations and onboard U.S. Navy ships while underway (U.S. Navy, 2018). These officers, like SAR crews, are required to make critical decisions during times in which they are impaired due to sleep inertia. Lessening the duration and severity of sleep inertia would significantly reduce the operational risk it causes.

2. Military First Responders

Many military duties require performance immediately upon waking. From the battlefield to the combatant command planning centers, military members need to react quickly and appropriately to counter highly complex and stressful situations. These vital military players could be making decisions during the first three minutes of being abruptly awakened, as noted by the Bruck and Pisani (1999) study, the findings of which support this thesis.

Bruck and Pisani (1999) used 12 subjects to simulate rapid awakening using a smoke detector sound at 75 decibels (dB). Participants were then required to take a computerized decision-making task to quantify their performance capability. Of note, four of the participants were unable to be awakened due to their extremely deep sleep stage when the alarm sounded. Figure 1 provides a graphic display of participants’ performance data against a baseline assessment, with the awakened condition data broken down by sleep

stage (note: the stages of sleep are discussed later in this thesis). In this study, decision performance based off of the 'Fire Chief' program was completed at 3-minute increments for 10 trials. These trials were taken at baseline, after arousal during the REM period and SWS arousal. As these data show, performance is impaired in the awakened conditions versus baseline.

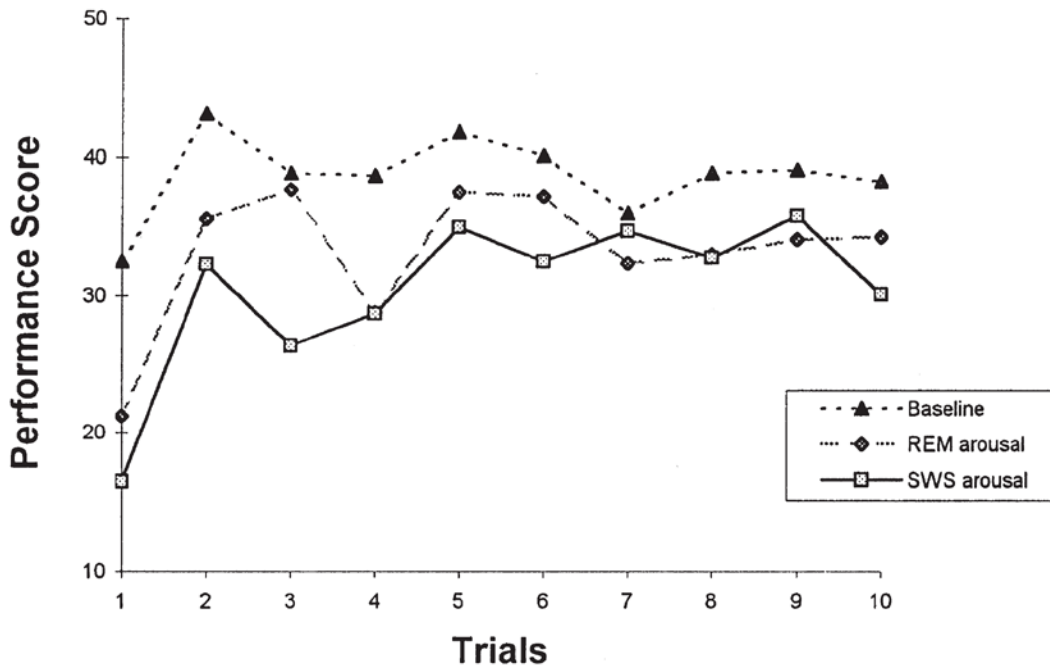


Figure 1. Performance during first three minutes of awakening. Source: Bruck and Pisani (1999).

3. Civilian First Responders

Within the civilian sector, many first responders (especially within the emergency medical field) stand similar duties to those held by B-0 watchstanders, to include day-long shifts or even shifts that stretch over several days. Depending on their rest/endurance protocol, these first responders may or may not be able to catch up on sleep while at their workplace. If they are allowed to sleep, once awakened, these first responders are susceptible to the same type of impairment as their military counterparts. The risk involved in their occupations is comparable.

In many cases, emergency response professionals are required to make split-second life-or-death decisions. As with military personnel, the operational environment of first responders can be characterized as harmful or dangerous if protocol or safety precautions and procedures are not followed. Several studies allude to these factors (e.g., El Sayed, Kue, McNeil, & Dyer [2011]; Reichard, Marsh, & Moore [2011]), making emergency medical providers and first responders some of the most hazardous occupations. Indeed, Page (2001) estimated the fatality rate per 100,000 full-time equivalent workers to be 4.0 for workers in general, 6.0 for firefighters, and up to 7.0 per 100,000 for emergency medical personnel; in addition, personnel whose jobs exposed them to harmful substances were found to have a substantially higher injury rates than workers in other fields (Page, 2011).

C. HUMAN SYSTEMS INTEGRATION

1. Background and History

HSI as we know it today throughout the Department of Defense (DoD) and the USCG had its earliest beginnings in 1986 (Booher, 2003). The U.S. Army was the first organization of its kind and size to implement the HSI approach through the development of systems to prevent such human-system related catastrophes, such as Three Mile Island in the United States, Bhopal in India, and Chernobyl in the USSR (Booher, 2003). The Army originally termed this program Manpower and Personnel Integration (MANPRINT); however, it is currently simply known as HSI (U.S. Army, 2018). At its inception, it was an extremely broad program with several domains: manpower, personnel, training, human factors engineering, system safety, and health hazards. Because of the numerous fratricide incidents that occurred during the first Gulf War, the domain of soldier survivability was also added (Booher, 2003). Survivability is a key domain within any military HSI program as it not only reduces the probability of detection but also enhances personnel and system resilience and survivability if attacked. The HSI method assists in system acquisition and procurement to shift away from the old methods of designing and developing “equipment only” to the new idea of a “total system” view.

DOD Instruction 5000.02 specifically directs the Defense Acquisition System. Enclosure 7 of that instruction describes the use of HSI within the DOD acquisition system. This instruction states:

Program manager[s] will plan for and implement HSI beginning early in the acquisition process and throughout the product life cycle. The goal will be to optimize total system performance and total ownership costs, while ensuring that the system is designed, operated, and maintained to effectively provide the user with the ability to complete their mission. (Department of Defense, 2017, p. 124)

The most important part of the HSI process, as the previous quote mentions, occurs at the beginning of the acquisition lifecycle. HSI personnel are most effective when they are able to include domain recommendations into the system requirements document.

Just as the Army transitioned to the term “HSI,” other military branches also evolved in the same manner. The Navy and Marine Corps’ equivalent was named Hardware/Manpower Integration (HARDMAN), and the Air Force established Integrated, Manpower, Personnel, and Comprehensive Training and Safety (IMPACTS), both of which are now known as HSI (Clark & Goulder, 2002). The USCG established its HSI technical authority in 2007, and it is currently located within the office of HSI (CG-1B3) at USCG headquarters (Novak et al., 2010). The USCG and Department of Homeland Security (DHS) significantly restructured their acquisition program to include CG-1B3 and other offices sharing similarities with the DoD, in large part due to mismanagement of the Integrated Deepwater Program (Merle & Hsu, 2006).

HSI is not a singular action within the design and acquisition of a system. Instead, HSI is a conglomerate of domains and interdisciplinary approaches designed to support the integration of that system to the various needs of the human operator. By identifying the trade-offs achieved by each domain, the total system may be optimized. HSI may be used in both materiel and non-materiel-based systems. Each service supports the HSI domains that are most pertinent to its mission set. The USCG for example, uses four domains with several subcategories within each: Performance and Training; System Safety; Human Factors Engineering; and Manpower and Personnel (USCG, n.d.). For the purposes of this thesis, the U.S. Navy-identified HSI domains will be used: Manpower, Personnel,

Training, Human Factors Engineering (HFE), Human Survivability, Health Hazards, and System Safety and Habitability (Naval Postgraduate School, 2015).

With the HSI practices and theory as the backbone of the study, this thesis examines the ability to assist future alert-duty watchstanders regardless of whether they are USCG aviators or civilian first responders. It explores effects and possible solutions to issues in the following HSI domains: HFE, health hazards and system safety, personnel, and even habitability.

2. Human Factors Engineering Domain

HFE assists with the optimization of a system through its design and interactions with its occupant and/or operator (Naval Postgraduate School, 2015). This thesis investigates an issue that has not been addressed directly thus far: the evaluation of the effects of sleep inertia on USCG aviators who stand B-0 alert-duty. All alert-duty watchstanders have a significant role to play within our society and maintain the ultimate responsibility of operating a complex machine safely, oftentimes in a demanding environment. On top of operating under extreme conditions, pilots and crew often operate while impaired due to sleep inertia. This thesis seeks to provide appropriate data for actual solutions and follow-on studies for system development and management. In doing so, this thesis directly supports the HFE and ergonomics HSI domain (Booher, 2003).

An excellent example of HFE and HSI in practice was the Army's RAH-66 Comanche helicopter. This aircraft was planned and procured from the ground up, with all domains of HSI predicated every aspect of its design. This system, centering completely around the human and the human-machine interface, was able to increase overall performance by significantly reducing pilot workload, thereby allowing the pilot to solely focus on the mission at hand, and not necessarily flying the aircraft (Booher, 2003, p. 664). It is the opinion of this researcher that some of the most significant HSI-related improvements to this system were reducing maintenance per flight hour down to only 2.6 hrs (vice five or more hours for currently flown aircraft) and only requiring 12 unique user-level tools to complete this maintenance (Garamone, 1998; Sikorsky Aircraft, 2014). The Comanche epitomized HSI in this very way. HFE is not about simply integrating the

operator inside the weapon system; it is about integrating any other human that interacts with the system for maintenance reasons or within the supply chain.

3. Health Hazards and System Safety Domains

Ensuring a system is compliant with health hazard and system-safety domain best practices, the system must be operated and maintained in such a way as to not endanger or harm the system itself or the personnel who operate and maintain it (Naval Postgraduate School, 2015). In order to eliminate human error, the health hazards and system-safety domains play a strong role in the early phases of system development (Booher, 2003). The study of the effects of sleep inertia and possible treatments to reduce sleep inertia will assist, perhaps, in realizing the “why” in many situations when it comes to human error, especially with mishaps. An alert-duty watchstander with a poor sleep schedule who stands a watch that may involve abrupt early-morning awakenings could have catastrophic consequences. The USCG identifies the hours of 3:00 AM to sunrise as the “red zone,” due to the heightened risk during reverse cycle operations (USCG, 2018). During the red zone phase, the circadian cycle (the natural process that regulates sleep, which is discussed in Chapter II), crew endurance, response time, and decision-making are at higher risk of severe and adverse impacts. The red zone idea was developed after several high-visibility mishaps occurred during or close to these hours, including Three Mile Island (4:37 AM), *Exxon Valdez* (12:04 AM), Chernobyl (1:23 AM), and USS *Roosevelt* and USS *Leyte Gulf* collisions (2:52 AM). This thesis aims to assist the USCG and other organizations that stand similar duties in fatigue management, by finding viable countermeasures or habitability improvements to reduce sleep inertia during abrupt awakenings, thereby supporting the health hazards and system safety domains.

4. Personnel Domain

The personnel domain are the “faces” of those who operate the system, whereas the manpower domain deals with the “spaces” filled by operators and support personnel. Specifically, the personnel domain directly applies to the selection process, and identifying operators and support staff who maintain the necessary knowledge, skills, and abilities (KSA) (Naval Postgraduate School, 2015). The idea of managing duty schedules to enable

a military member or civilian employee to be in the best possible state to perform their job is also at the heart of the personnel domain (Booher, 2003). The personnel domain is responsible for ensuring that the proper motivation, as well as performance measurement and evaluation measures, are in place. Not allowing a person in an organization to perform at the best level they can impacts this domain negatively and is one of the many avenues for improvement this study investigates.

Excellent examples of the personnel domain in action is the Armed Services Vocation Aptitude Battery (ASVAB) or the Aviation Selection Test Battery (ASTB). The ASVAB is a highly reliable and valid battery of tests that not only assesses whether or not a candidate is eligible for the Armed Forces but also indicates which occupation within the service the applicant will be most effective (Talboy, 2011). The ASVAB tests for arithmetic reasoning, mathematics knowledge, and paragraph and word comprehension (Talboy, 2011). The ASTB, on the other hand, is a battery of tests containing seven subparts that screens prospective Navy, Marine Corps, and Coast Guard aviators as part of the overall selection process into flight training (U.S. Navy, n.d.).

5. Habitability Domain

The habitability domain within HSI pertains to the attributes of the physical living spaces and support facilities of a system (Naval Postgraduate School, 2015). Typically, this domain is used when the system is occupied by human operators. For instance, the habitability domain entails design constraints restricting the amount of noise, temperature, light, and vibration operators may be exposed to when using the system (F25 Committee, 2013). This domain may apply to ships and shoreside facilities. Service members and first responders answering the call to assist in global and domestic crises may be disoriented and need time to fully awaken before they can react appropriately immediately after awakening from a deep sleep. Creating a space that seeks to assist in these kinds of situations supports the HSI domain known as habitability. As defined by the *Defense Acquisition Guidebook* (DAG), habitability within a system's design is "the consideration of the characteristics of systems focused on satisfying personnel needs that are dependent

upon physical environments, such as berthing and hygiene” (Department of Defense, 2018, sec. 5-4.2.7.1).

The National Aeronautics and Space Administration (NASA) is intimately familiar and concerned with research in the area of habitability. Since the mid-20th century, NASA has been concerned with the habitability domain and not only keeping astronauts alive for long-duration space missions, but also comfortable (Fraser, 1968). NASA continues its habitability research through their extreme environment mission operations (NEEMO) studies, while their undersea laboratory located on the Atlantic Ocean floor (appropriately named *Aquarius*) is manned for several days (Loff, 2015). NASA is currently conducting habitability research for future Moon exploration missions.

For the purposes of this study, ASTM international, as well as the National Sleep Foundation’s recommendations for sleeping environments, will be used. These entities give recommended parameters for designing habitable sleep spaces in both land and marine systems and facilities.

D. RESEARCH QUESTIONS

To effectively scope this thesis, the following research questions are addressed:

- What is the prevalence, severity, and duration of sleep inertia among USCG pilots standing B-0 duty?
- What practices and techniques are currently being used by USCG pilots standing B-0 duty in order to mitigate the effects of sleep inertia?
- What changes can be made in the spaces at an air station where pilots and crew stand duty, to minimize the prevalence, severity, and/or duration of sleep inertia?

E. HYPOTHESES

Based on the research questions above and the null hypothesis (H_o) being there is not a difference between off-duty and on-duty sleep inertia factors, the alternate hypotheses (H_a) for this study are the following:

1. Overall sleep comfort will be rated closer to the ideal (i.e., rated higher) off-duty, than on-duty.
2. Overall sleep quality will be rated closer to the ideal (i.e., rated higher) off-duty, than on-duty.
3. Noise levels will be rated closer to the ideal (i.e., rated higher) off-duty, than on duty.
4. Lighting quality will be rated closer to the ideal (i.e., rated higher) off-duty, than on-duty.
5. Temperature quality will be rated closer to the ideal (i.e., rated higher) off-duty, than on-duty.
6. Sleep inertia will affect B-0 watchstanders for a greater duration on-duty, than off-duty.
7. Sleep inertia will affect B-0 watchstanders with a greater prevalence on-duty, than off-duty.
8. Sleep inertia will affect B-0 watchstanders with a greater intensity on-duty, than off duty.

F. ORGANIZATION OF STUDY AND THESIS OUTLINE

This thesis is structured into six chapters. The current chapter provides a brief introduction into the problems that are addressed in the thesis, the research questions that we attempt to answer, and a brief overview of HSI. This chapter also provides the reader with background information pertinent to this study, not only to USCG alert-duty watchstanders but also to those adhering to similar standards within other branches of the military and the civilian sector. Chapter II provides an in-depth exploration of the literature in the fields of sleep, sleep inertia, the measures and effects of sleep on humans, and mitigating strategies. Chapter III gives an overview of the participants, research design,

procedures, and tools used within this study. Chapter IV presents the results of this study. Chapter V discusses the major findings as they relate back to the original research questions and HSI areas of focus. Last, Chapter VI provides conclusions that may be inferred from the results of this study as well as recommendations for possible organizational change and future research.

G. CHAPTER SUMMARY

This chapter highlights the importance of a total systems approach and the benefits of HSI in the acquisition of a new system or improvement of an existing one. This chapter also identifies and emphasizes the importance of several HSI domains, including the habitability domain, as they relate to first responders and duty watchstanders in the USCG, other branches of the military, and in the civilian sector combatting sleep inertia.

The study aims to contribute to both the success of our military as well as civilian first responders within the HFE, health hazards and system safety, personnel, and habitability HSI domains. Planning and preparation spaces, as well as those that are utilized for transitioning from sleep areas to operational postings (ladder wells, hallways, etc.), could also be engineered/re-engineered and improved to lessen the effects of sleep inertia. Upgrading the spaces that pilots and first responders occupy when on duty could, in turn, translate to quicker responses, better time-critical decisions, more lives saved, and less risk of mishaps or hazards.

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II. LITERATURE REVIEW

A. SLEEP AND SLEEP PERFORMANCE

Sleep is essential for humans to function. This chapter provides background information on the science of sleep, reviews some of the issues that could arise from poor sleeping habits, and discusses several currently used and theorized mitigating strategies to increase performance through proper sleep application.

1. Sleep Architecture and Benefits

The term “circadian rhythm” was coined by Franz Halberg, a pioneer biological researcher for the University of Minnesota (Dement & Vaughan, 1999, p.77). The term “circadian” comes from the Latin *circa*, which means “near” or “close to,” and *dias*, meaning “days.” To all living organisms on our planet, the circadian rhythm is much more important than just sleep. The circadian rhythm has been shown to manage several other functions, in many cases on the molecular level, to include gene expression and protein translation, both of which are essential for life to occur (Wulund & Reddy, 2015). Contrary to popular belief, the circadian rhythm does not just synchronize in a 24-hour cycle. Instead, the circadian rhythm may affect the physiology of humans from a period as short as seconds to as long as months in the case of seasonal effects (Wulund & Reddy, 2015).

The human sleep cycle may be separated into two rapid eye movement (REM) and non-REM (NREM) sleep (Monk, 1991). REM sleep is characterized by the presence of rapid eye movements (REMs), whereas during NREM sleep, these movements do not occur (Reber, Allen, & Reber, 2009). During the REM sleep stage, humans also exhibit a loss of muscle tone and appear to be sleeping lighter according to electroencephalogram (EEG) outputs (Monk, 1991). REM sleep is also the stage of sleep in which the most vivid dreams occur.

NREM sleep, on the other hand, is divided into four stages (Monk, 1991). The first stage in NREM sleep is the lightest, whereas stage 4 is where humans experience the deepest form of sleep. Stages 3 and 4 are often referred to as delta or slow-wave sleep (SWS). These stages of sleep, studies suggest, are to be the most therapeutic to the human

body (Walker, 2017). For example, studies have correlated instances of participants with psychological and mood disorders as having less time in SWS stages than their counterparts without these disorders (Monk, 1991). Figure 2 depicts the average time spent within the various stages of sleep throughout a standard eight-hour sleep event.

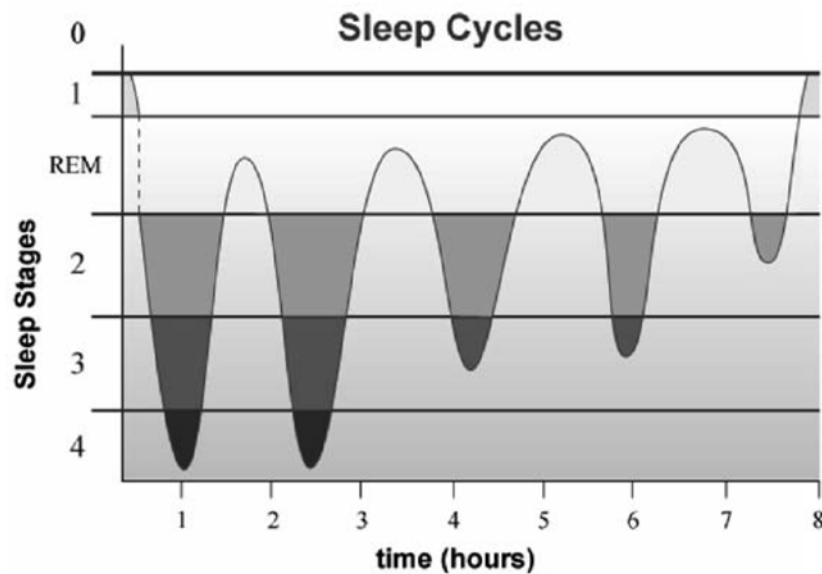


Figure 2. Sleep stages during a typical eight-hour nocturnal sleep event. Source: Miller, Matsangas, and Shattuck (2007).

The amount of sleep a living creature needs is predicated by several different physiological and behavior requirements (Walker, 2017). Numerous studies have suggested that the ideal duration a person should sleep is around eight hours.

As humans, our sleep patterns change as we age. While still in the womb at the end of the second trimester of pregnancy (approximately 23 weeks), a fetus has developed enough of the neural structures needed to be able to achieve both REM and NREM sleep (Walker, 2017). As a baby and a small child, the circadian rhythm is still being developed and refined. Because the circadian rhythm of this child is still developing, it may take several months for a baby to begin to sleep through the night and years for small children to grow out of taking naps. The proportion of REM and NREM sleep during early phases of child development also changes. As the child gets older and the hours of sleep decreases,

so does the duration they remain in the REM stage of sleep (Walker, 2017). Figure 3 is a pictorial representation of the sleep patterns from infancy until adulthood, as described in this section.

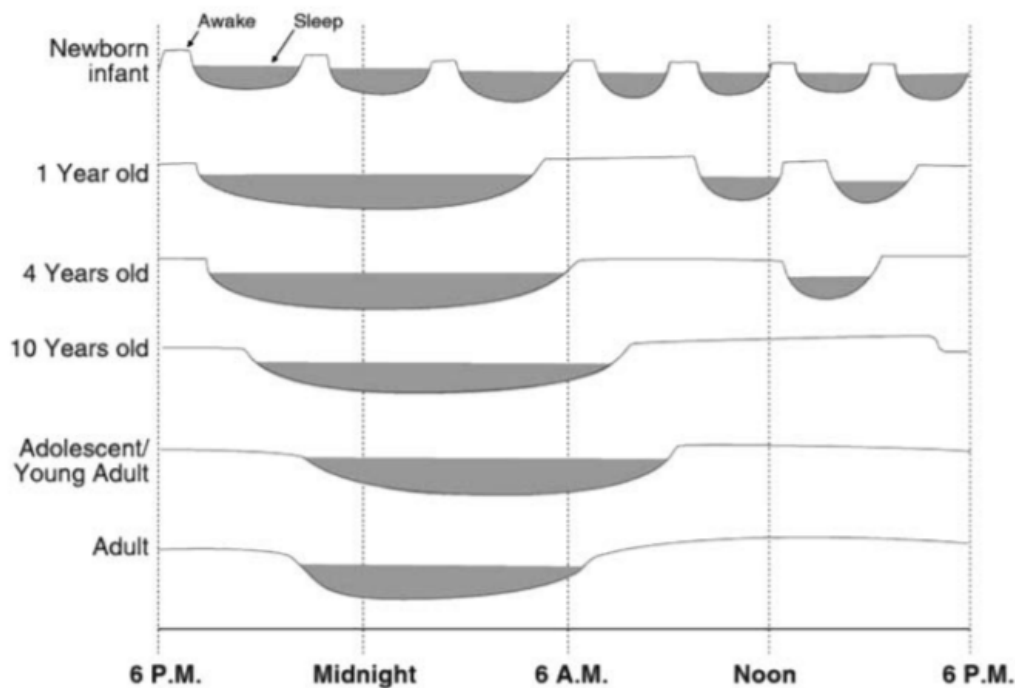


Figure 3. Sleep patterns over a lifespan. Source: Miller et al. (2007).

During the teenage and adolescent years, humans typically tend to sleep more than when they are adults. The reason behind this is that the brain is continually developing, and studies have shown that SWS could very well be the reason for this behavior (Walker, 2017). Some studies have even suggested that teens need as much sleep as small children (Dement & Vaughan, 1999). As we shift from adult and into later adult life, the proportion of REM and NREM sleep continues to change. This time, however, the NREM portion of sleep decreases as REM increases. Sleep also tends to degrade in the later years of life, due to other factors such as medication use, illness, disease, and a weakened bladder (Walker, 2017).

2. Sleep Debt

Contrary to popular belief, as humans, we cannot “bank” sleep and store extra hours of sleep for use later. “Sleep debt” and “sleep deficit” describe the cumulative hours of sleep that is lost when sleeping less than eight hours per night (Horne, 2014). Several studies have suggested that long-term adverse effects such as mood disorders and cardiovascular problems later in life occur due to this sleep indebtedness, often resulting from non-circadian-based work schedules. These types of atypical sleep schedules may be seen among military members and civilian first responders alike, as previously discussed (Shattuck et al., 2016). The long-term adverse effects are often shown later in life. In studies involving shift workers, the damage that occurs later in life may be linked to the years of interrupted and poorly scheduled sleep, an outcome known as “circadian scarring” (Monk et al., 2013). Monk et al. suggested that individuals with as little as one to seven years of sleep debt while abiding by shift work style schedules displayed signs of long-term sleep problems. Other studies have suggested that sleep debt, mainly from shift-work-type schedules, can result not only in immediate performance degradation but also have damaging physical impacts. The death rate in this population is seen to be higher as well as the occurrence of cardiovascular disease, digestive disorders and ulcers, and numerous psychological and mood disorders (Waterhouse, Folkard, & Minors, 1992).

3. Sleep Inertia

Sleep inertia is the primary reason that we often feel groggy or sleepy in the morning. The extent and duration of performance degradation depend significantly upon which stage of sleep someone awakens. Abruptly awakening during Stage 1, 2, or REM sleep produces much less sleep inertia than if awakened during SWS (Tassi & Muzet, 2000). Tassi and Muzet documented results from abrupt awakenings and sleep inertia, and prescribed mitigation techniques to expedite and increase an individual’s performance recovery. As was depicted in Figure 2, the typical eight-hour sleep cycle has several peaks and valleys, with the deeper valleys corresponding to deeper sleep stages that occur earlier in the night. The deeper the sleep, the harder it will be for a person to awaken from that stage of sleep, and the more significant sleep inertia will be.

A technique to reduce sleep inertia has been proposed through technology such as the Wake IQ smartphone application (Van Devender & Shang, 2013). Van Devender and Shang displayed how something as simple as a smartphone application can allow a user to set their alarm to potentially mitigate sleep inertia, ensuring awakening occurs during a lighter stage of sleep where the effects of sleep inertia are lower. The idea of using technology to decrease sleep inertia may come with several benefits; however, alert-duty watchstanders cannot necessarily choose when they wake up, especially for short-notice or no-notice mission requirements.

Sleep inertia imposes most of its effects within the cognitive domains (Scheer, Shea, Hilton, & Shea, 2008). Supporting the Tassi and Muzet study of the severity of sleep inertia during SWS. Scheer et al., found statistically significant effects of sleep inertia within the various levels of cognitive performance. Their findings suggested that the cognitive performance of participants was impaired by almost three-fold when awakened from the hours between 11:00 PM (2300) and 3:00 AM (0330) than the baseline taken during the hours of 3:00 PM (1500) and 7:00 PM (1900). Their study reported no differences between performance results and stage of sleep in which the participant was awakened; and these findings could greatly assist those within the target professions noted in this thesis, such as USCG watchstanders, firefighters, and other on-call medical and technical occupations.

Apart from identifying the effects of sleep inertia, very few studies attempt to mitigate sleep inertia and its impact. Hilditch, Centofanti, Dorrian, and Banks (2016) utilize naps versus deep sleep to minimize sleep inertia. Although perpetual napping during an at-sea deployment or throughout a 24-hour duty shift may not be feasible, Hilditch et al. offered many insights into sleep inertia. The researchers not only studied the effects of sleep inertia resulting from 10-minute and 30-minute napping periods versus a no-nap control, but also accounted for variations on time of day. They concluded that sleep inertia is more prevalent after 30-minute napping periods due to the participant actively entering SWS, while almost no performance change is observed after a 10-minute nap in the control group. This study also emphasized taking the psychomotor vigilance test (PVT) every few minutes (as opposed to once) from the time the participant has awakened to 47 minutes

afterward to ensure the effects of sleep inertia have subsided. Concerning alert-duty watchstanders, first responders, and military command staff members, the Hilditch et al. study is significant in that it identifies some mitigating strategies for sleep inertia; however, it does not offer ways for reducing sleep inertia after being abruptly awoken.

Performance impairment from sleep inertia occurs immediately after awakening, and the effects tend to be detrimental when awakening from the deepest part of the sleep cycle. Bruck and Pisani (1999) researched decision-making performance after subjects experienced sleep inertia. Their findings suggest that sleep inertia reduces decision-making performance for at least 30 minutes upon awakening, and that decision-making was most affected within three minutes after being abruptly awakened. Bruck and Pisani also noted that sleep inertia impacted decision-making more consistently following deep-sleep or SWS versus during REM. Their research alludes to the effects of sleep inertia during first-responder– and reactionary-type incidents. The participants were awakened abruptly by a 75-dB alarm versus gradually, in order to replicate a reactionary response as seen in many first responders. These studies, however, do not provide a countermeasure to assist in decreasing sleep inertia when a subject is awakened during an SWS episode.

B. FATIGUE

Poor sleep habits in adulthood may result in poor performance and dire consequences. This section focuses on some mishaps and issues that may arise from those who experience inadequate rest and are in a high-tempo operational environment. Operating in such a demanding environment is something shift workers, aviation personnel—including USCG duty-standers—and shipboard personnel do every day. The results in Figure 4 suggest that being fatigued is similar to being intoxicated according to one’s blood alcohol content (BAC) (Lamond & Dawson, 1999). Just as we would not want to have intoxicated on-duty ship captains, aviators, or nuclear-power plant engineers, based on these data we should also require those same individuals have adequate rest to complete their duties (less than 19 hours of wakefulness or the equivalent of approximately .08 BAC).

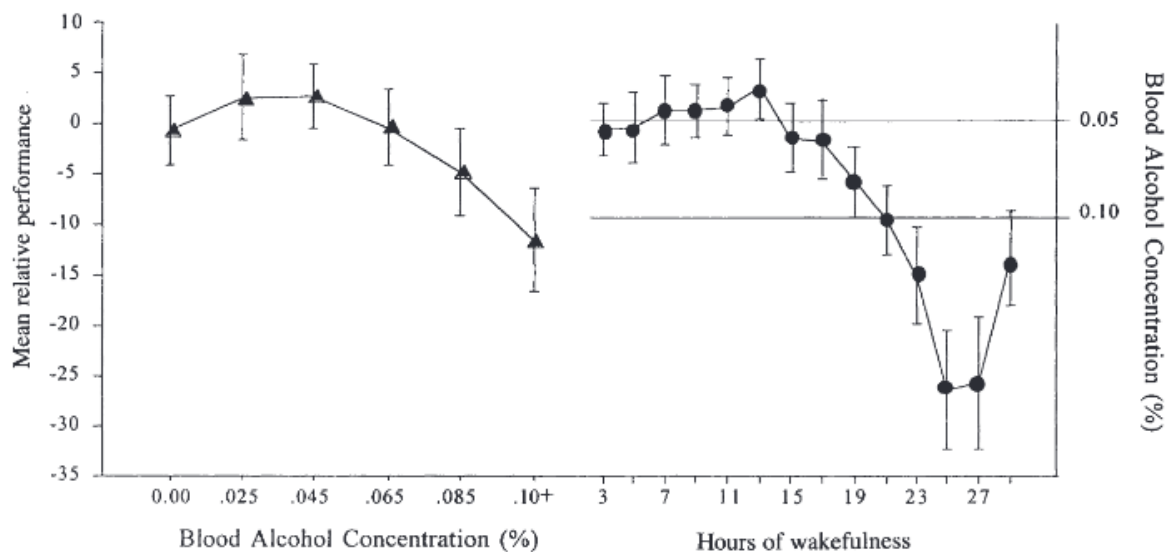


Figure 4. Results of mean relative performance levels for grammatical reasoning task compared to hours of wakefulness and BAC. Source: Lamond and Dawson (1999).

1. Fatigue in the Operational Environment

The U.S. military routinely operates under strenuous conditions, including repeatedly working long days where sleep suffers and fatigue often results. The detrimental effects of fatigue in these high-tempo operational environments may be seen in many recent events. Fatigue in aviation has been extensively studied and researched by the industry in the past several decades in both short-haul and long-haul commercial flights. Due to the confined spaces and restrictions of operating in such an environment, mitigating strategies can be limited. “Strategic napping” is one of the methods in which fixed-wing (FW) aviators currently use to mitigate fatigue and increase performance during their flights and where flights cross several time zones (Rosekind et al., 1994). Strategic naps while in an aircraft are limited to a short duration, and further remind us of the 2016 Hilditch et al. study in which fewer detrimental effects were realized with short naps (10 minutes) versus longer naps (at least 30 minutes). The USCG allows pilots to nap in their fixed-wing aircraft, “limited to 40 minutes, and all crewmembers shall be awakened one hour before an anticipated high-workload event” (USCG, 2018, pp. 4–5).

In many cases, lessons learned from operating fatigued in the operational environment are written in blood. In 2017, the destroyers USS *Fitzgerald* and USS *McCain* collided with merchant vessels in the busy shipping lanes off the coast of Asia in June and August, respectively, killing 17 sailors in all and injuring numerous more. As a direct result of these unfortunate incidents, the U.S. Navy is currently researching stress and fatigue countermeasures onboard ships in the form of crew manning and manpower as well as watch schedule adjustments (Stashwick, 2017). Looking toward the future, these reforms, among others, are projected to give crewmembers considerably more and higher-quality sleep, while also decreasing fatigue during operations, resulting in increased performance.

2. Sleep Inertia and Fatigue Mitigation Strategies

Individuals may use several mitigating strategies to reduce the effects of sleep inertia upon awakening. These include the use of light, sound, caffeine, strategic napping, and the application of water and cold compresses. Some new studies even suggest olfactory stimuli could assist in the awakening process. The following sections review these strategies.

a. Light as a Mitigation Strategy

One potential solution to sleep inertia based on the literature could be light exposure. Light exposure is a significant contributor to wakefulness and assists the circadian rhythm to become readjusted (Dinges, 2010; Young et al., 2015). The human circadian rhythm is exceptionally susceptible to light exposure and the phase, intensity, duration, and spectral characteristics of this light exposure can rapidly change the human biological (or internal) clock (Duffy & Wright, 2005).

NASA takes a particular interest in the interaction of light and circadian rhythms and its effect on humans. Astronauts operating on long-duration space missions such as the International Space Station (ISS) experience a lack of sunlight cycles that they would otherwise experience on Earth (National Aeronautics and Space Administration [NASA], 2018). NASA has since developed a lighting system that can be used in space as well as on Earth. This Dynamic Lighting System (DLS) can assist astronauts in adjusting to space when actual sunlight diurnal cycles do not exist, as well as:

- regulate sleep cycles
- improve sleep quality
- assist in the treatment of sleep disorders, including jet lag, and other non-24-hour sleep/wake issues
- improve worker efficiency on late-shift work (NASA, 2018)

An interesting effect of this system, which could have an impact on alert-duty watchstanders and those who need to perform optimally immediately upon awakening, is its ability to be manually adjusted to any user.

Duffy and Wright (2005) discuss the significance of the characteristics of light needed to allow a human to adjust to a 24-hour day. Their study also recognizes an essential failure of any sleep study: in many cases, it is difficult to truly study a human circadian rhythm (sleep inertia included) because the research must take place in a highly controlled environment, such as a sleep lab, using comprehensive measurement techniques. They discuss the various techniques used to attempt to entrain a human to a non-24-hour day and note some of the sleep disorder effects of those who cannot naturally reach entrainment. This entrainment is the matching of one's natural sleep pattern into their day. In addition to mentioning sleep disorders resulting from the inability of a person to entrain themselves based on light exposure, the study suggests that in most cases only a small amount (around 12 illumination units) of light could have profound impacts on the human circadian rhythm (Duffy & Wright, 2005).

Several other sleep studies have been conducted that view the role light plays with sleep inertia. The Santhi et al. (2013) study used both white light and blue light to measure cognitive effects from sleep inertia after their participants slept for roughly eight hours during their regular sleep time. The study used the PVT in addition to other measures to evaluate the participants' alertness, attention, and working memory. Although white light provided for a tendency to reduce the effects of sleep inertia upon awakening, there were no effects when the blue light was used. The results of their research continue to contribute to the overall research of sleep inertia; however, it should be noted that the participants

were awakened after eight hours of restful sleep as opposed to awakening them unexpectedly in the middle of a sleep episode, as likely to happen to someone standing alert duty.

Sleep inertia and wakefulness are affected by light mainly during the awakening and sleeping periods. Light therapy before the bedtime routine, whether white or blue light, significantly prolongs entry into REM sleep (Münch et al., 2011). On the other hand, introducing artificial light had statistical significance on a their wakefulness (Van De Werken et al., 2010). The study investigated whether or not simulating sunrise would reduce sleep inertia and increase wakefulness by gradually increasing the ambient light in subjects' room starting 30 minutes prior to an alarm. Although Van De Werken et al. depict the idea of “artificial dawn” as positively decreasing sleep inertia upon awakening, this technique of gradually increasing ambient light would not be possible for someone subjected to an abrupt awakening.

b. Auditory Techniques as a Mitigation Strategy

Various auditory techniques as a mitigation strategy to prevent sleep inertia have been studied as well. Hayashi, Uchida, Shoji, and Hori (2004) conclude that after a short nap, participants who were given doses of music of their choice awakened more rapidly. This study suggests that noise after an early-morning nap could assist in the elimination of sleep inertia. However, in another study, these same sounds have no effect on sleep inertia when the nap is taken later in the day (Bruck & Pisani, 1999).

c. Caffeine as a Mitigation Strategy

In the operational environment, caffeine is widely used and readily available. Caffeine ingested as coffee, chewing gum, or in other over-the-counter (OTC) forms (such as NoDoz or 5-hour Energy) has proven to be effective in reducing sleep inertia upon awakening (Van Dongen et al., 2001). On the other hand, caffeine carries several adverse side effects that include a temporary stimulating effect and loss of overall effectiveness with continued use over long periods (Miller et al., 2007).

In some cases, the caffeine in OTC products had a minimal effect on performance (Reyner & Horne, 2013). Within its *Air Operations Manual*, the USCG even warns its alert-duty crews of their caffeine intake and the associated side effects doing more harm than good, noting that its withdrawal symptoms may reduce performance and overall safety of flight (USCG, 2018). Furthermore, this idea is supported by the *U.S. Coast Guard Aviation Medicine Manual* (2012), which mandates that no more than 450 mg of caffeine (the equivalent to three to four cups of coffee). be consumed daily by any aircrew

d. Somatosensory Techniques as a Mitigation Strategy

Somatosensory techniques are those that use sensation to assist in the waking process. These sensations may be anything from pressure, pain, to varying temperature. One study's findings suggest that sleep inertia may actually be the action of pre-sleep relaxation in which blood flow moves from our extremities to our core (Kräuchi, Cajochen, Werth, & Wirz-Justice, 2000). The Kräuchi et al. study implied that the duration and severity of sleep inertia could be linked to the period in which pre-sleep relaxation techniques are also used, such as yoga or a warm shower. Applying a cool washcloth to the face while having a fan blow cool air onto the participant has been shown to assist with alertness and minimize sleep inertia upon awakening (Hirose & Nagasaka, 2003). From a habitability point of view, due to the decrease in core body temperature during restful sleep, it is important to keep a bedroom temperature of around 65 degrees (Walker, 2017, p. 275). Sleep.com promotes a bedroom temperature of 60–67 degrees.

e. Olfactory Techniques as a Mitigation Strategy

There are many studies and articles published on the topic of using olfactory techniques such as smelling salts to increase alertness. There are conflicting data and conclusions, however, regarding this. Smelling salts have been around since antiquity and operate by irritating the membranes in the nose and lungs, thereby stimulating inhalation through reflexes and causing a sense of alertness (McCrory, 2006). A 2004 study from Brown University tested this hypothesis and found that olfactory senses were able to detect the presence of peppermint (the scent used in the study) only when participants were awake and entering lighter stage 1 sleep (Carskadon & Herz, 2004).

In contrast, a study from a Japanese team of researchers found that out of 14 participants, 13 were awakened within two minutes when subjected to diluted wasabi mist (Warren, 2011). This study also tested roughly 100 different odors, including rotten eggs, and find that wasabi was most effective, whereas the Carskadon and Herz study only utilized peppermint as the scent in their study.

f. Recovery from Sleep Deprivation

Figure 5 displays some of the results from Belenky et al. (2003), who demonstrated just how vital recovery sleep is after a prolonged period of sleep deprivation. The Belenky et al. study examined chronic sleep restriction by using 66 participants separated into four groups. Each of these groups was then allowed an exact amount of time to spend in bed over a seven-day period. The participants were either limited or augmented to three, five, seven, and nine hours for their daily sleep routine. Following the seven-day sleep, study the participants were given three days to recover. All throughout the study, the PVT was given four times daily. The results suggested that the effects of sleep deprivation are almost immediate, and the recovery from an extended sleep-deprived period is slow. As their data suggest, although one may recover from a period of sleep indebtedness, that even after three nights of recovery sleep the participants in the Belenky study only achieved 82–85% of the performance as their peers who maintained 7–9 hours of sleep throughout the study.

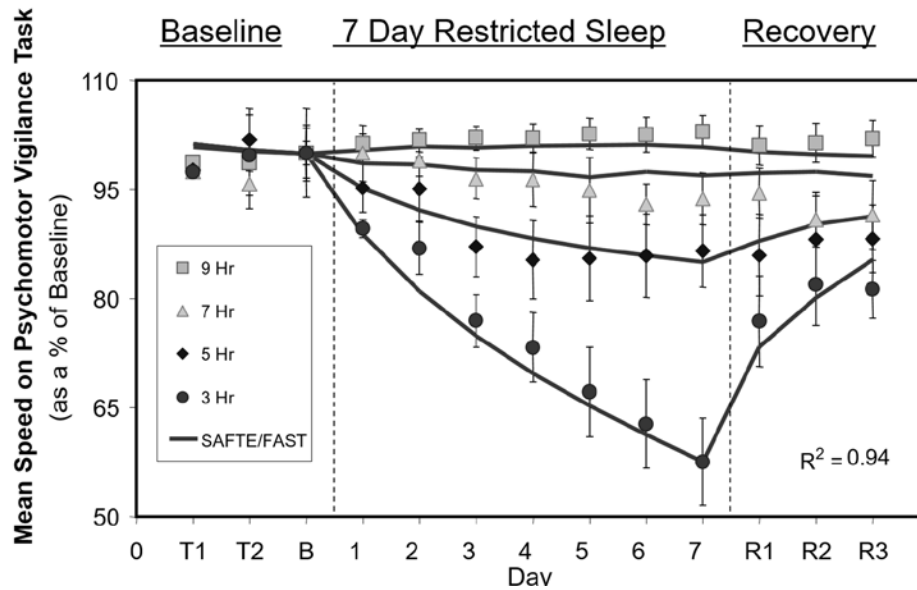


Figure 5. Mean PVT speeds with varying amounts of sleep deprivation. Source: Belenky et al. (2003).

C. CHAPTER SUMMARY

This chapter highlights the studies and research that have been completed over the past several decades on human circadian rhythms and sleep patterns. This chapter also highlights several environmental factors that affect the prevalence, duration, and severity of sleep inertia, specifically, light, sound, and temperature. Table 1 summarizes some of the studies discussed as they relate to sleep inertia countermeasures.

Table 1. Summary of sleep inertia and sleep/performance studies

Sleep inertia countermeasure	Study	Summary of findings
Caffeine	Van Dongen et al. (2001)	Participants who consumed caffeine immediately after awakening scored significantly better on the psychomotor vigilance test (PVT) after an awakening versus those without.
Napping	Hilditch et al. (2016)	Participants who took naps had a significant reduction in sleep inertia upon awakening. A 10-minute nap produced better results than a 30-minute nap.
Light	Czeisler et al. (1986)	Bright light resets the circadian rhythm and assists with awakening, regardless of the time of day or sleep-wake cycle.
Sound	Wright et al. (2005)	Audio alarms work well in alerting aviation crews. In the case of this study, wrist-worn audio alarms were used.
Damp/Cool Cloth	Hirose and Nagasaka (2003)	Using cool air and a wet towel in a comfortable atmosphere was effective in improving performance and alertness upon abruptly awakening participants.

III. METHODS

This thesis uses an HSI approach to investigate the individual and environmental conditions of alert-duty USCG pilots to identify factors that may contribute to their experience of sleep inertia. Data were collected through subjective and objective measures using a self-report fleet-wide electronic survey and through observational methods in operational units. The survey was developed to gain sleep-related insights on USCG aviators by comparing their experiences at home versus when they stand B-0 duty. The follow-up study provided an environmental or “habitability” assessment of the sleeping quarters aircrew members reside in during their B-0 duty period, to include objective measures of light, sound, and temperature.

This study was approved by the Institutional Review Board (IRB) of the Naval Postgraduate School (NPS) as well as the USCG.

A. STUDY 1 METHODS: SLEEP INERTIA SURVEY

1. Equipment and Instruments

A survey was developed, delivered, and maintained using the NPS Enterprise Survey tools located on the Internet and powered through LimeSurvey. The survey contained a total of 42 questions covering nine content domains. The complete survey, as given to each participant, is found in Appendix A.

Sections I and II contained basic information about the participant to include demographic items (i.e., age, gender, current pilot qualification level, current duty station, total years of military service) as well as the total number of military flight hours the participant has accumulated over their career.

Section III addressed the quality of sleep the individual receives while standing B-0 duty at their respective air station compared to their ideal sleeping conditions. Responses were provided using a 5-point Likert scale ranging from 1 = “Problematic” to 5 = “Ideal.”

Section IV contained questions similar to those in Section III, but instead referencing sleeping conditions at the individual's home or off-base residence.

Sections V-VII contained questions about sleep inertia. In Section V, members reported the frequency at which they are awakened from sleep for a mission while standing B-0 duty. In Sections VI and VII, they reported on the prevalence, severity, and duration of sleep inertia experienced while on B-0 duty versus at their home or their off-base residence, respectively.

Section VIII focused on the method in which the member prefers to be awakened to an after-hours mission launch while standing B-0 duty, presumably from a sleep state. The member was also queried regarding their preferred sleep inertia countermeasure method(s). The methods given were caffeine, white light exposure, noise exposure, water or damp cloth to the face, exercise, or nothing at all, all of which are based on previous literature (see Table 1).

Last, Sections IX and X allowed for open-ended responses. These sections pertained to not only the sleep inertia segment of this study but also the environmental assessment portion. In Section IX, participants were asked what they would change concerning their specific unit's duty berthing to improve sleep conditions and reduce sleep inertia. Participants were also given the opportunity to add any other comments or suggestions that may have been missed in the survey that they felt would add to this study.

2. Procedures

Once the survey was created within LimeSurvey, it was disseminated through email. A total of three emails were sent to 607 prospective participants across a two-week data-collection period. The first email was a general invitation to complete the survey with a web link to the survey. The second and third emails were reminder emails sent seven days after the initial email and within 48 hours of the survey closing.

Table 2 identifies the air stations that were included in the survey portion of the study. The goal was to only use personnel who have stood B-0 duty in the past six months. Due to this exclusion criterion, units which do not routinely stand due B-0 duty were

excluded from the email invitation. The USCG units that were excluded were Air Station Washington in Washington, DC; the training department (TRADEP) within the Aviation Training Center (ATC) in Mobile, AL; the Aviation Logistics Center in Elizabeth City, NC; the USCG pilots currently assigned to the U.S. Navy as instructor pilots; and the Helicopter Interdiction Tactical Squadron (HITRON) in Jacksonville, FL. Those pilots currently at Air Station Kodiak assigned to the Alaska Patrol (ALPAT) portion of the command were included, however, as they tend to stand B-0 duty in support of the air station more than once every six months. In all, 607 USCG pilots were invited to complete the survey portion of this thesis.

Table 2. USCG air station location and airframe type

Name of Station	Location	Airframes at Station
Air Station Cape Cod	Sandwich, MA	MH-60 and HC-144
Air Station Sacramento	McClellan Park, CA	HC-27
Air Station Atlantic City	Egg Harbor Township, NJ	MH-65
Air Station Elizabeth City	Elizabeth City, NC	MH-60 and HC-130
Air Station Clearwater	Clearwater, FL	MH-60 and HC-130
Air Station Miami	Opa-locka, FL	MH-65 and HC-144
Air Station Savannah	Savannah, GA	MH-65
Air Station Borinquen	Aguadilla, PR	MH-65
Air Station Houston	Houston, TX	MH-65
Sector/ Air Station Corpus Christi	Corpus Christi, TX	MH-65 and HC-144
Air Station New Orleans	Belle Chasse, LA	MH-65
Aviation Training Center (ATC) Mobile, Operation Department (OPDEP)	Mobile, AL	HC-144
Air Station Detroit	Selfridge ANGB, MI	MH-65
Air Station Traverse City	Traverse City, MI	MH-60
Sector/ Air Station Humboldt Bay	Samoa, CA	MH-65
Air Station San Francisco	San Francisco, CA	MH-65
Sector/ Air Station San Diego	San Diego, CA	MH-60
Sector/ Air Station Astoria	Warrenton, OR	MH-60
Sector/ Air Station North Bend	North Bend, OR	MH-65
Sector/ Air Station Port Angeles	Port Angeles, WA	MH-65
Air Station Barbers Point	Honolulu, HI	MH-65 and HC-130
Air Station Kodiak	Kodiak, AK	MH-60, MH-65 and HC-130
Air Station Sitka	Sitka, AK	MH-60

3. Analytical Approach

Statistical analyses were conducted using the LimeSurvey web application as well as JMP Pro 14 (SAS Institute; Cary, NC) and Microsoft Excel. The demographics sections of the survey (Sections I and II) were analyzed to gain a clearer understanding of the experience level for those who responded. Sections III-IV and Sections VI-VII were compared to one another using paired difference tests to evaluate sleep-related data at home versus on duty. If there were any missing data points, they were excluded from the analysis. Descriptive statistics were analyzed for Sections VI and VII to judge the prevalence, severity, and duration of sleep inertia each respondent experienced while on B-0 duty, in addition to their preferred method of being awakened and sleep inertia countermeasure. The Wilcoxon signed rank test for matched samples was used for non-parametric data while the Student's *t*-test for matched pairs was used for parametric data.

Content of the open-ended comments was analyzed to determine thematic categories of response. Three independent raters tallied the number of responses that fell into each category, to include categories for positive or negative tone, in accordance with Popping (2015). The overall tone and top five themes for each open-ended response were recorded.

B. STUDY 2 METHODS: USCG DUTY ROOM ENVIRONMENTAL / HABITABILITY ASSESSMENT

1. Equipment and Instruments

The habitability assessment portion of this study analyzed the duty rooms at two of the USCG air stations nearby NPS: Air Station Sacramento and Air Station San Francisco. The goal of Study 2 was to analyze the temperature, sound, and light intensity experienced by occupants within these duty rooms to characterize these environments and determine whether improvements could be made to increase the performance of alert-duty watchstanders and enhance their sleep quality.

To measure sound in these duty spaces, the Extech SDL600 sound level meter and datalogger were used. Each instrument was secured to a flat surface as not to be moved unintentionally during the sampling. This device has a monitoring range of 30–130 dB and

an accuracy of +/- 1.4 dB (Extech Instruments, 2019). The Extech SDL600 was programmed to sample sound data once per second, and the optional windscreen remained on. These data were stored on an SD card within each of the eight instruments in a format that was compatible with the data analysis software.

The HOBO data logger by Onset was used to measure light intensity and temperature. This device was secured near where the head of a sleeping individual would lie in the berthing space; or if used in a common area, was placed in a central location. The HOBO was preprogrammed to sample light and temperature peak data once every minute for the duration of the study. The unit has a temperature accuracy of +/- .95°F and a range of -4°F to 158°F (Onset Computer Corporation, n.d.). It has a relative light measurement range of 0 to 320,000 lux (0 to 30,000 lumens/ft²). The HOBO data logger has a small light indicating it is operational that was covered purposely so it would not interfere with individuals sleeping in the sampling areas as well as providing erroneous light data. Data from the HOBO were downloaded via the optical interface data transfer unit and the Onset HOBOWare software version 3.7.17 (Onset Computer Corporation, n.d.).

Photographs of each environmental monitoring apparatus, along with a brief description of their capabilities, are contained within Appendix B.

2. Procedures

USCG Air Stations Sacramento and San Francisco were selected by convenience based on their proximity to NPS. However, it is worth noting that Air Station Sacramento has FW aircraft assigned to it and Air Station San Francisco is a rotary-wing unit; thus, comparisons across these units may provide insights based on their primary platforms. All duty rooms that would be used by members of the aircrew standing B-0 duty had the environmental monitors placed next to where their head would generally rest. If there were multiple beds in the room, each bed would have a sound meter and HOBO datalogger placed next to it. At Air Station San Francisco only, the monitoring equipment was also placed in a centralized common area. Each data logger was set to record once per second for a total of one week. The study at Air Station Sacramento took place from June 23, 2019,

to June 30, 2019, and Air Station San Francisco assisted from July 12, 2019, through July 19, 2019.

In addition to the environmental data being collected from the dataloggers, objective observations of each duty room and common area were also taken to include the following information:

- size of the space, including its location to aircraft, planning spaces, and other amenities (such as phone, TV, and WIFI access)
- location of support facilities to include food preparation, restroom facilities, and health and wellness rooms
- habitability of the current rooms and quarters, including anything in the spaces that could affect light, noise, and temperature data

3. Analytical Approach

For each air station, as well as each duty room and common space where measurements were taken, descriptive statistics and analysis of variance (ANOVA) were used to characterize the data recorded. Because variations were assumed to have occurred from room to room based on room location and amenities, an analysis between each room was conducted for each of the light, sound, or temperature observations. Tukey's HSD (honestly significant difference) test was used as a post-hoc analysis in the event that significant differences were found. If any duty room data significantly varied from the others or from the recommended HSI standards, observational data were used to attempt to isolate the reason behind it. The environmental and observational data were then compared to optimal parameters from the National Sleep Foundation and ASTM International to generate recommendations for future improvements. Using the results, each of the duty berthing spaces were then compared to the habitability standards contained in Table 3.

Table 3. Habitability standards

Factor	Parameter Range	Standard
Light	< 45-60 lumens/sq-ft	ASTM International
Sound	< 40 decibels	National Sleep Foundation
Temperature	60°F-67°F	National Sleep Foundation

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IV. RESULTS

A. SURVEY RESULTS AND ANALYSIS

1. Demographics of Participants

Of the 607 USCG pilots invited to complete the survey, 255 accessed the survey and 169 completed the survey, yielding a 27.8% response rate. Table 4 presents demographic information for the participants. Overall, those who completed the survey appear to be representative of the total population of USCG pilots. For instance, 66 of the 607 (or 10.8%) invited to complete the survey were female, and 17 of the 169 responses received were from females (10.06%).

Participants were accomplished and experienced aviators, with over 70% currently or previously having served in the capacity of aircraft commander (i.e., having sole responsibility for the safe operation of the aircraft and crew) or higher in qualification and designation. In addition to these qualifications, the participants also reported having flown approximately 2200 hours in a military aircraft on average (median of 2000) as shown in Table 5. Participants also averaged over eight years on flight orders and reported standing, on average, over five (5.5) B-0 duties per month. Of the B-0 duties stood, participants reported being launched approximately 48% of the time, with little or no notice, to prosecute a USCG mission.

Figure 6 displays the distribution of participants by state. Although the majority of participants were from Florida and California, there was an even distribution among all the states that contain USCG air stations. Five survey respondents from Air Station Borinquen in Aguadilla, Puerto Rico, also participated in this study; however, these data are not displayed in Figure 6.

Table 4. Survey demographics summary

Detail	Count	Percentage
Sex		
-Male	150	88.8%
-Female	17	10.1%
-Did not specify	2	1.2%
Current Designation/Qualification		
-Flight Examiner (FE) or Instructor Pilot (IP)	57	33.7%
-Aircraft Commander (AC)	63	37.3%
-First Pilot (FP)	23	13.6%
-Co-Pilot (CP)	26	15.4%
Highest Designation/Qualification Ever Held		
-Flight Examiner (FE) or Instructor Pilot (IP)	87	51.5%
-Aircraft Commander (AC)	40	23.7%
-First Pilot (FP)	17	10.1%
-Co-Pilot (CP)	25	14.8%
Airframe currently assigned to fly		
-H60 medium range recovery helicopter	57	33.7%
-H65 short range recovery helicopter	78	46.1%
-C130 long range surveillance airplane	16	9.5%
-C27 medium range surveillance airplane	4	2.4%
-C144 medium range surveillance airplane	14	8.3%
-C37 long range command and control airplane	0	0%

Table 5. Age, flight experience, and B-0 duty descriptive statistics

Detail	Mean	Std Dev	Min	Median	Max
Age	34.22	6	25	33	50
Total time qualified for military aviation including prior service experience (in months)	101.0	74.1	2	90	324
Total Flight time (hrs)	2193.6	1410.5	160	2000	7000
Current Average Monthly Flight Time (hrs)	23.3	7.2	8	25	50
B-0 Duties Stood each month	5.5	3.1	0	5	32
Unscheduled launches	2.6	1.8	0	2	12
Hours of sleep while standing B-0 duty	6.5	1.2	0	7	7

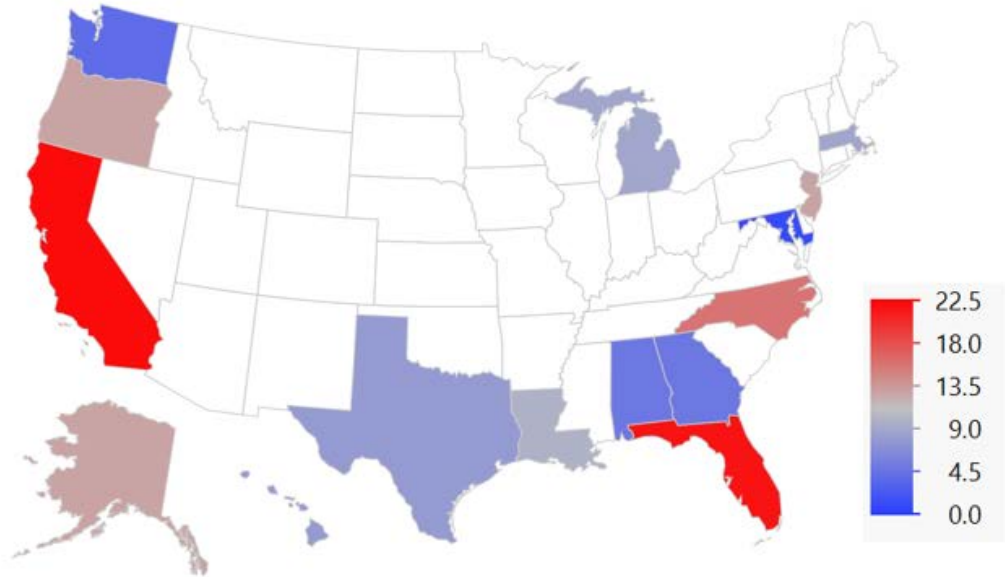


Figure 6. Quantity of respondents by state

2. B-0 Scheduling and Hours Stood

The start and completion times of B-0 duty for each of the participants' respective air station was polled, and the data suggest variation in these duty times during the weekday and weekend periods. Many duty stations appeared to commence their duty period during weekday afternoons; however, others moved to a morning relief time over the weekends. Table 6 provides these times based on the mean and median times reflective of the military's 24-hour clock.

Table 6. B-0 duty start- and end-time descriptive statistics

Description	Mean	Std Dev	Median
Weekday Start	14:42	2.1 hrs	15:00
Weekday End	15:15	1.5 hrs	15:30
Weekend Start	09:48	3.4 hrs	08:00
Weekend End	10:13	3.5 hrs	08:00

3. Sleep Statistical and Sentiment Analysis

Data from the survey provided an indication of participants' sleep quality on and off duty. A series of paired difference tests compared the responses taken from the participants' personal assessment of their off-duty (or assumedly home) environment and duty-room environment to their ideal personal preferences with regard to overall comfort, light, sound and noise levels, and temperature levels. Prior to conducting each analysis, the data were checked for normality; the observations were independent of one another; the variables were continuous and did not contain any outliers. Due to the data in this section being primarily ordinal, the Wilcoxon signed-rank test for matched pairs was completed.

Open-ended responses to the corresponding sections of the survey were content analyzed through a sentiment analysis. Key themes, as well as the overall tone, whether being positive or negative, were interpreted and recorded. The upper quartile of answers appears in the following sections. The remaining tally of themes from the responses are contained in Appendix D.

a. Overall Comfort Comparison

Participants were asked to rate the degree to which their on- and off-duty sleep environment compares to their ideal rest/sleep environment with regard to overall comfort. After providing their rating, they were given the opportunity to provide open ended feedback to this item. Tables 7 and 8 summarize the corresponding analyses. Results suggested that participants reported experiencing a greater amount of comfort off-duty ($M = 4.39$, $SD = .70$) than while on-duty ($M = 3.25$, $SD = .92$). This mean difference in overall comfort ($M = -1.14$, $SD = 1.16$) was statistically significant ($W = -5542.0$, $p < .0001$). Of the 94 comments received, 10% were positive, and 65% were negative when referencing their experiences on duty, with 35% positive and 0% negative when referencing their off-duty experiences. The key factors for their on-duty rating were external jet/helicopter noise and noise from adjacent and adjoining spaces as well as thin walls. Fifteen participants also mentioned that these noises were enough to significantly disturb their crew rest. Off-duty factors mentioned in the sentiment analysis were generally positive, indicating their overall

sound-level quality was close to, if not ideal, and the major source(s) of sound disturbance were from children or other typical household distractions.

Table 7. Results for overall comfort paired comparison

	Paired Differences					n	Signed Rank (W)	df	Sig.
Overall sleep quality differential on duty compared to off duty	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference					
				Lower	Upper				
	-1.14	1.16	.09	-1.3	-.7	165	-5542.0	164	.000

Table 8. Sentiment analysis for overall comfort comparison

	On Duty	Off Duty
Total Responses	31	11
Percent Positive	50%	10%
Percent Negative	40%	0%
Upper Quartile Responses (count)	- Mattress/Bed/Bedding Quality (11) - Noise: External (3) - Noise: Internal (2)	- Off duty, arrangements are ideal/adequate (4) - Mattresses are adequate (3) - Children cause the majority of disturbances (2)

b. Overall Sleep Quality Comparison

Participants were asked to rate the degree to which their on- and off-duty sleep environment compares to their ideal rest/sleep environment with regard to overall sleep quality. After providing their rating, they were given the opportunity to provide open ended feedback to this item. Tables 9 and 10 summarize the corresponding analyses. Results suggested that participants reported experiencing a greater quality of sleep off-duty ($M = 3.96$, $SD = .94$) than while on-duty ($M = 2.88$, $SD = .88$). This mean difference in overall sleep quality ($M = -1.08$, $SD = 1.29$) was statistically significant ($W = -5146.5$, $p < .0001$). Of the 100 comments received, 12% were positive, and 51% were negative when referencing their experiences on duty, with 26% positive and 0% negative when referencing their off-duty experiences. The key factors for their rating on duty were the anticipation of an unscheduled launch, noises internal to their quarters such as the

Operations Duty Officer (ODO) phone ringing, the overall quality of the room itself, and external noises such as from a jet or helicopter. Off-duty factors mentioned in the sentiment analysis were generally positive, indicating their overall sleep quality was close to, if not ideal, and the major source(s) of disturbance were from children or other typical distractions, and their work/flight schedule.

Table 9. Results for overall sleep quality paired comparison

	Paired Differences					n	Signed Rank (W)	df	Sig.
Overall comfort differential on duty compared to off duty	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference					
				Lower	Upper				
		-1.08	1.29	.1	-1.2	-.8	165	-5146.5	164

Table 10. Sentiment analysis for overall sleep quality comparison

	On Duty	Off Duty
Total Responses	57	43
Percent Positive	12%	26%
Percent Negative	51%	0%
Upper Quartile Responses (count)	-Anticipation/ hyper-alertness (12) -Noise, internal, ODO phone (9) -Ventilation (9) -Bedding/ Bed Quality (8) -Noise: external/ aircraft (7) -Room Quality (6)	- Children/ family disturbances (22) - Schedule (4)

c. Overall Noise Level Comparison

Participants were asked to rate the degree to which their on- and off-duty sleep environment compares to their ideal rest/sleep environment with regard to noise level. After providing their rating, they were given the opportunity to provide open-ended feedback on this item. Tables 11 and 12 summarize the corresponding analyses. Results suggested that participants reported experiencing a greater noise level quality off-duty ($M = 4.28$, $SD = .92$) than while on-duty ($M = 3.11$, $SD = 1.18$). This mean difference in overall noise level quality ($M = -1.14$, $SD = 1.54$) was statistically significant ($W = -4834.5$, $p < .0001$). Of the 94 comments received, 10% were positive, and 65% were negative when

referencing their experiences on duty, with 35% positive and 0% negative when referencing their off-duty experiences. The key factors for their on-duty rating were external jet/helicopter noise and noise from adjacent and adjoining spaces as well as thin walls. Fifteen participants also mentioned that these noises were enough to significantly disturb their crew rest. Off-duty factors mentioned in the sentiment analysis were generally positive, indicating their overall noise-level quality was close to, if not ideal, and the major source(s) of disturbance were from children or other typical household distractions.

Table 11. Results for overall noise-level intensity paired comparison

	Paired Differences					n	Signed Rank (W)	df	Sig.
Overall sound level differential on duty compared to off duty	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference					
				Lower	Upper				
	-1.14	1.54	.12	-1.4	-.9	165	-4834.5	164	.000

Table 12. Sentiment analysis for overall noise-level-intensity comparison

	On Duty	Off Duty
Total Responses	65	29
Percent Positive	10%	35%
Percent Negative	65%	0%
Upper Quartile Responses (count)	-Jet/helicopter noise (20) -Noise from adjacent spaces (19) -Noise impacts crew rest (15) - Thin walls (14)	-Children/ dogs/ internal family noises (13) - No noise issues (10)

d. Overall Lighting Quality Comparison

Participants were asked to rate the degree to which their on- and off-duty sleep environment compares to their ideal rest/sleep environment with regard to lighting quality. After providing their rating, they were given the opportunity to provide open ended feedback to this item. Tables 13 and 14 summarize the corresponding analyses. Results suggested that participants reported experiencing a greater lighting quality off-duty ($M = 4.22$, $SD = .89$) than while on-duty ($M = 3.51$, $SD = 1.11$). This mean difference in overall

lighting quality ($M = -0.71$, $SD = 1.36$) was statistically significant ($W = -3321.0$, $p < .0001$). Of the 68 comments received, 34% were positive, and 29% were negative when referencing their experiences on duty, with 38% positive and 0% negative when referencing their off-duty experiences. The key factors for their on-duty rating was that their duty room was too bright from light emissions originating from the windows and doors, the curtains in the room were not functioning or not present, the general location of their duty station affects the amount of light they receive on duty (e.g., high-latitude duty stations in the summer months), and the lighting available was not conducive to their pre-sleep routine. Off-duty factors mentioned in the sentiment analysis were generally positive, indicating that the participants either have, need, or want blackout curtains; have issues with lighting more so at high-latitude air stations; and in some cases may not be able to alter their lighting quality significantly due to their off-duty residence being a rental property.

Table 13. Results for overall lighting intensity paired comparison

	Paired Differences					<i>n</i>	Signed Rank (<i>W</i>)	<i>df</i>	Sig.
Overall comfort differential on duty compared to off duty	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference					
				Lower	Upper				
		-.71	1.36	.10	-.92	-.50	163	-3321.0	162

Table 14. Sentiment analysis for overall lighting intensity comparison

	On Duty	Off Duty
Total Responses	47	21
Percent Positive	34%	38%
Percent Negative	29%	0%
Upper Quartile Responses (count)	-Too bright/ light from windows or doors (15) -No curtains/ curtains in disrepair (10) - Environmental/ AK summers (5) -Lighting not conducive for pre-sleep routine (4)	-Have/ use blackout curtains (9) -Need/ want blackout curtains (7) -High latitude issues/ rental property and cannot alter (3)

e. Overall Temperature Comparison

Participants were asked to rate the degree to which their on- and off-duty sleep environment compares to their ideal rest/sleep environment with regard to temperature. After providing their rating, they were given the opportunity to provide open ended feedback to this item. Tables 15 and 16 summarize the corresponding analyses. Results suggested that participants reported experiencing greater temperature control and comfort associated to temperature off-duty ($M = 4.41$, $SD = .83$) than while on-duty ($M = 3.22$, $SD = 1.10$). This mean difference in overall temperature ($M = -1.19$, $SD = 1.48$) was statistically significant ($W = -781.50$, $p < .0001$). Of the 89 comments received, 30% were positive, and 34% were negative when referencing their experiences on duty, with 54% positive and 0% negative when referencing their off-duty experiences. The key factors for their on-duty rating that was their duty room temperature and environmental controls could be individually set, the rooms were either too hot or too cold, and attempting to control the temperature by opening the windows would allow insects to enter. Off-duty factors mentioned in the sentiment analysis were generally positive, indicating that the participants generally do not have an issue with temperature or environmental control at their off-duty residence. Twelve participants did mention that they either have insufficient or no air conditioning or that the cost of electricity is the limiting factor preventing an ideal temperature control situation.

Table 15. Results for overall temperature paired comparison

	Paired Differences					<i>n</i>	Signed Rank (<i>W</i>)	<i>df</i>	Sig.
Overall comfort differential on duty compared to off duty	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference					
				Lower	Upper				
	-1.19	1.48	.11	-1.4	-.9	162	-4781.5	161	.000

Table 16. Sentiment analysis for overall temperature comparison

	On Duty	Off Duty
Total Responses	53	26
Percent Positive	30%	54%
Percent Negative	34%	0%
Upper Quartile Responses (count)	- Cannot individually control their duty room/space (21) -Too hot or too cold (16) -HVAC is noisy or breaks often (8) -Opening windows would let insects in (5)	- No issue/ temperature is adequate (13) -Insufficient or no air conditioning (9) -Cost of electricity is the limiting factor (3)

4. Sleep Inertia Statistical Analysis

a. Sleep Inertia Duration Comparison (in Minutes)

Participants were asked to state the duration (in minutes) in which they were affected by sleep inertia on- and off-duty. Tables 17 and 18 summarize the corresponding analyses. Results suggested that participants reported experiencing sleep inertia for a greater duration (in minutes) on-duty ($M = 78.0$, $SD = 191.9$) than while off-duty ($M = 57.7$, $SD = 167.5$). This mean difference in sleep inertia duration ($M = 20.3$, $SD = 134.7$) was statistically significant; $t(20.3)=1.94$, $p = .0267$.

Table 17. Paired statistics for sleep inertia duration (in minutes)

	Mean	<i>n</i>	Std Deviation	Std. Error Mean
Off duty	57.7	167	167.5	12.96
On duty	78.0	167	191.9	14.8

Table 18. Results for sleep inertia duration paired comparison

	Paired Differences					<i>n</i>	<i>t</i>	<i>df</i>	Sig.
Sleep inertia duration (min) differential on duty compared to off duty	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference					
				Lower	Upper				
	20.3	134.7	10.4	-.3	40.8	167	1.94	166	.0267

b. Sleep Inertia Prevalence Comparison (Percent Occurrence)

Participants were asked to state the prevalence (by percent occurrence) in which they were affected by sleep inertia on- and off-duty. Tables 19 and 20 summarize the corresponding analyses. Results suggested that participants reported sleep inertia to be more prevalent on-duty ($M = 45.30$, $SD = 33.8$) than while off-duty ($M = 21.46$, $SD = 24.2$). This mean difference in sleep inertia duration ($M = 23.8$, $SD = 37.55$) was statistically significant; $t(23.8) = 8.21$, $p < .0001$.

Table 19. Paired statistics for sleep inertia prevalence (percent occurrence)

	Mean	<i>n</i>	Std Deviation	Std. Error Mean
Off duty	21.46	167	24.2	1.87
On duty	45.30	167	33.8	2.61

Table 20. Results for sleep inertia prevalence paired comparison

	Paired Differences					<i>n</i>	<i>t</i>	<i>df</i>	Sig.
Sleep inertia prevalence differential on duty compared to off duty	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference					
				Lower	Upper				
	23.80	37.55	2.9	18.1	29.6	167	8.21	166	.000

c. Sleep Inertia Intensity Comparison

Participants were asked to rate the degree to which they were affected by sleep inertia on- and off-duty with regard to intensity. Table 21 summarizes the corresponding analysis. Results suggested that participants reported sleep inertia to be more intense on-duty ($M = 2.76$, $SD = 0.77$) than while off-duty ($M = 2.27$, $SD = 0.82$). This mean difference in sleep inertia duration ($M = .48$, $SD = .90$) was statistically significant ($W = 3555.5$, $p < .0001$).

Table 21. Results for sleep inertia intensity paired comparison

	Paired Differences					n	Signed Rank (W)	df	Sig.
Overall comfort differential on duty compared to off duty	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference					
				Lower	Upper				
	.48	.90	.071	.34	.62	161	3555.5	160	.000

5. Analysis of Mitigation Strategies, Current Practices, and Other Types of Awakenings Experienced on Duty

Participants reported using caffeine as a preferred mitigation strategy to sleep inertia and to increase wakefulness upon an awakening. From the sentiment analysis, 33% (9 out of 27) of the respondents also suggested drinking water and taking a shower to expedite the awakening process. With respect to preferences for awakening while on duty, there was not a significant difference in the current practices being offered. Respondents stated that many of the methods suggested in the survey (e.g., cell phone, pager, knock on the door) were best used in conjunction with the SAR alarm over an intercom system. Respondents also noted that they are awakened frequently from restful sleep while on duty by both external ($M = 15.99\%$, $SD = 22.2$) and internal reasons ($M = 17.23\%$, $SD = 23.6$), and not just when alerted for a mission. These data are presented in Tables 22-24.

Table 22. Summary of sleep inertia mitigation strategies

Mitigation Strategy	Count	Percentage
Caffeine	127	75.1%
Water and/or damp cloth on face	81	47.9%
White light exposure	58	34.3%
Exercise	38	22.4%
Nothing, no special strategy	20	11.8%
Noise Exposure	14	8.2%
Other	27	15.9%

Table 23. Summary of preference for awakening while on duty

Practice	Preference Rating: count (%)						
	Highly dislike	Dislike	Indifferent	Prefer	Ideal	Left comment	No answer
SAR Alarm over intercom	35 (20.7)	29 (17.1)	53 (31.4)	35 (20.7)	12 (7.1)	41 (24.2)	5 (2.96)
Personal pager system	5 (2.9)	27 (15.9)	51 (31.2)	33 (19.5)	8 (4.7)	30 (17.7)	45 (26.6)
Cell Phone Call	10 (5.9)	27 (15.9)	47 (27.8)	52 (30.7)	21 (12.4)	34 (20.1)	12 (7.1)
Knock on the door	12 (7.1)	33 (19.5)	50 (29.6)	43 (25.4)	20 (11.8)	26 (15.3)	11 (6.5)
Other: Specified	1 (.59)	0(0)	8 (4.7)	3 (1.8)	3 (1.8)	8 (4.7)	154 (91.1)

Table 24. Frequency of awakenings on duty by other reasons

Frequency of awakenings on-duty due to the following situations (n=168)							
	Mean	SD	Min	Max	1 st Quartile	Median	3 rd Quartile
A legitimate mission	25.57	16.76	0	75	10	20	40
External/non-mission	15.99	22.2	0	100	3	5	20
Internal/personal	17.23	23.6	0	100	2	5	20

6. Recommendations and Other Survey Response Sentiment Analysis

Participants were given the opportunity to provide any recommendations they felt were achievable at their unit in order to mitigate sleep inertia and any other recommendations they felt could be of use in this or in future studies. A total of 188 responses were received. The top quartile of themes extracted from these comments is summarized in Table 25.

Table 25. Summary of recommended improvements for on-duty room environment

Theme	Count
Individual temperature/climate control and/or quiet HVAC system	30
Improved mattresses; improved bedding; ensure bedding/sheets are available	27
Noise reduction countermeasures such as insulation and soundproofing	25
Lighting improvements; blackout curtains; ensure rooms are sufficiently dark and use of natural lighting (day), red lighting (night)	24
Improved air quality; improved ventilation; improved airflow	23
Improved sleep awareness within the USCG as a whole	18
Manage sleep scheduling and wake crews more appropriately	16
Maintain a constant start/relief time to duty throughout the week; improve management of random recall status'	12
Acquire a duty room only type structure at each air station	10
Improve cleanliness of duty spaces	8
Prevent door slamming	7

B. HABITABILITY STUDY ANALYSIS

1. Air Station Sacramento General Arrangement

Air Station Sacramento is located on McClellan Airfield in Sacramento County, CA. Air Station Sacramento operates a total of six C-27J FW aircraft, with a normal crew of four standing duty at all times. The duty rooms are located on the second level of the hangar where the aircraft are kept. The pilot and enlisted berthings are separate, with only the duty pilot and ODO having shower and restroom facilities attached to their room through an adjoining space. The enlisted berthing is a short walk to their designated shower and restroom facilities, and the enlisted crew also have the capability of either using white or red lighting. Both enlisted and officer crews had a lounge area with food storage and preparation space. These areas also had comfortable couches and chairs as well as various types of entertainment. While data were being collected, the average temperature at this location was 72.9 degrees Fahrenheit, and the average hours of daylight were 14.8 hours ("Historical Weather Data," n.d.). Table 26 displays the various metrics of each berthing space, the usual occupant, and various other attributes or amenities within each room.

Table 26. Air Station Sacramento duty room arrangement

	Pilot Room	Co-pilot Room	ODO Room	Radio	Watch Captain	Extra Room	Extra Room	Drop Master	Drop Master 2
Sound sensor	CG01	CG02	CG03	CG04	CG05	CG06	CG07	CG08	NA
Light/temp sensor	CG01	CG02	CG03	CG04	CG05	CG06	CG07	CG08	CG09
Room size (sq-ft)	177.7	169.3	182.3	74.2	112.5	109.5	101.7	100.5	98.7
Bed size (sq-ft)	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7
Livable space (sq-ft)	150	141.6	154.6	46.5	84.8	81.8	74.0	72.8	71.0
Window					X	X	X	X	X
Curtains					X	X	X	X	
Alarm clock	X	X	X	X			X		
Loud speaker	X	X	X	X	X	X	X	X	X
Phone	X	X	X		X				
Lamp	X	X	X	X	X	X	X		
Overhead lights	X	X	X	X	X	X	X		
Air purifier		X					X		
Portable air conditioner	X	X	X			X		X	
Fan			X	X	X				X
Red light capable				X	X	X	X	X	
Adjoining restroom	X		X						
Detached restroom		X		X	X	X	X	X	X

Note: X indicates attribute or amenity was present within the room.

a. Light

Data from this habitability assessment show a wide variation of light and temperature data from room to room. This variability could lead one to suspect that the room might have been occupied or unoccupied during the data collection period. Complete charted data may be viewed in Appendix G. Below are three examples that may further explain these findings. Figure 7, for instance, depicts light and temperature data from a room that may not have been occupied during the data collection period; or, in

which the occupant did not turn on the lights until the latter third of the study. Figure 8 depicts a duty room that does not contain curtains to eliminate natural sunlight. The cyclical change in illumination is representative of the sun rising and setting each day. Figure 9 depicts a duty room which is red light capable for better night adaptation. The illumination intensity data suggests the room was readily occupied during the beginning of the data collection phase; however, toward the end of the study, lighting seemed to remain on for an extended period of time. These data suggest there was not an occupant in the space, or perhaps the occupant left the red lighting engaged.

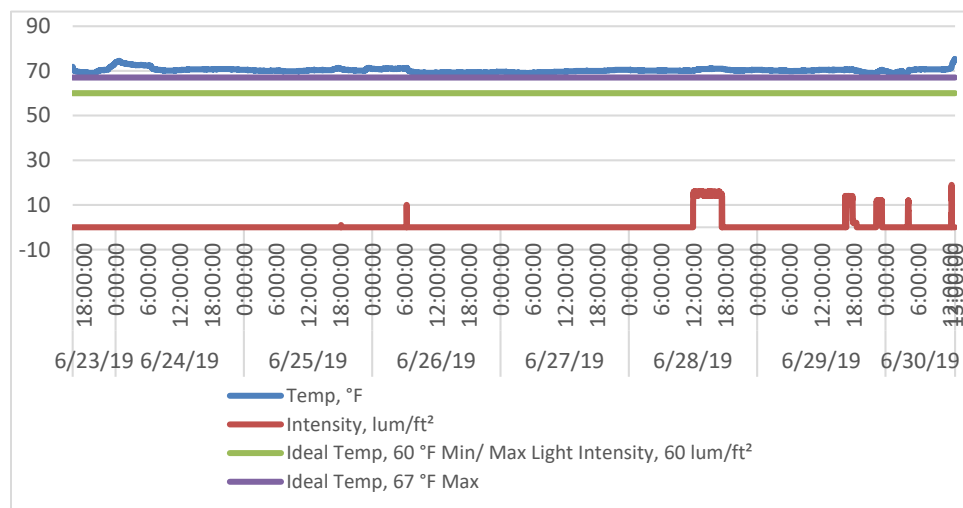


Figure 7. Example of a possibly unoccupied room

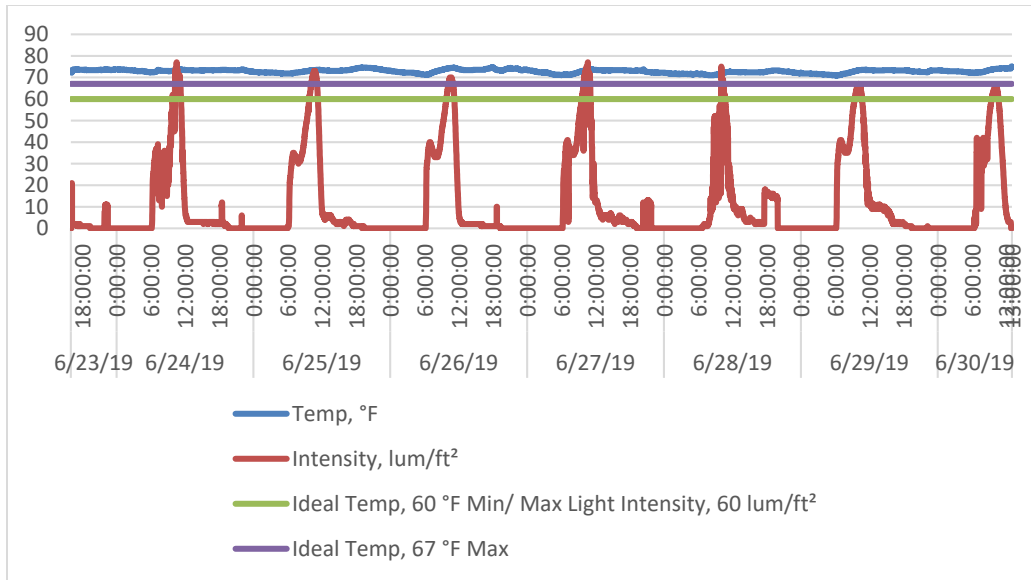


Figure 8. Example of a room without windows or curtains

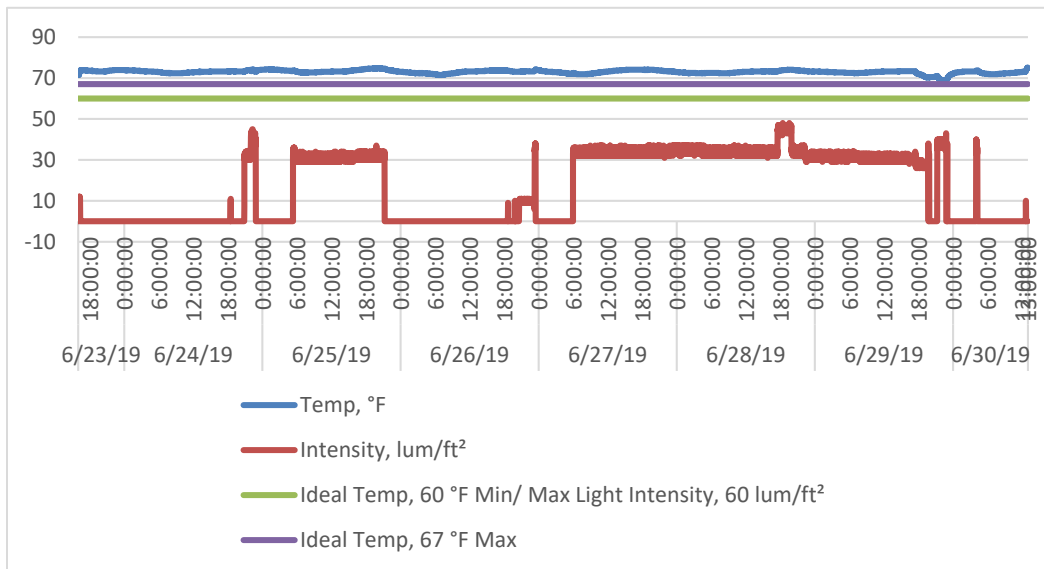


Figure 9. Example of a room with red lighting available

Table 27 summarizes the light data collected at Air Station Sacramento. These data are displayed in lumens/ sq-ft. For comparison purposes, there are about 900 lumens in a 60-watt light bulb (“Lighting Calculator,” n.d.). As stated previously, the average amount of sunlight during the data-collection phase was 14.8 hours per day. ASTM international recommends lighting in berthing spaces to remain within the range of 45-60 lumens/ sq-ft

or less. We can see that the spaces sampled at this air station achieve zero lumens/ sq-ft and, two of the rooms exceeded the recommended value.

A one-way ANOVA was conducted to compare the effect of light between each of the duty spaces to test for significant differences. With respect to light at Air Station Sacramento, a significant difference was found among the duty spaces ($F = 3318.07$, $p < 0.0001$). Post hoc comparisons using the Tukey HSD test indicated that 32 of the 36 paired comparisons between spaces sampled were significantly different. Of those comparisons, the Watch captain's room (CG05) and Extra room (CG06) differed the greatest with respect to light data. These data are presented in Table 28 and Appendix F.

Table 27. Light data collected from Air Station Sacramento

		Descriptive Statistics (lum/ sq-ft)						
Room	N	Mean	Std. Dev.	Std. Error	Upper 95% Mean	Lower 95% Mean	Min	Max
Pilot	9901	1.85	2.78	.028	1.9	1.79	0	23
Co pilot	9901	.88	2.62	.03	.93	.83	0	10
ODO	9901	.69	3.04	.03	.75	.63	0	19
Radio	9901	.28	1.93	.01	.31	.24	0	16
Watch captain	9901	16.65	16.64	.16	16.9	16.32	0	48
Extra room	9901	.27	1.43	.01	.30	.24	0	21
Extra room	9901	6.6	13.54	.13	6.87	6.34	0	61
Drop master	9901	3.86	5.82	.05	3.98	3.75	0	29
Drop master 2	9901	11.05	19.15	.19	11.43	10.68	0	77
Combined	89109	4.68	11.3	.03	4.76	4.61	0	77

Table 28. Analysis of variance for light data at Air Station Sacramento

Source	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Between Rooms	8	2627939	328492	3318.07	< .0001
Error	89100	8820986	99		
Total	89108	11448924			

b. Sound

Tables 29 and 30 summarize the sound data collected at Air Station Sacramento. These data are displayed in decibels (dB). For comparison purposes, a hair dryer produces about 90 dB of sound and a Boeing 747 aircraft at full throttle produces about 150 dB (Chepesiuk, 2005). Table 28 displays the descriptive statistics of the sound data, and Table 30 displays the total accumulation of data points within the > 40 dB, and >85 dB ranges. Take note that these occurrences represent a grand total for the entire data collection period and may include several instantaneous intervals of sound rather than a single event. The National Sleep Foundation recommends a sound level of less than 40 decibels for optimal sleep. We can see that all of the rooms except for the pilot room (40.9 decibel minimum reading) achieved this recommendation.

A one-way ANOVA was conducted to compare the effect of sound between each of the duty spaces to test for significant differences. With respect to sound at Air Station Sacramento, a significant difference was found among the duty spaces ($F = 519823.8$, $p < 0.0001$). Post hoc comparisons using the Tukey HSD test indicated that all 28 comparisons between spaces sampled were significantly different. Of those comparisons, Radio's room (CG04) and the Extra Room (CG07) differed the greatest with respect to the sound data collected. These data are presented in Table 31 and Appendix F.

Table 29. Sound data collected from Air Station Sacramento

		Descriptive Statistics (in dB)						
Room	N	Mean	Std. Dev.	Std. Error	Upper 95% Mean	Lower 95% Mean	Min	Max
Pilot	592926	48.22	6.68	.00	48.20	48.21	40.9	100.4
Co-pilot	593103	50.51	5.49	.00	50.50	50.49	30.1	92.3
ODO	592055	44.10	6.10	.00	44.11	44.08	32.4	96.2
Radio	593091	36.36	3.27	.00	36.37	36.36	29.4	89.1
Watch captain	591904	44.39	6.5	.00	44.4	44.3	30.3	105.3
Spare room	593172	37.40	4.37	.00	37.44	37.41	29.6	84.8
Spare room 2	592729	50.60	5.73	.00	50.62	50.59	36.8	95.9
Drop master	591746	44.80	6.97	.00	44.84	44.80	31.9	99.3
Drop master 2	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-
Combined	4740726	44.56	7.66	.0035	44.56	44.55	29.4	105.3

Table 30. Peak sound levels recorded from Air Station Sacramento

Room	Sum of Peak Sound level in decibels			
	>40 dB (sec)	% of study > 40 dB	>85 dB (sec)	% of study > 85 dB
Pilot	592926	100%	52	.008%
Co pilot	558965	94.2%	8	.001%
ODO	515262	87.0%	26	.004%
Radio	38941	6.6%	16	.000%
Watch captain	566983	95.7%	180	.000%
Spare room	46299	7.8%	0	0.0%
Spare room 2	591143	99.7%	280	.001%
Drop master	524752	88.6%	16	.000%
Drop master 2	-NA-	-NA-	-NA-	-NA-

Table 31. Analysis of variance for sound data at Air Station Sacramento

Source	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Between rooms	7	120884969	17269281	519823.8	< 0.0001
Error	4740718	157493340	33.221411		
Total	4740725	278378309			

c. Temperature

Table 32 summarizes the temperature data collected at Air Station Sacramento. These data are displayed in degrees Fahrenheit. As stated previously, the average daily temperature during the data collection phase was 72.9 degrees Fahrenheit. The National Sleep Foundation recommends the optimal sleeping temperature to fall within 60°F-67°F. We can see that 5 of 9 rooms achieved this recommendation.

A one-way ANOVA was conducted to compare the effect of temperature between each of the duty spaces to test for significant differences. With respect to temperature at Air Station Sacramento, a significant difference was found among the duty spaces ($F = 8078.04, p < 0.0001$). Post hoc comparisons using the Tukey HSD test indicated that all 36 comparisons between spaces sampled were significantly different. Of those comparisons, the Pilot's room (CG01) and the Watch Captain's room (CG05) differed the greatest with respect to the temperature data collected. These data are presented in Table 33 and Appendix F.

Table 32. Descriptive statistics of temperature data from Air Station Sacramento

		Descriptive Statistics (degrees Fahrenheit)						
Room	N	Mean	Std. Dev.	Std. Error	Upper 95% Mean	Lower 95% Mean	Min	Max
Pilot	9901	69.1	2.12	.021	69.145	69.06	62.598	77.225
Co pilot	9901	69.89	1.69	.017	69.93	69.86	63.455	77.4
ODO	9901	70.2	.854	.008	70.27	70.23	68.7	75.3
Radio	9901	71.96	.904	.009	71.98	71.94	70.48	74.96
Watch captain	9901	73.03	.82	.008	73.04	73.01	68.59	75.14
Spare room	9901	72.19	1.17	.011	72.22	72.17	68.42	74.96
Spare room 2	9901	71.69	2.2	.02	71.7	71.64	63.97	75.14
Drop master	9901	71.07	1.97	.019	71.11	71.03	65.85	76
Drop master 2	9901	72.87	.82	.008	72.89	72.85	70.82	75.14
Combined	89109	71.34	1.97	.006	71.35	71.32	62.59	77.4

Table 33. Analysis of variance for temperature data at Air Station Sacramento

Source	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Between rooms	8	146480.21	18310.0	8078.04	< 0.0001
Error	89100	201957.74	2.3		
Total	89108	348437.95			

2. Air Station San Francisco General Arrangement

Air Station San Francisco is located on San Francisco International Airport in San Mateo County, CA. The duty rooms are located on the ground level nearby where the aircraft are kept. The pilot and enlisted berthings are located in separate hallways where each room has shower and restroom facilities attached through an adjoining space. The line crew room had two beds with only one person usually occupying this space. Both enlisted and officer crews had a lounge area with food storage and preparation space. These areas also had comfortable couches and chairs as well as various types of entertainment. A total of three sensors were placed in the crew lounge as the space had three separate areas. The “Crew lounge 1” space was a kitchen space with an overhead skylight, allowing a large amount of daylight into the area. The “Crew lounge 2” space was dimly lit and designed for relaxing and watching television. The “Crew lounge 3” environment was a spacious area, again with many outside light sources, used primarily for gaming and entertainment. While data were being collected, the average temperature at this location was 65.7 degrees Fahrenheit, and the average hours of daylight were 14.5 hours (“Historical Weather Data,” n.d.). Table 34 displays the various metrics of each berthing space, the usual occupant, and various other attributes or amenities within each room.

Table 34. Air Station San Francisco duty room arrangement

	Pilot/ SDO	Co- Pilot	RS	FM	Watch Capt.	Line Crew	Line Crew 2	Ward -room	Crew Lounge 1	Crew Lounge 2	Crew Lounge 3
Sound sensor	CG01	CG02	CG03	CG04	CG05	CG06	CG07	CG08	-NA-	-NA-	-NA-
Light/temp sensor	CG01	CG02	CG03	CG04	CG05	CG06	CG07	CG08	CG09	CG10	CG11
Room size (sq-ft)	142.5	135	135.3	150	143.5	156.3	156.3	659.1	177	270	279
Bed size (sq-ft)	32.8	32.8	32.8	32.8	32.8	65.6	65.6	-NA-	-NA-	-NA-	-NA-
Livable space (sq-ft)	110.5	102.2	102.5	117.2	110.7	90.7	90.7	659.1	177	270	279
Window	X	X	X	X	X	X	X	X	X	X	X
Curtains	X	X	X	X	X	X	X	X	X	X	X
Alarm clock											
Loud speaker	X	X	X	X	X	X	X	X	X	X	X
Phone	X	X			X	X	X	X	X	X	X
Lamp	X	X	X	X	X	X	X				
Overhead lights	X	X	X	X	X	X	X	X	X	X	X
De-humidifier	X	X		X	X	X	X				
Fan			X	X	X	X	X				
Red light capable											
TV	X	X	X	X	X	X	X	X		X	
Adjoining restroom	X	X	X	X	X	X	X	X			
Detached restroom									X	X	X

Note: X indicates attribute or amenity was present within the room.

a. Light

Table 35 summarizes the light data collected at Air Station San Francisco. As stated previously, the average amount of sunlight during the data collection phase was 14.5 hours per day. ASTM international recommends lighting in berthing spaces to within the range of 45-60 lumens/ sq-ft or less. We can see that the spaces sampled at this air station achieved zero lumens/ sq-ft and 7 of the 11 rooms exceeded the recommended value.

A one-way ANOVA was conducted to compare the effect of light between each of the duty spaces to test for significant differences. With respect to light at Air Station San Francisco, a significant difference was found among the duty spaces ($F = 485.88$, $p < 0.0001$). Post hoc comparisons using the Tukey HSD test indicated that 38 of the 55

comparisons between spaces sampled were significantly different. Of those comparisons, the kitchen area of the crew lounge (CG09) and television area of the crew lounge (CG10) differed the greatest with respect to the light data studied. These data are presented in Table 36 and Appendix F.

Table 35. Light data collected from Air Station San Francisco

		Descriptive Statistics in lum/sq ft (*) denotes possible sensor malfunction. Data left out of combined statistics.						
Room	N	Mean	Std. Dev.	Std. Error	Upper 95% Mean	Lower 95% Mean	Min	Max
Pilot	10021	12.11	20.70	.2	12.52	11.71	0	128
Co Pilot	10021	6.16	16.70	.16	6.49	5.83	0	176
RS	10021	8.55	10.24	.10	8.75	8.35	0	104
FM	10021	1.57	4.45	.044	1.65	1.48	0	24
Watch Captain	10021	12.97	28.04	.28	13.52	12.42	0	184
Line Crew 1	10021	1.83	3.17	.032	1.89	1.77	0	20
Line Crew 2*	10021	31.9	367.09	3.66	39.09	24.72	0	7168
Wardroom	10021	4.01	4.46	.04	4.09	3.92	0	27
Crew Lounge 1	10021	93.24	163.10	1.63	96.4	90.04	0	576
Crew Lounge 2	10021	.54	1.02	.01	.55	.515	0	46
Crew Lounge 3	10021	12.27	13.49	.13	12.53	12.00	0	87
Combined	100210	15.32	59.47	.188	15.69	14.95	0	576

Table 36. Analysis of variance for light data at Air Station San Francisco

Source	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Between rooms	10	72086094.4	7208609	485.88	< 0.0001
Error	110220	1635225750	14836		
Total	110230	1707311844			

b. Sound

Tables 37 and 38 summarize the sound data collected at Air Station San Francisco. Table 37 displays the descriptive statistics of the sound data collected at Air Station San Francisco by berthing area. Table 38 displays the total accumulation of data points within the > 40 dB and > 85 dB ranges. Take note that these occurrences are a grand total for the entire data collection period and may represent several instantaneous intervals of sound rather than a single event. The National Sleep Foundation recommends a sound level of less than 40 decibels for optimal sleep. All of the rooms except for the wardroom (40.8 decibel minimum reading) achieved this recommendation.

A one-way ANOVA was conducted to compare the effect of sound between each of the duty spaces to test for significant differences. With respect to sound at Air Station San Francisco, a significant difference was found among the duty spaces ($F = 209930.6$, $p < 0.0001$). Post hoc comparisons using the Tukey HSD test indicated that 27 of the 28 comparisons between spaces sampled were significantly different. Of those comparisons, the Line Crew Room (CG06) and the Wardroom (CG08) differed the greatest with respect to sound data collected. These data are presented in Table 39 and Appendix F.

Table 37. Sound data collected from Air Station San Francisco

		Descriptive Statistics (in Decibels)						
Room	N	Mean	Std. Dev.	Std. Error	Upper 95% Mean	Lower 95% Mean	Min	Max
Pilot	604004	36.40	5.99	0.00	36.37	36.34	29.7	103.4
Co-pilot	604304	34.20	6.79	0.00	34.23	34.19	23.8	96
RS	603228	37.14	5.75	0.00	37.16	37.13	30.8	105.9
FM	602769	36.58	6.12	0.00	36.59	36.57	26.6	102.2
Watch Captain	602323	38.01	7.39	0.00	38.03	37.99	29.2	98.7
Line Crew 1	601748	34.18	7.39	0.00	34.2	34.16	25.1	104.1
Line Crew 2	602029	40.09	6.32	0.00	40.11	40.07	31.4	106.8
Wardroom	600817	46.07	6.11	0.00	46.09	46.06	40.8	109
Crew Lounge 1	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-
Crew Lounge 2	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-
Crew Lounge 3	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-
Combined	4821222	37.83	7.44	.00	37.83	37.82	23.8	109

Table 38. Peak sound levels recorded from Air Station San Francisco

Room	Sum of Peak Sound level in decibels			
	>40 dB (sec)	% of study > 40 dB	>85 dB (sec)	% of study > 85 dB
Pilot	137292	22.7%	25	.008%
Co pilot	558965	92.4%	6	.000%.
Rescue Swimmer	515262	85.4%	68	.000%
Flight Mechanic	38941	6.5%	81	.000%
Watch captain	566983	94.1%	232	.000%
Line Crew 1	46299	7.6%	225	.000%
Line Crew 2	591143	98.1%	113	.000%
Wardroom	524752	87.3%	29	.000%

Table 39. Analysis of variance for sound data at Air Station
San Francisco

Source	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Between rooms	7	62342030	8906004	209930.6	< 0.0001
Error	4821214	204533099	42		
Total	4821221	266875129			

c. Temperature

Table 40 summarizes the temperature data collected at Air Station San Francisco. These data are displayed in degrees Fahrenheit. As stated previously, the average daily temperature during the data collection phase was 65.75 degrees Fahrenheit. The National Sleep Foundation recommends the optimal sleeping temperature to fall within 60°F-67°F. We can see that all of the rooms achieved this recommendation.

A one-way ANOVA was conducted to compare the effect of temperature between each of the duty spaces to test for significant differences. With respect to temperature at Air Station San Francisco, a significant difference was found among the duty spaces ($F = 1350.29$, $p < 0.0001$). Post hoc comparisons using the Tukey HSD test indicated that 39 of the 44 comparisons between spaces sampled were significantly different. Of those comparisons, the crew lounge kitchen area (CG09) and crew lounge television area (CG10) differed the greatest with respect to the temperature data collected. These data are presented in Table 41 and Appendix F.

Table 40. Descriptive statistics of temperature data from Air Station
San Francisco

Room	N	Descriptive Statistics in degrees Fahrenheit						
		Mean	Std. Dev.	Std. Error	Upper 95% Mean	Lower 95% Mean	Min	Max
Pilot	10021	69.2	2.02	.02	69.3	69.2	64.48	75.66
Co-pilot	10021	68.9	2.2	.021	69.0	68.9	62.0	73.92
RS	10021	70.14	2.67	.03	70.2	70.0	62.0	73.9
FM	10021	70.0	2.86	.029	70.1	70.0	62.4	80.9
Watch captain	10021	69.7	2.42	.024	69.7	69.6	63.7	77.5
Line crew 1	10021	69.24	2.12	.021	69.3	69.2	65.1	75.6
Line crew 2	10021	69.1	2.16	.021	69.15	69.07	65.5	83.4
Wardroom	10021	70.5	1.81	.018	70.53	70.46	65.8	75.1
Crew lounge 1	10021	71.7	2.68	.027	71.74	71.63	66.8	78.6
Crew lounge 2	10021	69.17	1.8	.018	69.2	69.1	65.6	74.2
Crew lounge 3	10021	68.85	2.39	.023	68.9	68.8	64.4	75.7
Combined	110231	69.7	2.45	.007	69.71	69.68	62.0	83.4

Table 41. Analysis of variance for temperature data at Air Station
San Francisco

Source	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Between rooms	10	72318.62	7231.86	1350.29	< 0.0001
Error	110220	590313.81	5.36		
Total	110230	662632.43			

V. DISCUSSION

A. HYPOTHESIS REVIEW

- (1) **Hypothesis 1: Overall sleep comfort will be rated closer to the ideal (i.e., rated higher) off-duty than on-duty.**

Supported. The findings of this study suggest that the overall comfort reported for sleep on-duty was significantly less than off-duty. Therefore, we can reject the null hypothesis that no difference exists between on-duty and off-duty sleep comfort.

- (2) **Hypothesis 2: Overall sleep quality will be rated closer to the ideal (i.e., rated higher) off-duty, than on-duty.**

Supported. The findings of this study suggest that the overall sleep quality reported for sleep on-duty was significantly less than off-duty. Therefore, we can reject the null hypothesis that no difference exists between on-duty and off-duty sleep quality.

- (3) **Hypothesis 3: Noise levels will be rated closer to the ideal (i.e., rated higher) off-duty, than on-duty.**

Supported. The findings of this study suggest that the noise level quality reported for sleep on-duty was significantly less than off-duty. Therefore, we can reject the null hypothesis that no difference exists between on-duty and off-duty noise level quality.

- (4) **Hypothesis 4: Lighting quality will be rated closer to the ideal (i.e., rated higher) off-duty, than on-duty.**

Supported. The findings of this study suggest that the lighting quality reported for sleep on-duty was significantly less than off-duty. Therefore, we can reject the null hypothesis that no difference exists between on-duty and off-duty lighting quality.

- (5) **Hypothesis 5: Temperature quality will be rated closer to the ideal (i.e., rated higher) off-duty, than on-duty.**

Supported. The findings of this study suggest that the temperature quality reported for sleep on-duty was significantly less than off-duty. Therefore, we can reject the null hypothesis that no difference exists between on-duty and off-duty temperature quality.

(6) Hypothesis 6: Sleep inertia will affect B-0 watchstanders for a greater duration on-duty, than off-duty.

Supported. The findings of this study suggest that sleep inertia occurs for a greater duration on-duty than off-duty. Therefore, we can reject the null hypothesis that the duration of sleep inertia remains the same while on-duty and off-duty.

(7) Hypothesis 7: Sleep inertia will affect B-0 watchstanders with a greater prevalence on-duty, than off-duty.

Supported. The findings of this study suggest that sleep inertia was more prevalent for B-0 watchstanders while on-duty than off-duty, therefore, we can reject the null hypothesis that the prevalence of sleep inertia remains the same while on-duty and off-duty.

(8) Hypothesis 8: Sleep inertia will affect B-0 watchstanders with a greater intensity on-duty, than off-duty.

Supported. The findings of this study suggest that the intensity of sleep inertia experienced by B-0 watchstanders was greater on-duty than off-duty. Therefore, we can reject the null hypothesis that the intensity of sleep inertia remains the same on-duty and off-duty.

B. SLEEP INERTIA DISCUSSION

Tassi and Muzet (2000) suggest that sleep inertia is much more pronounced and severe when abruptly awakened, such as experienced by USCG pilots while standing B-0 duty. The results of this study support the sleep inertia hypothesis, with a significant number of pilots reporting that sleep inertia is worse in prevalence, severity/intensity, and duration while standing duty as compared to the sleep inertia in their off-duty residence. In fact, this study suggests that sleep inertia is more than twice as prevalent while on-duty than off-duty.

The results from Table 8 also suggest that an abrupt change in work schedule for duty watchstanders had a negative impact, as the turnover time for duty was during the afternoon hours whereas on the weekends it was during the morning timeframe. Several

comments from the sentiment analysis indicated a disruption in sleep patterns and a state of increased fatigue when required to commence duty in the morning hours versus the typical afternoon relief times during the week.

C. POSSIBLE EFFECTS OF SLEEP INERTIA ON COAST GUARD PILOTS

The sleep architecture of these pilots may also be severely disrupted because of standing B-0 duty several times each month while being sleep deprived. The idea of sleep architecture disruption is supported by this research in Table 4, as the participants of this study stated they received less than seven hours of sleep while standing over five duties on average per month. Of these five duties per month, participants stated they flew an average of 2.67 non-scheduled missions, while quite possibly in a sleep deprived state. Monk et al. (2013) supports the findings of this study by suggesting such a sleep debt over long periods of time could contribute to poor performance. Furthermore, Waterhouse et al. (1992) remind us that shiftwork, to include schedules similar to those stood by B-0 crews, could in fact result in long-term mood and psychological disorders as well.

Caffeine as a mitigation strategy to reduce sleep inertia was prominent among the participants of this study, as it was claimed to be used over 75% of the time to mitigate the effects of sleep inertia. The USCG and literature, such as Miller et al. (2007), continue to warn of this practice due to the many side effects that may result from overuse. In the case of a mission that is canceled prematurely, using caffeine to mitigate sleep inertia could alter or prevent the ability to fall back to sleep.

D. HABITABILITY DISCUSSION

The habitability of duty spaces that USCG aviators occupy while on B-0 duty was assessed and compared to recognized standards. The same comparisons were made for their off-duty residences. The findings of this study indicate that off-duty sleeping arrangements of USCG aviators provide a better sleeping environment when compared to the on-duty conditions. Specifically, differences were reported in sleep quality, comfort, lighting configuration, temperature control, and noise levels.

ASTM International and the National Sleep Foundation provide recommendations for lighting, temperature, and sound levels in sleeping spaces. These three aspects of habitability may have an extreme impact on the efficiency and effectiveness of a sleep period, which, in turn, may have long-term health and performance consequences.

The National Sleep Foundation suggests, and data supports, quiet, cool, and dark sleeping conditions: sleep spaces should be 40 dB or less and temperatures between 60 and 67 degrees Fahrenheit; with the sleeping environment as dark as possible (National Sleep Foundation, n.d.). Further, Duffy and Wright (2005) suggest that light intensities of as low as 12 lumens could have an effect on sleep quality. ASTM International provides their own set of standards, which in many cases the USCG and DOD adhere to when implementing HSI requirements into acquisition programs. ASTM International suggests the sleeping quarters and bedrooms within facilities should be designed with user adjustable temperature control able to be maintain between 69.5 and 73.5 degrees Fahrenheit (F25 Committee, 2013). The USCG prescribes times to utilize artificial and natural light when conducting operations during extended nighttime missions (USCG, 2018). ASTM International also recommends bedroom spaces be able to maintain between 45–60 lumen/sq ft when lit to maintain proper illumination of the space; the use of red light for night adaptation; and when noises persist above 85 dB, hearing protection is required to be worn in order to bring the exposure level to below the 85 dB threshold (F25 Committee, 2013). The same requirement is also found within the USCG Safety and Environmental Health Manual (U.S. Coast Guard, 2019b).

E. THE RELEVANCE OF HABITABILITY FINDINGS TO COAST GUARD AVIATORS

The findings from this study speak to the importance of prioritizing habitability for USCG aviators and any individual susceptible to sleep inertia and fatigue in safety critical environments. While many parameters of lighting, sound, and temperature recorded within the crew berthing spaces of Air Station Sacramento and Air Station San Francisco were within the recommended ASTM and National Sleep Foundation, many were not. The results from the sentiment analysis and data from the fleet wide survey also suggest that these same issues reside in most every air station currently operating B-0 duty crews.

F. LIMITATIONS

One of the limitations within this study that became apparent upon touring actual B-0 crew berthing spaces was that not all duty watchstanders chose to sleep in their duty rooms. This conclusion may be evident from data in Appendix G, as well as Figures 7-9. As a result, habitability data from all the spaces where crew members could have possibly slept while standing B-0 duty were not collected through sensors or with the fleetwide survey. Taking observations of each light source, as well as interviewing watchstanders, may have been able to provide solutions to these limitations.

Another limitation to this study was the number of light, sound, and temperature sensors available. As a result, not every space at each air station could be analyzed in these ways. Using only two air stations for this study could also be considered a limitation; however, in this study, the idea was not to analyze if air stations greatly differed from one another, but rather, what the current habitability situation is at a base home to FW and rotary-winged B-0 watchstanders.

Sensor placement and continuity may be considered a limitation to this study as well. Due to the variability within each arrangement, shape, and size of the room, the variability in sensor placement may have added variability or confounds to this study. In order to limit these possible confounds, future studies should utilize a more standard placement of these devices.

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VI. CONCLUSIONS, RECOMMENDATIONS, AND AREAS FOR FURTHER RESEARCH

A. CONCLUSIONS

This study touches on several domains of HSI: HFE, health hazards and systems safety, personnel, and habitability. HSI enables decision makers and command personnel to make informed decisions in order to enhance the performance of their organization while enhancing the work environment for the employee, which is, in this case, USCG B-0 watchstanders. As seen through the habitability domain, effects could be as far reaching as morale improvement and increased retention. Some practices noted through the survey and habitability study, which may provide a benefit to B-0 watchstanders Coast Guard-wide, are listed in the section below.

Results of this study show that there are differences in the prevalence, severity, and duration of sleep inertia for USCG B-0 watchstanders on duty compared to when they are off duty. These differences could perhaps be attributed to the observation that habitability factors (light, temperature, sound, and comfort) differ between off-duty and on-duty sleeping arrangements. This study also suggests from qualitative and quantitative data that the scheduling of B-0 duty relief times throughout the week and weekend may also affect crew fatigue and sleep inertia. Environmental factors to include the location of the duty room itself or whether the air station is located in a high-latitude region also plays a key role in many of the habitability factors outlined in this study. Further investigation of these key contributing factors to fatigue and sleep inertia is recommended.

B. RECOMMENDATIONS

Based on the findings of this study, the following recommendations for watchstanders who may be affected by sleep inertia are proposed. These recommendations were formed based on the quantitative data collected in this study and survey comments.

- Add awareness of sleep inertia, the importance of sleep, and its effects to all pilots and aircrew through annual Crew Resource Management (CRM) as well as operational hazard (OPHAZARD) training curricula.

- Propose funding and increases to support better ready/alert crew berthing at USCG air stations.
- Conduct similar habitability studies throughout all air stations in order to find cost-effective methods to decrease fatigue and sleep inertia, thereby increasing safety and performance. These measures may include:
 - adding or repairing blackout shades/curtains
 - modifying ways in which crews are alerted to an unscheduled launch
 - adjusting duty schedules to better fit circadian patterns
 - utilize red lighting in crew spaces to aid in night adaptation

C. RECOMMENDATIONS FOR FUTURE RESEARCH DIRECTIONS

Further research is planned at NPS and the NASA Ames Research Center to analyze the detrimental effects of sleep inertia on individuals. This research should then be used to assist in mitigating sleep inertia in not just pilots but also expand the eliminating sleep inertia within crew members.

Not only is the continued study of sleep and fatigue among USCG aviation personnel warranted but, also, based on several responses from the survey, future research within the rotary-wing air intercept (RWAI) mission set is needed as well. Since 2006, these pilots have the daunting task of intercepting and protecting the National Capital Region (NCR) from airborne threats (North American Aerospace Defense Command, 2007). These pilots and crew maintain rigorous schedules and must be airborne within an even smaller time-window than B-0 crews. They play a critical role in protecting the NCR, and as a result, should assume their duties fully rested in order to maximize their performance.

Research between sleep and sound must also be continued. As many USCG air stations are co-located at airfields, and in many cases within close proximity to running

aircraft engines, the level of noise one may acclimate to should be investigated. Exploration in this field should not only include the intensity of sound but also what types of sound an individual may acclimate or prefer to be awakened. Imaginative sleep arousal techniques for B-0 watchstanders and other first responders should continue to be examined, such as the wasabi fire alarm (using a wasabi mist to awaken those who cannot hear; Warren, 2011).

Data from the current study supports the notion that better sleep can be obtained through better sleeping conditions. Although these results were based on a subjective, self-report survey, the collective experiences of the respondents suggested there is considerable room for improvement within the sleep and crew rest environments that B-0 watchstanders reside in on a daily basis. Future research should further explore habitability factors associated with the sleep and sleep inertia experiences of B-0 pilots and aircrew using less subjective approaches. For instance, a follow-on study might investigate whether there are quantifiable differences in performance between watchstanders who are awoken from sleep in an ideal berthing space compared to their operational sleeping conditions.

Another aspect of B-0 watchstander performance that should be further investigated is the process and transition from awakening to aircraft launch. The current study indicated that B-0 watchstanders feel their performance is degraded due to sleep inertia when awakened in the middle of the night or from a deep sleep while on duty. The literature would suggest application of white light as a sleep inertia mitigation strategy; however, this method may not work for the population of this study. USCG B-0 watchstanders, more often than not, need to maintain their night vision as well as increase performance during the 30 minute launch window from awakening until take-off. All Coast Guard aircraft are currently night and Night Vision Goggle (NVG) adapted, such that they contain red and green lighting to allow the crew's vision to remain night adapted and eliminate their NVGs from being washed out. Future research should examine whether use of white light is appropriate as an awakening strategy for this population, or if it causes more harm than good by reducing night vision adaptation.

Lastly, B-0 watchstanders under ideal conditions should be able to awaken from a deep sleep, plan their flight, transit to their aircraft, start their aircraft, and take-off all

within a 30 minute window. Future research should explore habitability and process-optimization strategies for reducing error, increasing efficiency and consistency of operations, and maximizing overall total system performance across these procedures. In this type of research, objective measures may include: distance and time traveled to the aircraft and planning center from the rest facility after awakening from sleep, performance and biometric data, decision making and cognitive performance, and even aircraft start up time.

This thesis examined habitability features in relation B-0 watchstanders' sleep and sleep inertia experiences. Habitability, however, is just one of several HSI domains. To reap the benefits of HSI, a multi-domain approach is preferred, as this allows for decision-makers to consider tradeoffs between domains given limited resources (Clark & Goulder, 2002). By doing so, HSI optimizes total system performance.

APPENDIX A. SURVEY QUESTIONS

SLEEP INERTIA AND CREW REST FACILITIES IN U.S. COAST GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE

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Consent

Naval Postgraduate School
Consent to Participate in Research

Introduction. You are invited to participate in a research study entitled "Sleep inertia and crew rest facilities in U.S. Coast Guard alert-duty watchstanders". The purpose of the research is to investigate the prevalence and severity of sleep inertia among USCG pilots, determine factors contributing to the sleep inertia, and the mitigation strategies they report using.

1. Participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you would otherwise be entitled, and you may discontinue participation at any time without penalty or loss of benefits to which you otherwise would be entitled.
2. The purpose of the research is to investigate the prevalence and severity of sleep inertia among USCG pilots, determine factors contributing to the sleep inertia, and the mitigation strategies they report using.
3. Breach of confidentiality is the possible risk.
4. Results of this study will be used to determine areas of improvement in accordance with the best practices of Human Systems Integration.
5. The alternative of participation is not to participate.

Procedures.

- Please answer each question to the best of your ability.
- This survey will take approximately 30 minutes to complete.
- Approximately 800 aviators will be invited to this study.
- No monetary compensation will be given to complete this study.

Location. On line. The survey will be supported by LimeSurvey.

Cost. There is no cost to participate in this research study.

Compensation for Participation. No tangible compensation will be given.

Points of Contact. If you have any questions or comments about the research, or you experience an injury or have questions about any discomforts that you experience while taking part in this study please contact the Principal Investigator, Dr. Nita L. Shattuck, (831) 656-2281, nlishattu@nps.edu. Questions about your rights as a research subject or any other concerns may be addressed to the Navy Postgraduate School IRB Vice Chair, Mr. Bryan Hudgens, 831-656-2039, bryan.hudgens@nps.edu.

Statement of Consent. I have read the information provided above. I have been given the opportunity to ask questions and all the questions have been answered to my satisfaction. I have been provided a copy of this form for my records and I agree to participate in this study. I understand that by agreeing to participate in this research and signing this form, I do not waive any of my legal rights.

Select 'yes' if you consent to participate in the research.

Select 'no' if you do not consent to participate in the research.

☐ Yes ☐ No

Load unfinished survey

Resume later

Next >

Exit and clear survey

73

SLEEP INERTIA AND CREW REST FACILITIES IN U.S. COAST GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE

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Section I: Basic Information

What is your age (in whole years)?
Only numbers may be entered in this field.

What is your sex?

☐ Female ☐ Male ☒ No answer

What is your approximate height in inches (rounded to the nearest whole inch)?
Only numbers may be entered in this field.

What is your approximate weight in pounds (rounded to the nearest whole pound)?
Only numbers may be entered in this field.

[Resume later](#)

[Next >](#)

[Exit and clear survey](#)

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Section ID: Demographics

Please choose your current designation/qualification:

Please select at most one answer

- ☐ Flight Examiner (FE) or Instructor Pilot (IP)
- ☐ Aircraft Commander (AC)
- ☐ First Pilot (FP)
- ☐ Co-Pilot (CP)

Please choose the highest designation/qualification you have held in the U.S. Coast Guard:

Please select at most one answer

- ☐ Flight Examiner (FE) or Instructor Pilot (IP)
- ☐ Aircraft Commander (AC)
- ☐ First Pilot (FP)
- ☐ Co-Pilot (CP)

In months, how long have you been qualified for military (including prior service experience) duty involving flight? (e.g. 2 years, 1 month would be 25 months)

Each answer must be at least 0

Only integer value may be entered in this field.

Total number of military flight hours (approx.):

Each answer must be at least 0

Only integer value may be entered in this field.

Round to the nearest whole number.

What aircraft are you currently flying?

Choose one of the following answers

Please choose...

Where are you currently stationed (city, state):

City:

State (abbreviation please):

What are your current bravo zero (B-0) duty hours?

Only numbers may be entered in these fields.

Each answer must be between 0000 and 2400

Weekday start time (HHMM):

Weekday end time (HHMM):

Weekend start time (HHMM):

Weekend end time (HHMM):

Example: 3PM turnover and 8AM relief would be 1500 and 0800 respectively

In your current position, how much flight time do you usually log each month (hrs)?

Only numbers may be entered in this field.

In a given month, approximately how many bravo zero (B-0) duties do you stand each month?

Each answer must be between 0 and 32

Only integer value may be entered in this field.

While on B-0 duty, approximately how many unscheduled launches (SAR, LE, MEP, etc.) are you requested to fly on each month?

Choose one of the following answers

Please choose...

Approximately, how many hours do you sleep on average during a typical bravo zero (B-0) pilot duty?

Only numbers may be entered in this field.

Each answer must be between 0 and 24

Return later

Next >

Exit and clear survey

0%  100%

Section III: Sleep quality on duty
 The following questions pertain to the quality of sleep you get while on Bravo Zero (B-0) duty.

Compared to your ideal rest/sleep environment, how would you rate your overall sleep quality while on B-0 duty?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than Adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

Compared to your ideal rest/sleep environment, how would you rate the lighting in your duty room?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

Compared to your ideal rest/sleep environment, how would you rate the temperature control in your duty room?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

Compared to your ideal rest/sleep environment, how would you rate the noise level in your duty room?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

Compared to your ideal rest/sleep environment, how would you rate your overall comfort in your duty room?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

[Resume later](#)
[Next >](#)
[Exit and clear survey](#)

SLEEP INERTIA AND CREW REST FACILITIES IN U.S. COAST GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE

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Section IV: Sleep quality at home or off-duty residence
The following questions pertain to the quality of sleep you get while at home or off-duty residence.

Compared to your ideal rest/sleep environment, how would you rate your sleep quality off-duty?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

Compared to your ideal rest/sleep environment, how would you rate the lighting off-duty?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

Compared to your ideal rest/sleep environment, how would you rate the temperature control off duty?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

Compared to your ideal rest/sleep environment, how would you rate the noise level off duty?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

Compared to your ideal rest/sleep environment, how would you rate the overall comfort off duty?

Choose one of the following answers

- ☐ Problematic
- ☐ Less than adequate
- ☐ Adequate
- ☐ More than adequate but less than ideal
- ☐ Ideal
- ☐ No answer

Please enter your comment here:

SLEEP INERTIA AND CREW REST FACILITIES IN U.S. COAST GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE

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Section V: Frequency of awakenings while on duty

The following questions pertain to the frequency of awakenings while on bravo-zero (B-0) duty.

Given all of the overnight duties you have stood in the Coast Guard, what percentage of duty nights are you awakened during sleep for a mission?

Only numbers may be entered in this field.

Each answer must be between 0 and 100

? 0-100%

Given all of the overnight duties you have stood in the Coast Guard, what percentage of duty nights are you awakened during sleep for external/non-mission related reasons?

Only numbers may be entered in this field.

Each answer must be between 0 and 100

? 0-100%

e.g. doors slamming, street noises, etc.

Given all of the overnight duties you have stood in the Coast Guard, what percentage of duty nights are you awakened during sleep for internal or personal reasons?

Only numbers may be entered in this field.

Each answer must be between 0 and 100

? 0-100%

e.g. stress, bathroom visits, etc.

SLEEP INERTIA AND CREW REST FACILITIES IN U.S. COAST GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE

0% 100%

Section VI: Sleep inertia while on duty

The following questions pertain to the prevalence, severity and duration of sleep inertia experienced while on bravo-zero (B-0) duty.

Given the definition: Sleep inertia is the state of lowered arousal associated with decreased performance and is the primary reason why we often feel groggy or sleepy in the morning (Tassi & Muzet, 2000)

As a percentage, how often do you experience sleep inertia while standing B-0 duty when awakened from a sleep event for an unscheduled sortie/launch (SAR/LE/ etc.)?

Only numbers may be entered in this field.

Each answer must be between 0 and 100

? 0-100%

How would you rate the intensity of sleep inertia that you experience on duty?

Choose one of the following answers

- ☐ Insignificant
- ☐ Minor
- ☐ Mild
- ☐ Major
- ☐ Extreme
- ☐ No answer

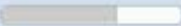
How long (in whole minutes) after awakening does sleep inertia affect you on duty?

Each answer must be between 0 and 1440

Only integer value may be entered in this field.

? Rounded to the nearest whole minute

SLEEP INERTIA AND CREW REST FACILITIES IN U.S. COARD GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE

0%  100%

Section VII: Sleep inertia at off-duty residence

The following questions pertain to the prevalence, severity and duration of sleep inertia experienced while at home or your off-duty residence.

Given the definition: Sleep inertia is the state of lowered arousal associated with decreased performance and is the primary reason why we often feel groggy or sleepy in the morning (Tassi & Muzet, 2000).

As a percentage, how often do you experience sleep inertia while off duty?
Only numbers may be entered in this field.
Each answer must be between 0 and 100

? 0-100%

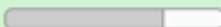
How would you rate the intensity of sleep inertia that you experience off duty?
Choose one of the following answers

- ☐ Insignificant
- ☐ Minor
- ☐ Mild
- ☐ Major
- ☐ Extreme
- ☒ No answer

How long (in whole minutes) after awakening does sleep inertia affect you off duty?
Each answer must be between 0 and 1440
Only integer value may be entered in this field.

? Duration in whole minutes

SLEEP INERTIA AND CREW REST FACILITIES IN U.S. COARD GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE

0%  100%

Section VIII: Current practices

The questions below pertain to the current practices and techniques to limit sleep inertia and increase alertness while on duty.

What do you do to help become more alert and increase your performance when awakened from a sleep event?

Check any that apply

- ☐ Caffeine
- ☐ White Light Exposure
- ☐ Noise Exposure
- ☐ Water and/or damp cloth to the face
- ☐ Exercise
- ☐ Nothing, I don't engage in any special strategy
- ☐ Other:

? If you answered other, please specify.

0%  100%

Section IX: Preferred Awakening Technique

The questions below pertain to the preferred awakening technique(s) while on bravo zero (B-0) duty.

Rate each method of awakening from a sleep event while on B-0 duty:

SAR Alarm over intercom system:
Choose one of the following answers

- ☐ Highly Dislike
☐ Dislike
☐ Indifferent
☐ Prefer
☐ Ideal
☒ No answer

Please enter your comment here:

Personal Pager System:
Choose one of the following answers

- ☐ Highly Dislike
☐ Dislike
☐ Indifferent
☐ Prefer
☐ Ideal
☒ No answer

Please enter your comment here:

Cell Phone Call
Choose one of the following answers

- ☐ Highly Dislike
☐ Dislike
☐ Indifferent
☐ Prefer
☐ Ideal
☒ No answer

Please enter your comment here:

Knock on the door.
Choose one of the following answers

- ☐ Highly Dislike
☐ Dislike
☐ Indifferent
☐ Prefer
☐ Ideal
☒ No answer

Please enter your comment here:

Other/Please Specify:
Choose one of the following answers

- ☐ Highly Dislike
☐ Dislike
☐ Indifferent
☐ Prefer
☐ Ideal
☒ No answer

Please enter your comment here:

SLEEP INERTIA AND CREW REST FACILITIES IN U.S. COAST GUARD ALERT-DUTY WATCHSTANDER PERFORMANCE

0%  100%

Section X: Recommendations

The questions below pertain to recommendations on how to improve sleep on duty and reduce sleep inertia if awakened as well as other comments or recommendations.

Based on your understanding of fatigue, rest, and sleep inertia; what would you change to your unit's duty room/spaces/policies to improve sleep conditions and/or reduce sleep inertia?

Please enter any other comments or suggestions you have regarding this study.

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APPENDIX B. HABITABILITY STUDY APPARATUS



Features

Specifications

Downloads

Accessories

- High accuracy $\pm 1.4\text{dB}$ meets ANSI and IEC 61672-1 Type 2 standards
- 30 to 130dB measurement range
- Auto or Manual ranging
- AC analog output for connection to an analyzer or recorder
- Large backlit LCD display
- Stores 99 readings manually and 20M readings via 2G SD card
- Datalogger date/time stamps and stores readings on an SD card in Excel® format for easy transfer to a PC
- User programmable sampling rate: 1 to 3600 seconds
- Min/Max, Data Hold, Auto Power Off
- Complete with 6 AA batteries, SD Card, wind screen, and hard carrying case

Extech SDL600: Sound Level Datalogger. Source: Extech Instruments (2019).

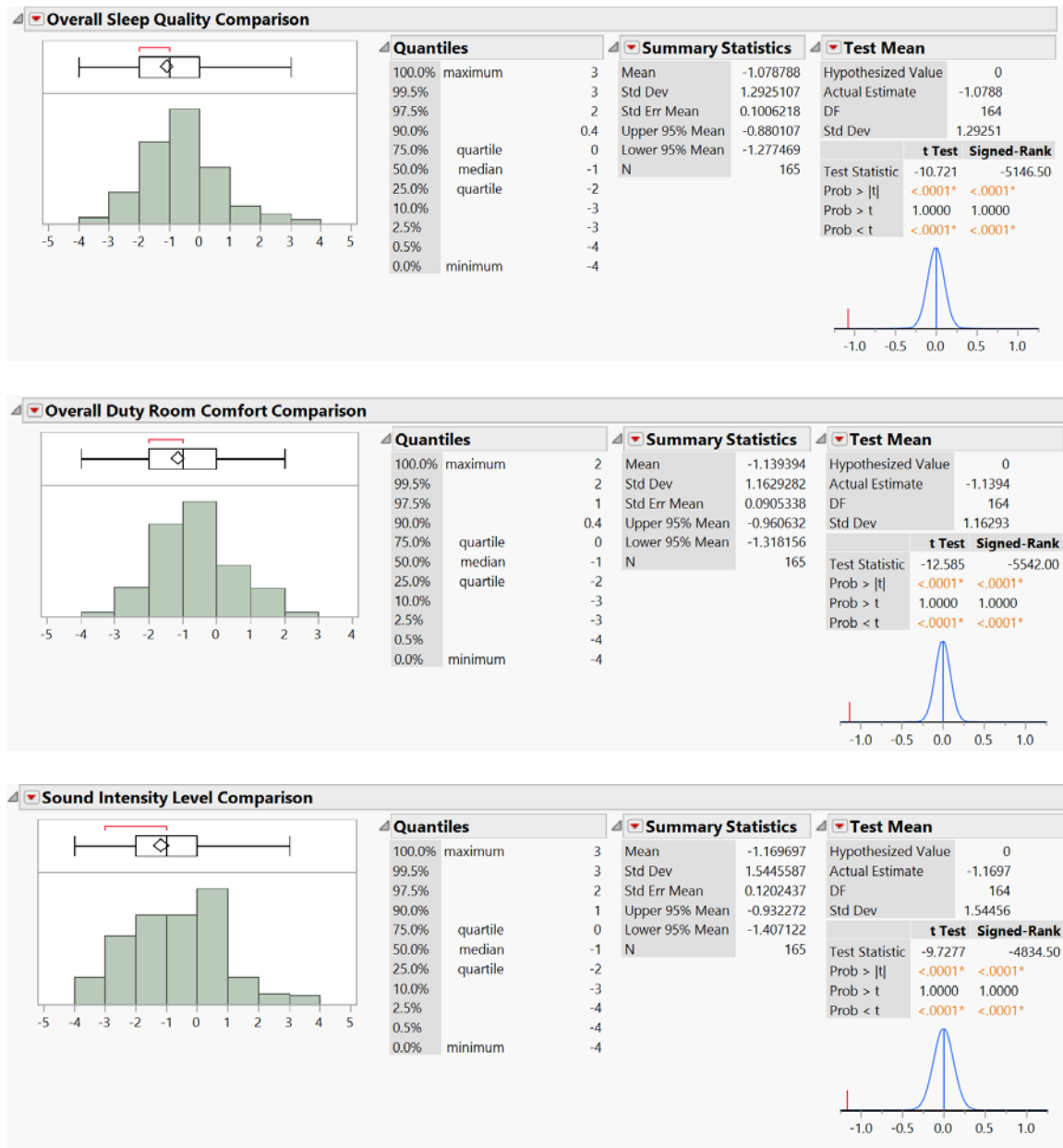


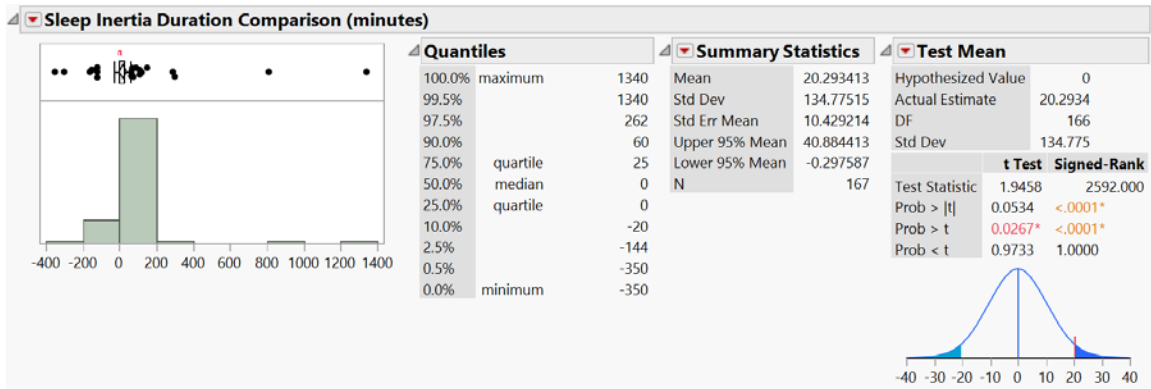
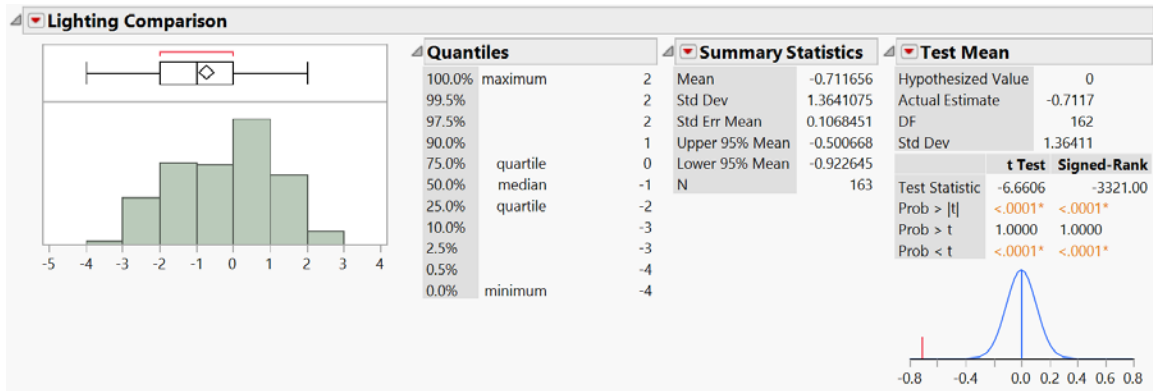
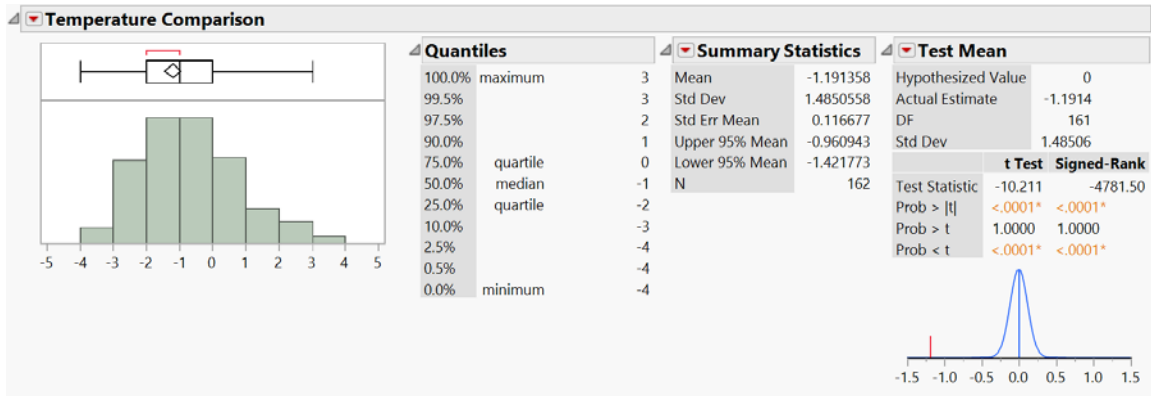
Measurement						Range
Temperature:	-20°	to	70°C	(-4°	to	158°F)
Light:	0 to 320,000 lux (0 to 30,000 lumens/ft²)					
Accuracy						
Temperature:	± 0.53°C from 0° to 50°C (± 0.95°F from 32° to 122°F), see Plot A in manual					
Light intensity:	Designed for measurement of relative light levels, see Plot D for light wavelength response					
Resolution						
Temperature:	0.14°C	at	25°C	(0.25°F	at	77°F), see Plot A in manual
Drift:	Less than 0.1°C/year (0.2°F/year)					

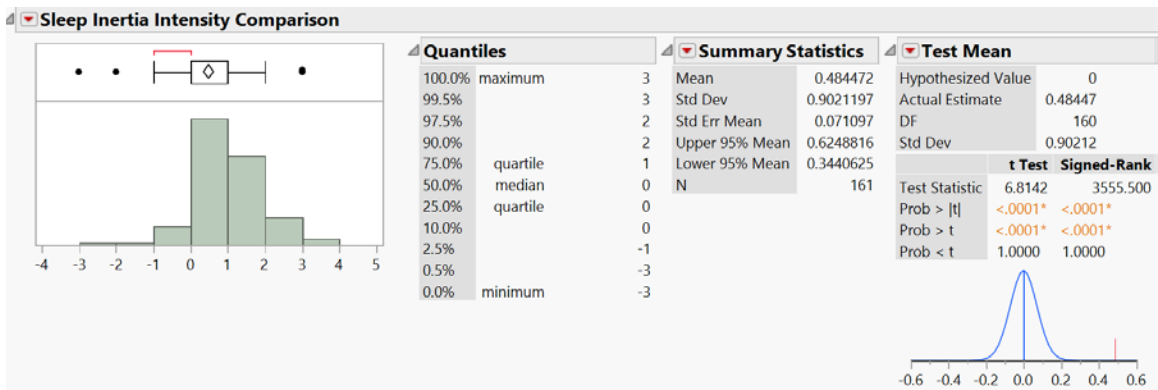
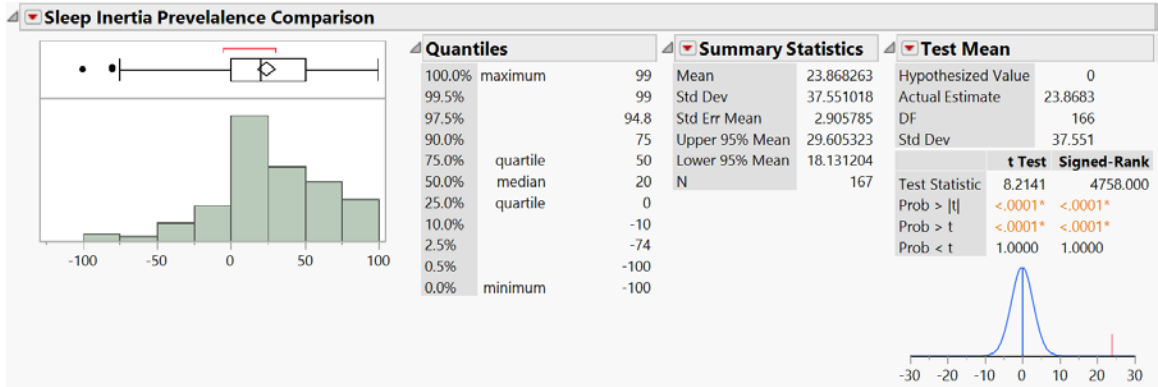
HOBO by Onset Data Logger. Adapted from Onset Computer Corporation (n.d.).

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APPENDIX C. COMPARISON TEST RAW STATISTICAL OUTPUT







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APPENDIX D. OPEN-ENDED SURVEY RESPONSES

A. (SleepQualDuty1) Compared to your idea rest/sleep environment, how would you rate your overall sleep quality while on B-0 duty.

1. Room quality is sub par, rats occasionally die in the overhead, and I don't sleep great with the ventilation in the room.
2. Perpetually stay in "light" sleep mode
3. I sneeze out of control in the duty rooms. Mold or something in the AC system.
4. Bed is comfortable, but not YOUR bed...
5. Rooms do not have individual control of the environmental control system. Room temps often set low. The provided bedding is worn and inadequate. I have to stack multiple blankets to stay warm enough through the entire night.
6. Facilities are aged and generally inadequate. The walls are so "thin" I routinely wake up when the ODO phone rings two rooms down the hall.
7. ODO phone ringing, tossing/turning in different bed, and often a poorly cobbled together evening meal.
8. We sleep in buildings that are 75 years old. Air flow is terrible.
9. Adequate rest facilities. I don't rest well because I am constantly anticipating a SAR launch.
10. I do not sleep on B0 duty. I stand strip alert for RWAI mission, max duty day is 12 hours.
11. Noisy space, pipes can be heard in duty rooms regardless of crew rest requirements (ie colors). Command expectation that duty pilots be awake for command morning brief regardless of if the crew can reset or not.
12. I wake up much more frequently while on duty.
13. We have poor beds in our Duty Rooms and BPR process has been difficult to procure replacements.
14. Shared sleeping space, old building, less than ideal drinking water and food prep space.

15. I do not stand B-0 duty. I am an RWAI-Only aviator. I do 6–7 18 day trips per year to the NCRADF. I stand 6 days of day shift (0545-14450), have 48 hours off, stand 6 days of night shift (1445-0000), have 24 hours off, then stand 3 mid shifts (0000-0600). On shorter dRWAI trips I stand a set duty rotation for the duration of the TFR.
16. Restful sleep is tough to obtain when going to bed on alert.
17. allergies are awful in the BOQ. Have thought about sleeping elsewhere.
18. Beds are comfortable, AC works, rooms are dark, but it isn't home.
19. The facilities (Air conditioning, sleeping arrangements, bedding, etc.) do not fully support a good night's rest.
20. Unable to adjust heat/cooling in individual rooms; duty rooms abnormally hot, w/ central heater unable to be turned off, during summer months. Boiler broken half of the winter and using multiple space heaters trips circuit breakers to the rooms.
21. Rooms are okay. We have a mosquito issue right now and we're right next to the runways so the planes keep us up a lot.
22. Collateral duties, coupled with the work environment keep me from getting good rest.
23. No kids around but noises(especially if sleeping in for case) and unfamiliar environment not ideal.
24. SAR alarm is sounded to launch C130 even if H65 crew is not being launched. This occasionally makes a full night of rest unlikely. But this is not the norm.
25. Terrible beds everywhere I have stood duty. Supply departments do not always let new beds or high quality beds be purchased.
26. Hard to get comfortable and get into a normal wind-down routine for sleep. I rarely get a good night's sleep while on duty.
27. Mattresses suck
28. Poor air quality. Wake up in RCB with nose stuffy. High moisture and I'm pretty sure mold in RCB.
29. I've been in the game long enough that anticipating the SAR alarm does not keep me up, but the duty bed causes hay fever symptoms.

30. The main problem is noise, be it from inside the building or people/animals outside.
31. I'm an ALPATER, my data may skew your survey. We sleep on a ship, which is to say we are sleep deprived for weeks on end.
32. Stressful sleep, constantly waking up thinking the alarm is going off.
33. Never sleep as good as at home
34. Noisy doors, late night trainers.
35. At home
36. Between duty rooms and being hyper vigilant about noises waiting for the alarm, sleep is hard to come by
37. You have anxiety knowing that the radio or alarm could go off any second.
38. I don't sleep well here, there is noise from phone calls all night that wake me up. I constantly worry about getting launched. There is lots of noise from outside the room.
39. Berthing is dirty (musty) and the bed is very uncomfortable, but it gets the job done.
40. Duty rooms have climate control issues; mattresses different than home are less comfortable cause waking periods throughout the night to shift around
41. Bed quality, structure noise, daylight suppression all play a part.
42. Aging infrastructure, bad ventilation, pests in the ceiling (rodents) running around. Inability to control climate in room.
43. The bed is gross, would be nice if we had a sheet contract like my previous unit.
44. Poor ventilation/temperature control for duty rooms. our building is a giant mold spore.
45. Inadequate time to adapt to day-night-mid shift while standing RWAI Alert Duty at NCR.
46. Day shift is 0430 wakeup, mids are 0000–0600. Duty cycle shifts make regular sleep difficult.

- 47. Unable to sleep due to strip alert launch requirements
- 48. The barracks at ATC are excellent but I still never get a restful night of sleep. I don't believe it's an issue with the physical environment of the barracks but rather the stress involved with standing a B-0 duty.
- 49. Our Air Station is at the international airport with commercial flights all night. Extremely noisy.
- 50. AC's often shortcycle, room isn't dark enough, can be noisy.
- 51. We got new mattresses not too long ago that are nice and the RCB is cool and quiet.
- 52. No kids waking me up
- 53. Rooms are equivalent to a sketchy motel 6.
- 54. New building came with very uncomfortable (hard) mattresses. Supply bought foam toppers to mitigate.
- 55. We have dual B-0, so that other brief time is 1200. Along with normal non-duty days show at 0730. Potential for four different work hours in a given 7 day period.
- 56. Mold/air quality issues
- 57. I have lower than normal cases

B. (SleepQualDuty2) Compared to your ideal rest/sleep environment, how would you rate the *lighting* in your duty room?

1. Fairly well blacked out, but Hawaii doesn't have long daylight hours in the summer time to mess with sleep schedules.
2. Not dark enough
3. One small window. Curtain is falling down from the top so light is coming in. Keep meaning to Jury rig it
4. Blinds & curtains, but curtains dilapidated.
5. Lighting is adequate, I would like to have darkening shades over the windows. Currently we have standard blinds.
6. Cheap blinds that have broken panels
7. I do not sleep on B0 duty. I stand strip alert for RWAI mission, max duty day is 12 hours.
8. The blackout curtains help.
9. We have blackout curtains
10. Summer time in Alaska with poor blackout curtains. BPR process has made it difficult to procure suitable replacements.
11. Has blackout window covers.
12. During the summer sunlight enters the room before completing an eight hour sleep. While duty crews will have 10 hours for crew rest and 8 hours for sleep the sunlight interrupts sleep at 6 hours.
13. Blackout curtains were recently removed, making sleeping after late night case difficult
14. Slatted shade with slats missing. I typically bring and eye mask to compensate.
15. Only sleep in there.
16. Depending on the rooms some are dark, but the blinds don't work well or keep light out in others.
17. N/A

18. We have cordless blinds!...unfortunately they are so old that the cord used to retract/adjust them has broken off and they are permanently in the down position and do very little light filtering. They are also delaminating. Installed lighting is adequate.
19. Co-pilot room nice and dark, AC room not dark if sleeping in after a late case.
20. The thick, light-blocking shades make sleep relatively easy.
21. Light from the hallway shines through the (huge) crack under the door. I usually put a towel on the floor to make the room dark.
22. No real issues. Dark curtains and a roll to hide the light that comes in under the door.
23. We need blackout curtains
24. The only time it becomes a problem is during the summer months when it gets light very early
25. Again, on a ship, 378s are just terrible.
26. Better black out curtains and fluorescent overhead lighting is not good for getting ready for sleep.
27. Blackout curtains help.
28. Florescent lights are not helpful for sleep prep. Window shades are barely adequate in the Morning
29. N/A
30. No complaints with lighting in the duty rooms
31. More light than I normally sleep with gets in
32. The duty room hasn't changed since the 1970s. We have no money to fix it. If we did have money the process to fix such things is worse than anyone could imagine. Thought of by the same committee that came up with the soup sandwich and football bat.
33. Lamp and overhead lighting.
34. Extended daylight hours combined with insufficient window coverings make sleeping difficult

35. We could use some better bedside lamps than old GSA specials. Overhead florescent lights are fine.
36. I try to use natural light and avoid the bright halogens
37. we have blackout curtains which is nice.
38. Push to use LED lighting resulted in overly bright LED lights being installed in duty rooms.
39. The RWAI mission does not employ individual duty rooms. Common spaces are shared and lighting configurations are not standardized.
40. I usually cover up the computer lights but besides that the lighting control is excellent.
41. Too bright from outside sources
42. There are overhead lights and a lamp.
43. Black out shades
44. It hums when energized, but otherwise, ok.
45. Aluminum blinds do not seal out light. Also, windowsills do not have edge, so light filters around the blinds as well. Hard to sleep past sunrise. Funding not secured (over a year) for blackout curtains. Also, crack under door lets in lots of white light from hallway. No way to dim hallway lights or make them red.
46. Black out curtains very helpful
47. Dimly lit. It is fine for sleeping, not for much else.

C. (SleepQualDuty3) Compared to your ideal rest/sleep environment, how would you rate the *temperature* control in your duty room?

1. Not very cool and poor air circulation
2. Rooms do not have individual control of the environmental control system. Room temps often set low. The provided bedding is worn and inadequate. I have to stack multiple blankets to stay warm enough through the entire night.
3. It is controlled well for the hall, but I have no individual control.
4. There is a thermostat in the room. It can be difficult at times to regulate the temperature.
5. Having autonomous temperature control of the room would be ideal.
6. I do not sleep on B0 duty. I stand strip alert for RWAI mission, max duty day is 12 hours.
7. Can open a window but then noise from birds is problematic.
8. You cannot control the temperature and the thermostat is set too cold for the blankets provided.
9. Temp control is substandard. Typically have to crack open a window to cool the room down. Not ideal when it comes to living next to the airport.
10. Unless were spending the night somewhere, then it would be problematic.
11. Recently installed system works, but has a vibrating noise that happens every 10 minutes that is loud and interrupts sleep. Manufacturer has stated that this is normal for the “industrial” system. Currently duty standers either unplug the system or use a noise machine.
12. Always too hot and muggy.
13. It gets cold!
14. Air Conditioning systems consistently have issues and I wake with irritated throat and sinuses.
15. Temp control is normally inop

16. Unable to adjust heat/cooling in individual rooms; duty rooms abnormally hot, w/ central heater unable to be turned off, during summer months. Boiler broken half of the winter and using multiple space heaters trips circuit breakers to the rooms.
17. HVAC isn't great in the rooms, and you can't open the windows because of the mosquitos.
18. No air conditioning for warmer nights
19. Co-pilot room you wake up every couple of hours either sweating or cold.
20. There is no individual temperature controls. Additionally, members have a tendency to take the fans out of duty rooms for use in their offices. While I am comfortable with the temp, I do know some who struggle.
21. It is either too hot or too cold. Never just right.
22. Duty room temp is fine, but the thermostat in the room doesn't alter the temp at all.
23. Typically holds what you ask, but they are infrequently out of service. This leads to portable heater/cooler and/or opening the window.
24. Have to open the window to cool it down which lets in airplane noise.
25. Duty rooms do not have individual climate controls for personal taste.
26. There is maybe 5 days a year when it gets too hot in the room but for the most part its not bad. The window can't be open when sleeping though because of all the noise outside.
27. Have actually had icicles growing on the bulkhead in my stateroom.
28. It tends to get warm in the duty room during the summer months and transition seasons when the AC is not always on.
29. Fine.
30. N/A
31. Temp seems difficult to control, occasionally requires opening windows in the summer or wearing warmer clothing in winter
32. Given the age of the building the temperature control during the winter months especially can be hard.

33. Temperature control in the room is linked to another duty room and doesn't set the temperature well.
34. Air condition is an old system. It goes out a lot.
35. I can't control the temp anywhere on base. The U.S. government has to mandate our temperature from the comfort of Washington, DC. The FACENG guy doesn't care because he works 35 hours a week is a lock for O5 and never has to sleep on base.
36. There's a couple of fans, so it gets the job done. A little AC window unit would be ideal
37. Installed central systems are old/in ill repair and not zoned by duty room; space heaters/cooling units are used to compensate poorly and are often loud/annoying.
38. There is no way to control the temperature. Windows cannot physically be opened as an alternative. With aging infrastructure currently operating with underperforming AC in a hot tropical summer environment.
39. There is no control. The room runs cold when the AC gets turned on.
40. There is no individual room control so fans are primarily used for cooling.
41. During summer months, AC cannot keep temperature in room less than 75 degrees until early morning hours when outside temperature drops.
42. new AC! very nice
43. The USCG design build of the common alert spaces did not adequately design environmental cooling systems.
44. Sometimes the heat/AC work well and sometimes they don't.
45. Turning on the heat causes the fire alarms to go off. Bringing extra blankets and closing the windows usually keeps the rooms warm enough.
46. Works ok when it's working, fails about one time per quarter Temp can't be controlled but we have an overhead fan you can adjust.
47. 69
48. I don't really have control over the temp in my room. There's a fan and a blanket though, that's all.

49. Rooms individually controlled; however, during some months when it is in between hot/cold, all rooms are controlled by Hot/Cold by master thermostat. Temps can be controlled within either Hot or Cold range, but master setting must be agreed on by duty crews. Usually can be worked out fine.
50. We have lots of HVAC issues in which the temperature is WAY too hot or WAY too cold. FACENG can't seem to ever fix it.
51. Cool room, OOA 67 degrees

D. (SleepQuality4) Compared to your ideal rest environment, how would you rate the noise level in your duty room?

1. Sometimes can be loud due to air handlers beeping and thin walls to adjacent duty rooms. If you're sleeping in for crew rest there is no way to avoid noise in the rooms as they are just across the hall from the open and bull pen.
2. I can hear the phone everytime it goes off in the OOD room. When they do fuel samples in the morning I can hear the hangar doors make their alarm sound when they get raised.
3. Lots of noise in the hallway from other pilots (and currently cadets)
4. My room is right next to the stair well. If the helo crew gets launched or the watch captains have to address a problem, I hear a door slam and people running up/down the stairs
5. Facilities are aged and generally inadequate. The walls are so "thin" I routinely wake up when the ODO phone rings two rooms down the hall. Additionally, nighttime engine runs by the fixed wing maintenance teams are loud enough, even through exterior walls, to occasionally wake me up.
6. Phone ringing for ODO (non-SAR) is the worst offender. Generally ok otherwise.
7. You can hear nights running engines and you can hear vehicles driving by.
8. Quiet hours are posted outside the duty rooms, which helps keep the noise down.
9. Birds, boat station, pipes ect. Not good
10. The door to the locker room is outside duty room and people go in and out of it in the morning.
11. Can easily hear adjoining room activities, most notably shower.
12. No sound insulation between bunkrooms, unpredictable noise level based on personnel and operations.
13. Very little sound proofing in duty rooms. You can easily hear activity in the hallway and outside noise.
14. Unless were spending the night somewhere, then it would be problematic.
15. Room is next to exterior door that slams loudly when closing. Members use that door throughout the night.

16. Noise machine to hide noise of HVAC system. Occasionally non-rate BEQ residents are loud after 2200 interrupting duty sleep.
17. Air Sta San Fran is located on SFO property with commercial airline ops taking off and landing all night.
18. duty room is adjacent to the hangar where nights works till late completing maintenance. Additionally, the hangar door movement alarm wakes me up about 45 minutes prior to my intended wake up time due to morning aircraft checks.
19. Were sleeping at an airport.
20. Attached to a Sector, every morning from 0630 onward, it sounds like a stampede going up and down the stairway that backs up to all the duty bunk rooms.
21. You can hear every plane taking off
22. N/A.
23. Affected by being in hallway next to offices
24. Thin walls, mixed with toilets that apparently flush with the force of a hurricane, make it a little harder to sleep fully while standing duty with someone who has a late night head visit.
25. We're on the departure end of the runway at SFO, it get's loud sometimes.
26. Located next to the runway and unit, the soundproofing is insufficient to sleep through noise.
27. Heavy cargo aircraft take off during early morning hours.
28. If I sleep with ear plugs in.
29. There are 4 pilot duty rooms at ASBP. The senior CP room is directly across the hall from the locker room. At about 0500, the locker room door begins to slam as people show up for work. And it's difficult to stay asleep.
30. The duty rooms are adjacent to the office spaces. The office spaces are shared with non duty standers who don't pay particular attention to noise level.
31. Very quiet. Only hear your neighboring duty member if they plug something into or bump the adjoining wall.
32. Have to open the window to cool it down which lets in airplane noise.

33. Planes, cars, etc.
34. The duty rooms border the locker room and the wardroom and you can hear any type of activity going on in either of them. Outside, colors is piped every morning in all of the spaces, we have other units in a close proximity that conduct maintenance and audio tests early in the morning. The other major problem is the Canadian Geese and Seagulls that over populate the base make lots of noise throughout the night.
35. Ever sleep on top of a running car's engine, without a muffler?
36. Thin walls and doors are noisy.
37. Rooms are close to flight line and noise level from aircraft operations can impact sleep quality.
38. Thin walls
39. Noisy when others get up early or on a case (dual airframe).
40. N/A
41. I am a very light sleeper and there always seems to either people's doors opening and closing, which are very loud or the ventilation system is loud.
42. Were at an airport so....
43. You can literally hear the person in the other room cough
44. Duty room is right near the hanger so when mids is doing mx and they open the hangar doors you here the opening and closing alarm for the hangar door.
45. Its way too loud. C130 pilots eating chips. Constant phone calls to the ODO that wake me up regarding flights that aren't mine. I live 10 minutes from base. Why can't I just sleep in my bed.
46. All the airline traffic is very loud in the duty rooms.
47. Excepting cooling unit noise mentioned above, rooms are well sound insulated enough
48. Building structure amplifies hallway noise

49. Two airframe unit, so the SAR alarm could be for the other airframe. RCB for pilots is in the vicinity of office areas so people arriving or leaving late from work opening and shutting doors is very loud. Critters running around in the ceiling/crawl space.
50. You can hear the CP urinating or showering. Rooms are not soundproofed.
51. Night time engine runs are loud and interrupt sleep.
52. Any passing vehicle traffic is heard and movement from adjoining room is also heard.
53. thin walls, but its fine. If a neighboring room has a phone or alarm go off it wakes me up.
54. Alert crews must monitor 24/7 FAA's Domestic Events Network (DEN).
55. The walls at ATC Mobile are very thin and you can hear everything in the hallway and in the rooms adjacent to you. It's a known issue here but it still causes disturbances in rest.
56. Doors are loud in the duty room area.
57. Commercial flights at the airport occur all night.
58. Any noise from the hallway can be heard, as well as large commercial traffic landing, and A/C cutting in and out about once per minute.
59. Constant noise from machines outside duty rooms. Loud airplanes constantly passing by throughout the night.
60. Right next to San Diego International airport.
61. Jack and Jill bathroom shared with other pilot that lets in tons of noise. Doors aren't all the way to the floor going into the hallway because the command has to comply with some BS hotel regulations...even though we certainly aren't in a hotel on base.
62. Sounds like one of the windows was not sealed properly when wind is greater than 15 knots (which it often is here).
63. Army base has helos and fixed wing landing throughout early morning hours. Also 'pipes' throughout base as late as 2300 and early as 0630.

64. Can hear the duty phone ring from ODO room. Wake up from random phone calls at night
65. I have never heard a noise from the AIRSTA Savannah duty room. I have heard noises in the AIRFAC Charleston Duty rooms. Other duty doors opening and closing.

E. (SleepQualDuty5) Compared to your idea rest/sleep environment, how would you rate your overall comfort in your duty room?

1. Mattresses are fairly new but I don't think I sleep well on the foam mattresses.
2. In particular our copilot duty room. The mattress has a large divit in the middle because the mattress isn't designed for the bed frame. The AC room is good though
3. Would like the mattress liner to be cleaned daily
4. I bring a blanket to stay warm.
5. Mattress is good.
6. Sleep environment is adequate but it is very easy to be woken up if there is any noise at all (ex: other duty crew gets launched in the middle of the night)
7. Unless were spending the night somewhere, then it would be problematic
8. Comparable to a typical hotel.
9. outdated rooms in poor condition. recent changes have been made to get new beds, but everything else is still outdated.
10. Spend as little time in the room as possible.
11. It is better than a cutter rack, but it isn't home
12. Bedding and temperature are the two biggest factors that affect the quality of sleep I get, and both are sub-par.
13. Uncomfortable bedding
14. A bed, desk, and a recliner enable a relaxing environment for the 24 hour duties.
15. The duty rooms could be better, but not without a major redesign of the facilities. They meet the basic requirements.
16. Duty room is ok. The lounge area is terrible.
17. All of the metrics are good, but I have a hard time getting comfortable and sleeping soundly while on duty.
18. High moisture content. Poor air quality.

19. We recently received new mattresses but they were put on old box springs which almost negate the new mattress. The other major problem is the noises.
20. It's referred to as the telephone booth, and two of us share the space.
21. I need to bring better bedding. But that's my fault.
22. N/A
23. The station does a great job at purchasing new linens, mattresses, etc. Everyone has their own bathroom and facilities are regularly cleaned. However, a mint or fresh flowers in the room occasionally would be nice.
24. Gets the job done
25. The recently new beds make it adequate. Comforter feels dirty and I always bring my own sheets. Our contract doesn't call for fitted sheets on our beds and eventually those non fitted sheets fall off so I bring my own now. Bring my pillow too.
26. Bed is pretty uncomfortable and dirty (stained).
27. Gets the job done, but could be cleaner and updated.
28. Bringing my own pillow and blanket makes sleeping manageable.
29. The RWAI mission does not employ individual duty rooms.
30. It's aight. I've had better duty rooms.
31. Bed is queen size, comfortable. Chair to study/relax in.

F. (SleepQualHome1) Compared to your ideal rest/sleep environment, how would you rate your sleep quality off-duty?

1. As a night owl, I wish I didn't have to wake up so early -7-3pm workdays shouldn't be a thing.
2. #SleepNumberBed
3. Sleep quality is great except when the kiddos wake up early.
4. I just need to decide to go to bed earlier.
5. I take OPS calls about 7-10 nights a month.
6. I have a Tempur-Pedic mattress, and I don't like it.
7. Children... that goes without saying.
8. Live in Alaska, the sun stays up until midnight in the summer.
9. Young kids at home.
10. Only due to small children
11. Depends on my kids and wife. Usually adequate, but can be less than adequate with early wake-ups, wife not sleeping well, etc.
12. I have a baby at home so I am up at 0600 every morning.
13. I typically get adequate sleep at home.
14. Great, unless a transient/homeless person is stepping on my property trying to steal my recycling at 2-3AM, activating my motion alarm. This is a real, recurring problem.
15. I have a super comfortable bed and a pitch black room.
16. I've invested in quality mattresses, shades, and climate control items to make sleep at home a priority.
17. Sleeping in a bed with someone else makes me(a light sleeper) wake up a couple of times.
18. I don't like waking up to an alarm. Could definitely sleep longer.

19. Child at home.
20. Children always wake me up.
21. My wife is awesome about letting me get good sleep, especially before duty/flight. newborn
22. Hoping to get some better shades for the summer do block out more light
23. HA, again I skew your data, I am a geo- bachelor and live in the barracks at my home unit. Less than awesome.
24. Kids!
25. AS operations officer, I frequently receive calls in the middle of the night that wake me up. While I typically am able to fall back asleep quickly, there are times that I am up for a long time before going back to sleep.
26. I have two children under the age of two at home.
27. 3 kids
28. Usually just fine but depending on flights/stresses it can be hard to get good sleep
29. If it wasn't Ideal then there is something wrong.
30. I have small children but I sleep decently at home. I have a comfortable bed and can adjust the thermostat
31. I have a 9 month old at home.
32. Better management of my home regimen would help.
33. I miss my old king size bed. Temporarily downsized.
34. Infant waking up frequently.
35. I have little kids.
36. I have young kids
37. NCRADF Permanent Party stand a mix of day, night, and overnight shift in blocks of three consecutive units. It is very difficult to fully adapt from one extreme to the other.

- 38. Usually interrupted by kids and pets.
- 39. kids under 3 years old.
- 40. Have 2 young kids and dog, so up most nights currently.
- 41. As good as you get when you're a parent of little kids.
- 42. two small children
- 43. I don't stand much duty now, but after 10 years of duty, and lots of late LE / reverse cycle jiatf, and billets at 58 degrees North latitude (abnormal light conditions), my sleep cycles are degraded.

G. (SleepQualHome2) Compared to your ideal rest/sleep environment, how would you rate the lighting off-duty?

1. Need to install blackout curtains
2. Blackout window shades
3. I could put up darkening curtains/shades, but I just haven't.
4. We're in the process of moving to BQN and the MWR housing does not have blackout curtains/blinds. The light shines bright into the room in the 0500 hour.
5. Hard to block out light completely during summer months.
6. Rental property so can't install different, more adequate total blackout curtains.
7. My wife likes night lights...
8. N/A.
9. Ability to have/use room darkening shades works well for me!
10. I've invested in quality mattresses, shades, and climate control items to make sleep at home a priority.
11. Our curtains/blinds don't do nearly enough light blocking, but I have three kids so I'm normally up early.
12. 18 hours of daylight during the summer so taping up foil on windows and trying to shut out light is actually the difficult part.
13. Spouse is very engaged in good curtains and light bulbs.
14. Kodiak summer nights...
15. I am unaware what ideal lighting is for sleep.
16. Some cultural lighting makes it through our window shades.
17. No blackout capability, gets light early in summer months.
18. I use lower wattage lights in my bedroom at home.
19. black out curtains

20. My house, my rules, I can control what goes where and what type.

21. Black out curtains

H. (SleepQualHome3) Compared to your ideal rest/sleep environment, how would you rate the temperature control off duty?

1. A/C is on its way out
2. Window AC unit in Miami = sucks
3. I can control the temp setting in my own house. The temps stay where we want them.
4. My house is comfortable.
5. No central air
6. My home doesn't have A/C, and putting in a system is beyond my budget.
7. I am cheap and would rather have a warm room than pay the electric bill.
8. I have good temperature control at my home; this provides a good environment for quality sleep.
9. User controlled temperature adjustment works well for me!
10. I've invested in quality mattresses, shades, and climate control items to make sleep at home a priority.
11. Learning to live with forced air heating. It is noisy when it kicks on and heats up the room to very hot with a gradual cool down.
12. We have central air. We set the temp. It's perfect.
13. Temp control is usually pretty good. But three times this year the BOSS contractor forgot to reset the HVAC systems after maintenance and the place gets hot enough to sweat right around 2am when it gets noticed.
14. No AC in Kodiak Base Housing
15. Summers on Cape without AC can a bit brutal, but only lasts a couple weeks.
16. No air conditioning in house, so temperature and humidity can be high during summer months.
17. I could get a nest thermostat is the CG would pay me more.

18. I have a thermostat control on the wall, but not on my phone. #firstworldproblems
19. I'm able to control the thermostat and keep my room cool.
20. Old house, no AC.
21. Freon leaks make the master bedroom AC inefficient.
22. Too cheap to crank the AC at night in my house.
23. Total control over my thermostat/AC and our fan, and tons of blankets if required.
Itssweet.
24. Even with AC, I struggle to sleep in the summer
25. Home temp 72 degrees. Cooler at duty station
26. Sleeping next to my wife is problematic. She is on a different temperature spectrum than I am. When I am alone, the temperature control is ideal.

I. (SleepQualHome4) Compared to your idea rest/sleep environment, how would you rate the noise level off duty?

1. Yard crew once every two weeks, trash truck one a week
2. Except for the kiddos being early risers, no noise problems off duty.
3. I live in a quiet neighborhood.
4. I have kids and dogs.
5. Noisy kids
6. Quiet neighborhood. Quiet neighbors
7. I have 4 kids so there is always someone keeping or waking me up.
8. Sleep with earplugs in due to proximity to other neighbors.
9. I can't hear a thing in my room.
10. N/A.
11. I've invested in quality mattresses, shades, and climate control items to make sleep at home a priority.
12. Neighbors sometimes have late parties and play loud music.
13. We live at the end of a cul-de-sac full of older folks. No issues.
14. Kids wake up early
15. Fire rated doors on the barracks mean if anyone comes or goes in the night the whole floor gets woken up. The doors are HEAVY and have a massive system to ensure they slam shut, to meet fire code. Shakes the building, wakes everyone up. Nice.
16. Kids! Dogs!
17. I wear ear plugs in the morning so the kids don't wake me up.
18. 3 kids...
19. I have kids and a dog

- 20. especially as we just installed hurricane impact windows makes it extremely quiet in side.
- 21. Baby nursery connected to my bedroom
- 22. Occasional road noise
- 23. Baby monitor.
- 24. Near a busy road.
- 25. My community tends to be noisy
- 26. Wake up every time my kids do and they make a noise... or when my wife does as well.
- 27. pretty quiet.
- 28. 4 small children
- 29. AC makes noise

J. (SleepQualHome5) Compared to your ideal rest/sleep environment, how would you rate the overall comfort off duty?

1. My house is comfortable.
2. Kids 5,3,1
3. I've invested in quality mattresses, shades, and climate control items to make sleep at home a priority.
4. We bought a memory foam mattress topper and it's super comfy. I sleep like a baby.
5. No one over 21 should have to live in a barracks unless they are in an active war zone.
6. I have 3 kids...
7. I live in the garbage state of Florida so nothing is ideal
8. Airstation Clearwater will often try to recall pilots between 2400–0600. This results in lots of people losing sleep. Its an awful way to do business.
9. NCRADF Permanent Party stand a mix of day, night, and overnight shift in blocks of three consecutive units. It is very difficult to fully adapt from one extreme to the other.
10. Neighbors too close.
11. I have a bed/mattress combo and comfy surroundings I create to my liking. Obviously it will be the best I can make it to ideal.

K. (CurrentPractices1) What do you do to help become more alert and increase performance when awakened from a sleep event?

1. Games, riddles, brainteasers
2. Move about
3. Shower w/ multiple temp variations (alternating hot/cold)
4. get up -walk to a different room
5. Take a shower
6. Drink water
7. eat snack
8. shower
9. pray
10. Chug water, super hydration
11. I sleep so lightly on base, that I don't suffer from much sleep inertia at all.
12. Eat something sour like granny smith apples
13. Shower
14. check weather/notams and get my brain going
15. I normally rise fully awake. I am rarely groggy in the morning whether on-duty or off-duty.
16. Shower
17. brush my teeth
18. Time
19. Engagement in mission planning
20. Shower
21. Brushing Teeth
22. shower
23. time
24. 15 years of standing duty/watch
25. Snacking
26. music
27. Chewing tobacco, oral fixation

L. (CurrentPractices2a) SAR Alarm over Intercom System

1. Gives a rush of adrenaline, and wakes up both 65 and 130 side at the same time.
2. Sometimes this is a benefit so that the pilots that aren't launched can help plan the case.
3. Good to use during duty day
4. This is my preferred method, though currently, Air Sta Clearwater has procedures in place that prevent the sounding of the alarm before the pipe of the nature of the case and location. Typically, this means I don't wake up and recognize what is going on until half way through the announcement, thus missing critical information. I have to spend time chasing down the ODO to backfill the info.
5. Sometimes I'm in a spot where I can't hear the details of the pipe, or I'm not awake enough to comprehend them yet.
6. I prefer a phone call.
7. In my current RWAI mission, this is the primary method of notifying pilots of an unexpected launch.
8. It is inop at Air Station Kodiak
9. Nice to not have to wake up if the case isn't for your airframe but also nice to wake up and offer other crew planning help to assist in night launch.
10. We don't use a SAR alarm over an intercom during sleeping hours.
11. Some ODOs improperly sound station alarms during quiet hours, the other aircraft crew is woken up disrupting crew rest.
12. Loud and jarring, typically gets my heart rate instantly up which gets me fairly wide awake.
13. only before taps, we have 2 B0 and don't need to wake everyone up.
14. Works well to alert everyone
15. this is very startling
16. At a dual airframe unit, this method awakens everyone for the launch of one asset. This is not ideal. At a single airframe unit this would be a different matter.
17. Hard to hear. Hard to understand pertinent information.
18. effects are immediate, sudden adrenaline reduces sleep inertia

19. It jolts my system and gets my heart going. Gonna save a life!
20. a loud SAR alarm or phone call help build my adrenaline response. It's the reason I seldom, if ever, experience sleep inertia while on duty.
21. Never enjoy it but it works
22. Some AC's knock on your door before they hit the alarm to give you a minute to get your bearings.
23. 18 years, it still gives me a heart attack every time.
24. It scares the crap out of me.
25. I dislike because it takes me a minute to wake up so I feel like I miss the majority of the information passed.
26. like a little shot of adrenaline. Still enjoy it!!
27. Much easier to get going than a quiet phone call that I fear I'll miss.
28. Its dumb and the C130 wakes me up too.
29. Wakes up other people.
30. Multi airframe unit.
31. Usually only activate this after the Pilot in Command has already been awoken by phone for specifics of the case; is the best method to get everyone required moving in the right direction all at once though
32. Tried and true method.
33. Intercom announcements are not always clear and do not always grab your attention, especially in a deep sleep.
34. never at night
35. Too jarring
36. We share the same barracks as the students at ATC so this is not an option.
37. Gets you up and moving as a crew.
38. Radio's in Miami and a knock on the door in Mobile... intercom isn't used during sleeping hours due to other watch standers on base.
39. Sound it. That's what we're here for.

- 40. This is only done by COMCEN during day hours, otherwise, phone call.
- 41. Abrupt wakeup startles personnel awake.
- 42. We have 2 types of aircraft, do not want to wake up both crews. I have no experience with being awakened at night from alarm.

M. (CurrentPractices2b) Personal Pager System

1. Not likely to hear/feel.
2. No experience.
3. Air Sta Clearwater currently does not employ a personal pager system. 6 years ago, Air Sta Kodiak employed this type of system. The pagers were typically sounded before the intercom system. Both worked fine. I have no preference between the two.
4. This is the old school way I was used to, but those pager systems might not be worth the effort anymore. I liked having it with me and being able to hear/understand it.
5. have never used a pager system
6. We don't use this system, and I have no experience with it.
7. Has variable volume and tone/vibrate options.
8. It's the most disorienting sound that causes an increase in stress.
9. I sleep through pager alerts.
10. Not a method we use to pass information regarding SAR.
11. Works well.
12. Never had a pager system.
13. We do not use the personal pager.
14. Reliable. Able to play message over again. Able to hear and understand message.
15. I don't love or hate it, but if the alert is too short I run the risk of sleeping through it.
16. Easy to miss pages, misplace pager, have some go off and not others. It's been tried and failed.
17. Don't have one as the copilot but I would like to have one of these because similar to the knock on the door, it would be preferential to the SAR alarm
18. This works pretty well when the ring tone is something you can set. Using your on cell is not good.

19. Never used one. I get cell calls for everything else.
20. Have never used the Pager System, but I think this is the way to go at a dual airframe unit since I am currently woken up for any C-130 event as well.
21. Its better than the intercom
22. Multi airframe unit.
23. Never experienced
24. Would be worried about it not working and missing the call.
25. We use pagers on duty so I am accustomed to this system and probably biased.
26. sure? but the phone works fine in the room.
27. higher chance of not hearing it, could mistake for a phone while still half asleep. SAR Alarm gets the entire crew up and moving fastest.
28. Carried pagers for 4 years- not enough info passed.
29. Usually wake up more angry from a loud radio.
30. Only if the pagers are akin to the volunteer Fire Department style, with a legit alarm system and paging system installed. Look at AirSta Kodiak for Example.

N. (CurrentPracices2c) Cell Phone Call

1. Still not sure I will hear it every time. I am a deep sleeper off duty. When I go on duty, I continuously wake myself up in fear that I might sleep through an alarm.
2. Less aggressive wake up.
3. Prefer after hours
4. I don't have a special ring tone just for the Air Sta, so I do not distinguish a SAR launch phone call from a call from my wife.
5. I always have my phone on vibrate only, so I might not wake up to it. I'd turn the ringer on, but I'd be just as likely to get an unwanted call waking me up as I would a SAR call.
6. I prefer calls over the SAR alarm.
7. May be hard to differentiate between work/personal tasking.
8. If it is a confirmed launch the SAR alarm is the best. Sometimes I can sleep through my phone.
9. If I have to leave my cell phone on it means I'm also alerted of other incoming text messages, emails, etc.
10. Highly preferred to be contacted by cell phone.
11. Phone is often turned down to prevent unnecessary sleep disruption.
12. I turn ringer off because of telemarketer calls at all times of night.
13. Cell phone signal is not strong in all areas of ASBP duty crew berthing. Additionally, this method takes a large portion of time as it isn't possible to call everyone at once.
14. I wouldn't trust it to wake me up. Too many settings that could be changed that would make it unreliable.
15. My cell phone acts as my alarm clock while at home and on duty. A call certainly wakes me up.
16. a loud SAR alarm or phone call help build my adrenaline response. It's the reason I seldom, if ever, experience sleep inertia while on duty.
17. A phone call before the SAR alarm goes off is always nice, but it can't happen all the time or for everyone.

18. Same as above
19. If it's a personal cell, this is bad. You have no idea why the phone is ringing, could just be a telemarketer.
20. Worried I'll miss it
21. Not too bad.
22. I would need to keep volume on, meaning other people could call for non-duty reasons and wake me up.
23. Requires more time than pager notification, but also ensures positive notification
24. Never experienced
25. I miss calls too often due to phone on mute.
26. works, but if phone is dead or doesn't have service the landline in the room is preferred.
27. Doesn't get entire crew moving.
28. The barracks has poor reception and calls often seem to get dropped at ATC Mobile.
29. Good way to get info, doesn't get the rest of the crew moving though.
30. I can pick my ring tone.
31. No. I'll call you for details, not the other way around.
32. The duty cell ring always gives you a jolt because it usually only rings for cases. Your brain almost overreacts after it learns the ring. Even when it finishes charging at night, it makes me startle in bed.
33. Don't have
34. Familiar way to wake up, volume control

O. (CurrentPractices2d) Knock on the door

1. Prefer if in crew rest
2. This is a good technique employed by proactive ODOs to get the Acft Cdr's attention while still getting the details on the phone with SMC.
3. It's the best way to wake me up and I like being able to ask questions of the CP or ODO when I'm being told of the launch.
4. Not enough of a jolt.
5. Ensures the pilot is awake. I do it as a curtesy to the other pilot just to make sure because I have slept through the pipe on the phone before.
6. Number 2 method, but definitely preferred for notification of SAR.
7. Can be confusing, often receives confused response.
8. Knocking on door doesn't wake me up enough and often causes sleep inertia.
9. This is likely unit specific. This is unsustainable at large units where the ODO is far removed from crew berthing. For a small unit where ODO and crew berthing are within a
10. foot walk this might be an ideal method.
11. Too slow.
12. first thought is usually...did I sleep through morning brief? why is someone knocking on my door? SAR alarm is way better
13. If not done for long enough I will sleep through it.
14. Just as annoying as the SAR alarm
15. Least intrusive and best way to have to wake up
16. I have used this technique in the past if a crew member does not answer their phone.
17. Again, worried I would miss it
18. Not reasonable for multi airframe unit with members in multiple buildings. Time consuming.
19. Too long to answer if sleeping in less than presentable clothing.

- 20. Seems inconvenient for someone else to have to be up too
- 21. Could be scary / startling.
- 22. A knock has the added gain of accountability.
- 23. only if all other phones are dead.
- 24. downside is it takes time and slows down the response.
- 25. Might as well, just in case after the alarm goes off, or before to get you facts straight with SMC before we rouse the crew.
- 26. Method not normally used at our air station.
- 27. Time consuming for making notifications; if in deep sleep then may not hear knock

P. (CurrentPractices2e) Other/Please Specify:

1. hand held radios- we're a multi airframe unit so the PA system is less than ideal at night when only launching one crew so we use radios on two different channels. The launch info is given to everyone on this common freq who needs to be involved (AC, CP, FM, RS, Line Crew, Watch Capt) simultaneously and permits open conversation between all
2. I personally can't stand an alarm off duty but on duty, I just need to be woken up - I don't care how.
3. CGAS Miami used a walkie-talkie system that each crewmember carried. It was an effective way to wake individual crews up (rotary vs fixed wing B-0), also to verify that everyone received the call.
4. N/A.
5. There isn't really a good option for being woke-up prior to being fully rested, especially with less than 4 hours of total sleep between going to bed and being woke up.
6. Best wake up call ever was a weather report, done in a very soothing voice, no panic, not urgent, just the weather being read over the load speaker. Once the weather was read then the actual announcement was made. Fantastic! The easy weather slowly brought you out of your sleep without shocking you, but you knew why you were hearing the weather, you are going flying. Then as you come to the details make sense. SAR alarms just confuse the hell out of you and you miss the entire call out. And you are perplexed why you're up and panicked, oh yea, I'm at work, that was the SAR alarm. Calm down and go find out what is going on. Just a horrible way of doing business.
7. A radio system (while not employed at my unit) is best. It allows all crew to respond and coordinate immediately via voice, without having to dial numbers, type messages, etc. 194 Landline/office phone

Q. (Recommendations1) Based on your understanding of fatigue, rest, and sleep inertia; what would you change to your units duty room/spaces/policies to improve sleep conditions and/or reduce sleep inertia?

1. My dad was a firefighter for many years (Orange County Fire Authority, CA), and during his tenure, he saw several new fire stations open. One of the interesting features was that the alarm system was modified to gently wake up the crew on duty. I don't know where the study came from, but apparently this study said that a gentle wake up was more effective, even with deep sleepers. It also reduced the stress level of a crew having to respond to a call even in the dead of night. I think a similar system could be incorporated into duty rooms to 1. give crews the peace of mind knowing that there is a system that will actually wake them up, and 2. not induce a heart attack every time the alarm goes off.
2. Better appointed rooms, more removed from office activity.
3. ensure all blackout blinds work properly, set AC boundaries to individual rooms, funding/support for bedding/laundered sheets and covers.
4. change the volume on the OOD phone and wardroom phone ringer so it doesn't wake the AC. New bed frame and mattress for the copilot room.
5. Get better blackout curtains, individual A/C controls, and clean the mattress liner.
6. Clean the AC units/ducting so that I'm not sneezing all night/morning. I am not the only one that experiences this either.
7. There is not much my unit has not already addressed. Some of my fatigue is not related to lighting, or comfort, but the heightens state of alertness for the potentially get launched. More prevalent at high tempo units (Miami)
8. They are as good as they can be. Primary driver of sleep inertia is SAR launches, which is why we are here.
9. Provide individual temperature control for each room. Improve sound insulation in both interior and exterior walls of the sleeping quarters to prevent disturbed sleep from various noises.
10. I'd fix the curtains & general upkeep. I'd provide an evening meal.
11. have the non-SAR ODO line ring quietly like it used to.
12. Ensure adequate facilities - bedding, restroom, with climate controls
13. Have more control of the AC/heat in our duty rooms.

14. Increased air flow. Ensure there is no mold and get new buildings.
15. No SAR alarms at 2300, and use black out curtains on the windows.
16. I would bypass the unit's air conditioning to the duty rooms and lounge areas so that on-duty personnel could tailor them to their own comfort level
17. This is a strip alert unit and people should not normally be sleeping on duty. If they are, they need to be able to immediately respond to the launch klaxon.
18. Better blinds to block out light in the rooms that have windows.
19. darker shades to keep out light
20. Encourage duty crew to remove themselves from the workday more often to rest and ensure a ready/capable SAR crew. Currently, the B-0 crew often lands from night sorties around 2300L and is expected to be up and at their desks at 0730L. If an aviator is not, it would be considered unusual.
21. Construct duty rooms in a purpose built building separate from the hangar.
22. Add ceiling fan. In a perfect situation, increase room size for a full/queen bed. Unfortunately the rooms sizes have to option to make bigger without a new building so this is unlikely to happen.
23. Nothing. Rooms are comfortable, spacious, and relatively quiet. AC works great and windows have tint in addition to blinds.
24. White noise machine
25. Have a duty stander that picks up the SAR call from Sector, then hits the SAR alarm.
26. NOthing - we would have done it already
27. Newport duty is great. Duty starts and ends at 1200. North Bend duty is less ideal. On weekends we start and end at 0800 and on week days we start and end at 1600.
28. The duty rooms at Air Station Kodiak are germ havens. I regularly get sick after sleeping in the duty rooms. When I don't get sick I still wakeup with a sore throat and congested. This doesn't happen when sleeping anywhere else, nor has it happened at previous units.

29. Better climate control.
30. Better blinds, bedding, soundproofing, temp control needed.
31. Maintain consistent 1600–1600 duty relief through the week and weekend.
32. Better mattresses and more sound cancellation. Duty rooms are surrounded by working offices and I am often woken by members arriving early to work.
33. I would change the scheduling of the air station. Fireman type schedule would allow for more restful duty days and less back and forth between day and nights on off duty days.
34. Better sound proofing in the duty rooms.
35. I would push back the day shift relief time to 0645.
36. better blinds to block out the street light. better sound protection to block out the electrical generator 20 ft away
37. Increase the airflow/air quality and fix the doors.
38. I have none
39. Install blackout curtains. Replace the HVAC system to one that is quiet. Unfortunately since it is a new system this won't happen.
40. Generally sleep inertia isn't a big issue for me personally.
41. better insulation to eliminate noise from neighboring duty rooms. Black out curtains.
42. Our units don't have a temperature control so to get air flow throughout the night we have to open the window and I typically get woken up by aircraft taking off and landing. The mattresses are really stiff making it difficult to get comfortable.
43. Most basically make the room darker for better rest.
44. add a few pictures to the wall to get your mind to relax, repaint the walls a more soothing color, add a noise machine to help drown out white noise.
45. It totally needs to be redone. the lounge area is outdated with nothing to prepare own meals, and the galley dinner (which has been closed for months) is subpar. The rooms are old, muggy, and dusty (repainted recently) and the mattresses are stiff. I always bring my own linens and blankets, would probably be unbearable without that.

46. I would have the duty rooms away from the stairway, in a quiet corner of the building.
47. Clearly defined late-rack policy, and enforcement/adherence of that policy
48. The ability to control temperature in the room. Also, it would be nice to have a pager system in place so I don't hear the SAR alarm for another aircraft in the middle of the night.
49. Fix the broken blinds to make the rooms darker
50. deep cleaning of the room once per month, new carpet, new blinds/curtains, remove mold from all duty rooms
51. 55+ year old facility needs to be remodeled and updated to better accommodate sleeping arrangements and environment for duty crews. Air conditioning upgrades and building upgrades to better control temperature, humidity, air quality, and comfort to promote a quality sleep environment will greatly help reduce sleep inertia and grogginess.
52. Double paned windows or other equivalent noise-reducing efforts which reduce outside noise.
53. Better climate control and bedding
54. New, room darkening, shades in all duty rooms. Ability to adjust to a specific temperature in each room; wall-mounted radiator often not able to overcome central air coming into room. Lower priority would be better soundproofing or toilets that don't flush with the force of the mighty MH-65(?).
55. Environmental change, The rooms are old and the walls are thin.
56. Invest in mattresses, curtains and sound proofing.
57. Better sound proofing from external airport noise.
58. Not allow anyone in the wardroom after a late case and the pilots are sleeping in. Ideally, move sleep rooms away from hangar so opening the hangar doors does not wake up resting crews.
59. No good options based on current duty standing policies. If changing duty policy is an option then only standing 12 hour shifts were you have a nightshift and a dayshift so there is no sleeping and everyone is adapted to their schedule.

60. I would recommend an effort to reduce the shutting force of doors to prevent slamming that resonates. I would also advocate for a signal system to notify personnel arriving for work that duty crews are sleeping and conversation should be avoided in the hallway.
61. Additional door on hallway to help with light control and noise.
62. Separate work spaces and duty spaces. Have a schedule that optimizes SAR readiness not ability to do collateral work. Use a pager system with a more comfortable tone to alert of cases. Don't let Supply have a say in what we can and can't purchase for duty rooms
63. no shared duty rooms, better sound insulation, high quality, comfortable mattresses, individual room temperature control.
64. Increase door hinge strength to minimize door slamming, improve wall insulation to remove pipe noise and noises between rooms.
65. Black out windows (not just curtains). Install white noise machines and ceiling fans. Move common spaces away from berthing areas - our wardroom is adjacent to the duty rooms.
66. Have the ability to dim the lights in the hallway and locker room after 2000L. Everything else is just fine at my unit. I have a harder time mentally falling asleep and sleeping soundly as I'm constantly on the alert for a SAR launch, especially as the AC.
67. Better mattresses, blackout curtains, more sound proofing, better heat/cooling controls
68. Knock down the building and get a new one. Showers are horrible, rooms are horrible.
69. Musty smell.
70. Adjust duty times
71. Improve the facilities in crew rest berthing
72. my previous unit always sounded the SAR alarm, day or night, for a launch. Because my current unit is dual airframe, the SAR alarm is not used so as to prevent waking the other crew. I prefer the SAR alarm because it leads to a "fight or flight" response out of a deep sleep, increases adrenaline flow, and prevents sleep inertia. A phone call works similarly, but for me, nothing is as effective as the ALARM at 2 AM

73. Provide better allergy-proof mattresses and pillows, plus higher-quality linens that actually fit the bed. Provide individual room climate control.
74. Unlink the thermostat from the motion detector and have housecleaning set a reasonable daytime temperature every morning. Get better mattresses. Install lockers in pilot duty rooms for personal belongings.
75. A decent amount. New box springs for the beds, maybe some type of sound proofing for the walls. Not piping colors every morning, and working with the other units to change times they conduct siren tests/any loud mechanical work. Also dealing with the wild life on base by ensuring they are at least not hanging out near the building.
76. Move the ready crew berthing and ready helicopter away from the bureaucracy of the Air Station so it could function like a separate firehouse. Ever see a fireman working on the logistics of having his boss's office painted under an adversarial BOSS contractor negotiation... oh my God I have to go fly right now? We have made not being ready the USCG's main priority, sad but oh well. Forewarned is forearmed.
77. Improved sound proofing in walls. Improved ventilation and air quality in rooms. Higher thread count sheets.
78. Make the temperature adjustable in the individual rooms.
79. Improve noise insulation from noise external to building and internal noises from within adjoining rooms and hallways.
80. Improve climate control to one constant temperature.
81. Better sound proofed rooms for better quality sleep.
82. We are fortunate enough to have a very new facility that is comfortable and pleasant to rest in. Some duty crew rooms are located over (2nd deck) doors that lead outside and slam when used by the evening shift as they leave. This can sometimes wake up duty standers. Installing slow closers on those doors or restricting their use during night duty hours would alleviate this problem.
83. The air circulation in the duty rooms is terrible. Sometimes the cleaning crew wakes up the duty crew if we had a late flight and are sleeping in.
84. Better insulated walls. More of a cultural push to not be up early.

85. new heating and cooling system - definitely too cold in the rooms in the winter, and not cool enough in the summer. I bring my own blankets and pillows to help improve sleep comfort
86. We are attempting to buy new mattresses, but the BPR supply process is making this extremely difficult. Same problem with trying to refresh our custom fit blinds.
87. Sleeping at home on base is amazing.
88. I would try to make the duty rooms a little more sound proof. Additionally, there are sometimes where random alarms go off and it seems as though we do not have the right personnel to silence them on duty nights. This can cause a lot of loss of sleep.
89. I would incorporate black out curtains to minimize ambient light in the room.
90. Better pillows, individualized A/C capability.
91. Improve our facilities, they are old and falling apart.
92. I need a cup of coffee after I wake up. A nearby Keurig would be good.
93. Environmental controls would be at the top. Best sleep is at a hotel, Without kids, collateral distractions, etc. Follow the model of a decent Hampton Inn.
94. Sound insulation and better Temperature Control
95. Increase bed size from twin to full or queen but the architecture of the ready crew berthing building prohibits the expansion required. Add ceiling fans to rooms.
96. Duty rooms have a lot of moisture in the air. There's work being done to rectify the humidity levels, but mold has been an issue. Most of my sleep issues on duty are from a personal nature. I cannot rest well if I know that I may get a call to launch any minute. Every noise I hear, I suspect it is the ODO getting a phone call and heading down to wake me up.
97. Remove the weekend 0800–0800 duty schedule change. 1500 reliefs works much better, allows for a new crew to be sharp for the night versus having been at work all day which can be mentally fatiguing.
98. Change the mattress and air conditioning system.
99. Get insulation in the walls maybe to cut back on noise issues, more comfortable beds, quieter HVAC system

100. Update the facilities. Why does the hot water not work 75 % of the time I'm on duty. I can't even take a shower before going to bed sometimes. The Air condition goes out or the thermostat have a movement sensor on them, so when I do fall asleep and stop moving the ac shuts off! We need to put money in the facilities just like all the other services do. Miami is plagued with clay pipes and in some buildings all we can do is a number #1. These places haven't been updated in 60–75 YEARS!
101. Better temperature control. Better humidity control. Better cleaning.
102. Most pilots are good about letting other pilots sleep after a long night but the close proximity of a busy area like the wardroom makes for a poor sleeping environment.
103. Build a new BOQ. To better do this we should fire all the FACENG folks and move to something similar to how ATC mobile runs their operation.
104. Use a steady increasing light system in the room to awake the crew and then sound a muffled horn. Rather than sounding a blaring horn in the middle of the night.
105. Better beds, cleaner space. Window unit for heat/AC. Better access to coffee in the morning!
106. Better pillow, sheets, and comforter in the duty room (more comfortable).
107. HVAC and better blinds.
108. Separate building or portion of building that isn't utilized during the day. Crews that sleep in to "reset" are often woken up by morning traffic up and down the hall.
109. Independent climate control for each room. Use radios for notifications.
110. Primarily - upgrades to the duty rooms to align with quality hotel spaces; lowest bidder procurement always fails to obtain quality materials in mattresses, lighting, etc. Facility funding falls behind air/sfc assets and so climate controls is by cheap portable units that are both ineffective and noisy. Improved mattresses/bedding, invest in blackout curtains, install objects to limit noise (door quieters, etc)
111. Provide the ability for natural lighting in the room. Have working lamps and a bedside table where the phone is and a place to put your cell phone which doubles for most as an alarm clock as well.
112. Noise insulation, linen service.

113. I think the duty rooms and sleep conditions are adequate to meet the needs of all those that use them; it would be impossible to individually tailor each person's individual sleep situation.
114. We recently bought memory foam mattresses, pillows, air purifiers, and dehumidifiers to improve sleeping conditions. I think the effects are definitely measureable but can still be improved with softer lighting.
115. Improve building to reduce outside noise intrusion into the room, as well as improve climate control/ventilation of the duty rooms.
116. get a new building with no mold and less than 80% relative humidity. A dehumidifier might help, but only treats the symptoms, not the root cause of the problem.
117. We could shift policy for duty standing at NCR (RWAI) to allow for longer times on the same shift or not starting with day shift. Most crewmembers struggle with day shift and don't recover from the chronic fatigue through the rest of the deployment.
118. Nope.
119. It is too close to the hanger, offices, and locker rooms--once anyone is moving, it is impossible to sleep.
120. Eliminate daylight (4000K+) LED lights which replaced fluorescent tube lights (which were more like 2300K).
121. Increase alert detachment/airsta PAL to support optimal manning. Finding budget resourcing to attain FOC (NCRADF resourced for IOC since 2006).
122. The rooms need more sound proofing to create a better sleep environment.
123. Update the HVAC system.
124. My unit requires duty pilots to attend 0715 command morning brief regardless of previous night flight or mission. This makes it impossible for duty pilots to reset in the summer hours due to the late night flights. This is not as much of a problem in winter when sunset is much earlier.
125. Blackout curtains would be a good start, but the other changes require good repairs to the A/C systems and noise insulation.
126. Air Conditioning/temp control as well as spend the money for top quality mattresses.

127. Invest in quality furniture, mattresses, and lighting/air conditioning.
128. Night trainers prevent getting to bed “early” to better prepare for a possible unscheduled launch. We are already in a less than ideal environment and these late night flights do nothing to contribute to getting the proper amount of sleep.
129. getting sound proofing so we cant hear the commercial jets taking off and landing all night. They also sound the small boat station alarm in the aircrew duty rooms which also wakes us up
130. Put better blinds over the windows so you can sleep in if you do have a late night flight and need to sleep in the next day.
131. Better mattresses. The current ones are pretty old and I have heard from several people that they can't sleep, because it is very uncomfortable.
132. White or Brown noise machine. Sound dampening bathroom and hallway doors.
133. Bulldoze our crappy BOQ/BEQ which is likely infested with rodents/insects and actually build a modern crew rest facility.
134. Blackout curtains, reduce light coming from under door (either weather stripping along bottom or change lighting in hallway), and mattresses that don't need foam toppers to be usable. I don't know what the best way to wake someone up in the middle of the night is, but another major issue is the COMCEN calling the duty crew out of order e.g., they call Watch Captain and wake the entire crew up before calling the AC and even accepting the mission. Often they could wait five minutes (especially for cases that are an hour away) and make a few phone calls before waking everyone up and then finding the person in 5 minutes and standing down the SAR launch.
135. have fresh bedding available. hard to get a good nights sleep when sleeping in a sleeping bag. Don't always remember to bring own sheets/comforter
136. I would not change anything.
137. Duty relief should be the same every day of the week. Units with high optempo are unable to support this on weekends as they would require an additional day off to members. This is unsat.
138. Darker curtains in AC duty room
139. Change the pillows more often

- 140. Thicker walls around ODO to prevent phone call noise in other rooms. But good common room and TV, food and A/C.
- 141. I sleep well on duty when not being launched, so I have nothing to change.
- 142. Make it look more like a modern hotel room. Increase the size. Update to a modern bedroom set. Contract services to make the room ready for guests.

R. (Recommendations2) Please enter any other comments or suggestions you have regarding this study.

1. The 1500 weekday relief and 0800 weekend relief is a terrible duty schedule and is unnecessarily fatiguing. My experience when on the 1500 relief daily was that I was well rested and ready to fly through the night if necessary. I recently had a duty day where I flew a 2.5 hr trainer on a Sunday morning and then was notified at 2045 to launch at 2200 for a R21 outage all night. Technically we 'reset' but it was not adequate rest and the entire crew was unnecessarily (and dangerously) fatigued. Other issues are first light searches when on a morning relief schedule.
2. Most duty rooms at air stations are fine, but I don't understand how we just have people figure out what to do with a dirty mattress instead of funding sheets/pillows/blankets/laundry services.
3. I've been woken up at 4 in the morning to discuss a Pollution response case that at the earliest we would take off at 0730. Seemed silly to get that call during a normal deep sleep time when it could of waited.
4. Good luck!
5. As I have aged within the CG Aviation community, I have noticed a significant increase in my recovery time from disrupted sleep. When I was a new CP, I would bounce back quickly from a disrupted night's sleep. Now, 12 years into my aviation career, a disrupted night sleep will linger with me for a day or two. Getting good rest has become increasingly important for me.
6. Enjoy your 1B3 payback on LL9!
7. beds are comfortable, but is still different than mine at home so my sleep quality isn't the same. Don't know how you'd change this, I think it's just the cost of doing business. And there are fewer distractions (kids, wife, dogs, etc) so maybe that cancels out?
8. I don't think this study is tailored for non-SAR operations.
9. Current duty rooms are simply offices with beds in them? The USCG has conducted SAR for 50+ years from this location and the unit lacks purpose built duty rooms and a galley. UNSAT.
10. Sleep and rest at this unit are not taken seriously. Flt mechs and swimmers have been displaced from adequate berthing for months. Pipes are heard throughout the facility despite crews being up late, interrupting sleep and not allowing crews to adequately reset.

11. Starting and ending duty at 1200 is when I feel the most rested.
12. Sleep on duty is pretty much expected to be less than ideal, I think the impact that affects Coast Guard aviators is the long-term routine duty standing. With a pilot shortage, there are still the same number of duties with fewer pilots. A 2 week TDY trip is more restful, even though you fly 90 hours, than standing duty on and off 3 times a week.
13. It is my opinion that the lack of consistent sleep and effective scheduling that has lead to an increase in mental conditions and illness.
14. I always get better sleep at home rather than on duty. Even when I sleep through the night on duty I still feel more rested after sleeping at home.
15. Thanks for reaching out!
16. Each unit is different for how frequent SAR cases happen and how long people are used for a case. Humboldt rarely has cases that use more than one crew. The biggest sleep issue is that we don't have consistent sleep schedules. Night flight one day, day flight another. My bed time varies from 2100–0100 depending on the events that I am scheduled for.
17. I wish all units would shift to a 1500–1500 schedule to keep pilots in a normal pattern and develop uniformity. I think it would aid in sleep patterns and benefit members on weekend duties so we can keep the same duty day patterns.
18. Very good research study that is extremely applicable and needed.
19. Did not complete most of the survey since I do not stand B-0 duty. However, I do stand RWAI duty, which disturbs my sleep schedule much more than B-0 duty but did not want to skew the survey as it does not specifically address RWAI.
20. I've done a lot of night flying and reverse cycle OPS. Some of the most fatiguing days are when we are forced to stay up longer than 18 hours or when being forced into another period of wakefulness with limited sleep i.e., a B0 launch on 2hrs of sleep. These are some of our most dangerous situations.
21. Stand up for the pilots flying the line and don't let the XO's push for more collateral time.
22. I think sleep inertia is much more of an issue for aircrew than for pilots. The act of flight planning and starting engines and manipulating flight controls forces the mind to engage and the body to respond accordingly. When a flight mech or rescue swimmer get woken up, unless it's a confirmed PIW or something of similar urgency, there is nothing to inspire the mind to engage. They wake up,

- they pull the plane out, and then they sit in a chair... and watch. For overdue vessel cases, for UNCOR mayday cases, for days-old PIW cases. Perhaps it appears more difficult to me because I have never done it.
23. I already bring my own pillow to work to mimic the aggregation of marginal gains strategy of the British cycling team in the early 2000's
 24. Great idea and the topic needs to be considered much more than it is.
 25. We don't fly much in the Coast Guard, but our higher echelons love to espouse how we are professional pilots. Bull, we aren't, so maybe we should consider not flying missions at night and really reducing our risk and burden of needing lots and lots of equipment and people. I know, no one ever made it to Admiral with those ideas. The truth is out there.
 26. Fatigue tends to be worse during the summer transfer season when duty standers are assigned more frequent duty and are launched more frequently due to the uptick in SAR cases.
 27. Comment removed.
 28. Comment removed.
 29. Good idea. Hard to specify some of the numbers requested.
 30. I also do the Aerial intercept mission. There's a host of sleep issues associated with this mission and the duty and rest requirements. I can elaborate on that as well.
 31. Good luck with the project, I'd love to hear the results of your study!
 32. I've experience sleep inertia more violently the deep I'm sleeping and the way I get woken up. In Miami we usually radios for after hours, which isn't that bad in the middle of night. But it hits me the worst when I am taking an afternoon nap on the weekends and they sound the alarm. I jump out of bed faster and then when it hits me the most.
 33. The recent "need" for B-2 crews and duty backups being found late at night is difficult. The requirement to be able to respond that I am available or not available 24/7 means I have my phone on loud when I sleep and have to wake up to all texts. This has made my at-home sleeping environment degrade for myself and spouse.
 34. The Coast Guard doesn't value sleep

35. Thanks!
36. The survey only allowed me to enter one set of hours for B-0 duty. North Bend has two B-0 H65. I entered hours for the North Bend duty, but the airfac duty hours are 1200–1200 24/7.
37. Mandating keeping a regular duty relief time throughout the week. switching to a different schedule on the weekends and using crews to fly first thing when arriving on duty just burns hours early for a potentially long SAR case causing more crews to be called in to back fill. We tried a constant 1500–1500 schedule and it worked great but was not working for the aviation engineering side of the house as far as maintenance went but we VERY convenient for crews, allowing them to potentially sleep in before assuming duty and work out, assume duty, and not plan to flight until the following morning to keep crews fresh for the dreaded middle of the night SAR alarm.
38. We switched to a 1545 relief 24/7/365. I think it is great. morning relief on the weekend is hard on sleep. It is nice to sleep in on the weekend days.
39. I feel this study is valuable in gauging our effectiveness and the hazards associated with sleep inertia affecting our initial response for mission launches.
40. Many crew mbrs wake up groggy and express the feeling as comparable to being hungover when standing the ready. Air purity/humidity may be additional factors to consider in your study.
41. Best of luck with this study; however, I think it may be more beneficial to study burn out among CG pilots, particularly dual mission qual'd units (like H65 SAR & RWAI).
42. Eliminate the requirement to attend the command morning brief for the duty pilots. Replace them with a designated non-duty pilot to allow the duty pilots to recover/reset.
43. Good luck.
44. Hi buddy.
45. I appreciate you doing this survey, sleep is a major issue in this service. It's hard to maintain effective sleep rhythms while standing a B-0, and I believe that has long term health implications.

APPENDIX E. SENTIMENT ANALYSIS RESULTS

(SleepQualDuty1) Compared to your idea rest/sleep environment, how would you rate your overall sleep quality while on B-0 duty.

THEMES	TOTAL
N/A or Entire Response Disregarded	11
Other	4
Positive	0
Negative	0
Adjust duty period/maintain constant relief time 7days/wk/How we manage random recall	12
Replace bedding more frequently	1
Sleep management & Scheduling/Wake crews more appropriately	7
Follow on research for RWAI	3
Follow on research for aircrew	1
More sleep awareness in the USCG as a whole	18

(SleepQualDuty2) Compared to your ideal rest/sleep environment, how would you rate the *lighting* in your duty room?

THEMES	TOTALS
N/A or Entire Response Disregarded/not corresponding to study	10
Other	0
Positive	16
Negative	10
Too Bright (light coming in from windows or external doors)	15
Too Dark	0
No Curtains/Blinds	4
Blinds/Curtains are in disrepair/do not work	6
Environment (e.g. AK in summer or summer months)	5
Lighting not good for pre-sleep routine	4
Lighting noise	1

(SleepQualDuty3) Compared to your ideal rest/sleep environment, how would you rate the temperature control in your duty room?

THEMES	TOTALS
N/A or Entire Response Disregarded	4
Other	1
Positive	16
Negative	18
Too Hot	8
Too cold	8
Cannot regulate temperature/Are not individually controlled	21
Need for automatic system	1
Need to open windows to compensate	0
too dry	0
too humid	1
HVAC is noisy/does not work/breaks often	8
Throat, sinus allergy issues	1
Air Flow too high	0
Air flow too little	1
Opening windows cause issue (noise/bugs)	5
Fans used	0
Seasonal Issues (too hot summer/too cold winter)	1

(SleepQualduty4) Compared to your ideal rest environment, how would you rate the noise level in your duty room?

THEMES	TOTALS
N/A or Entire Response Disregarded	3
Other	2
Positive	6
Negative	42
Noise from AC/Heating units	6
Noise from adjacent rooms/bathrooms/lockerrooms/Offices	19
Noise from ODO phones	5
Noise from outside/outdoor sources not jet noise	6
Noise from other members w/in facility/hallways/doors shutting etc.	9
Jet/Helicopter Noise	20
Noise impacts crew rest/sleep	15
Affected by noise Occasionally	1
Affected by noise all the time	8
Thin Walls	14
Night Time Engine Runs/Maintenance	6
Quiet hour Signs used help	1
Quiet hour signs used disregarded	0
General Announcements/Pipes/loudspeaker	3
Noise Machine Used	0
Ear Plugs used	1

(SleepQualDuty5) Compared to your idea rest/sleep environment, how would you rate your overall comfort in your duty room?

THEMES	TOTALS
N/A or Entire Response Disregarded	2
Other	1
Positive	15
Negative	12
Room quality	1
Infestation (rodents/insects)	0
Mattress/Bed/Bedding Quality	11
Noise: Internal Environmental Noise outside Room (e.g. ODO Phone/other alarms)	2
Food: Lack of preparation/storage/unaccommodating schedule	0
Doesn't feel like home	2
Noise: External Environmental outside Noise (cars, planes)	3
General Work/mandatory briefs/Other Duty Scheduling	0
Anticipation of alarms/overly alert/Can't wind down	0
Temperature Control	1
Temperature (hot)	0
Temperature (cold)	1
Lighting (artificial)	0
Lighting Suppression (external, i.e., shades helping or not working)	0
Ventilation/Allergies	1
Cleanliness of spaces	2

(SleepQualHome1) Compared to your ideal rest/sleep environment, how would you rate your sleep quality off-duty?

THEMES	TOTALS
N/A or Entire Response Disregarded	1
Other	1
Positive	11
Negative	0
Wake up routine/schedule	4
Bedding/mattress issues	1
Children/Family disturbances	22
Sleeping next to a partner disturbances	2
Geobachelor/living away from family	1
Command/Operations Officer calls keep getting awakened	2
Abnormal lighting due to environment (e.g. Alaska)	3
Stress from flights/winding down after flight event	1

(SleepQualHome2) Compared to your ideal rest/sleep environment, how would you rate the lighting off-duty?

THEMES	TOTALS
N/A or Entire Response Disregarded	0
Other	2
Positive	8
Negative	0
Need Black out curtains	7
Have black out curtains	9
Rental property, can't modify	1
High latitude lighting issues	2

(SleepQualHome3) Compared to your ideal rest/sleep environment, how would you rate the temperature control off duty?

THEMES	TOTALS
N/A or Entire Response Disregarded	0
Other	0
Positive	14
Negative	0
Live in a naturally hot environment	0
Insufficient or No air conditioning	9
No issues with temp	13
Cost of electricity limiting factor	3
Insufficient heating	0
Household members prefer diff. temp	1

(SleepQualHome4) Compared to your idea rest/sleep environment, how would you rate the noise level off duty?

THEMES	TOTALS
N/A or Entire Response Disregarded	2
Other	0
Positive	10
Negative	0
Garbage truck noise	1
Neighbors/Neighborhood noise	2
Children/dogs/internal family	13
No noise issues	10
Road noise	2
AC/home equipment makes noise	1

(SleepQualHome5) Compared to your ideal rest/sleep environment, how would you rate the overall comfort off duty?

THEMES	TOTALS
N/A or Entire Response Disregarded	3
Other	0
Positive	1
Negative	0
Off duty is idea/adequate	4
Good mattress	3
Pilot recall/operations	1
Neighbors causing issue	1
Children cause majority of disturbances	2

(CurrentPractices1) What do you do to help become more alert and increase performance when awakened from a sleep event?

THEMES	TOTALS
N/A or Entire Response Disregarded	0
Other	2
Positive	0
Negative	0
Exercise/move	2
Brain/mind stimulation/games	3
Shower	7
Water	2
Snack	0
Nothing/time	2
Music	1
Chew gum/eat a snack etc.	4
No sleep inertia	2
brush Teeth	2

(CurrentPractices2a) SAR Alarm over Intercom System

THEMES	TOTALS
N/A or Entire Response Disregarded	0
Other	0
Positive	1
Negative	3
Effective	14
Preferred	3
Not Preferred	6
Does not function properly/ineffective/hard to hear info	4
Better if used as a secondary measure to door knocking etc.	3
Disorienting, startling	9
Shouldn't be/is not used at night/Daytime only use	4
Wakes up other members it shouldn't/i.e., dual airframe units	7
Can't hear the alarm/pipe, don't hear it asleep	1

(CurrentPractices2b) Personal Pager System

THEMES	TOTALS
N/A or Entire Response Disregarded	0
Other	0
Positive	2
Negative	0
Effective	8
Not Effective	0
Preferred Method	3
Not Preferred Method	3
No preference	3
No experience with this method	8
Difficult to hear call/missed alert/ worried about missing an alert	7
Like how it varies volume and vibration level	1
Disorienting/startling	2
Not for passing voice information	1
Good to have at multi airframe units	3

(CurrentPracices2c) Cell Phone Call

THEMES	TOTALS
N/A or Entire Response Disregarded	1
Other	2
Positive	4
Negative	2
Effective	5
Not Effective	2
Preffered Method	3
Not Preferred Method	7
No preference	1
No experience with this method	2
Difficult to hear call/missed alert/ worried about missing an alert	13
Like how it varies volume and vibration level	0
Disorienting/startling	1
Not for passing voice information	0
Good to have at multi airframe units	0
Not disoritenting/less aggressive	1
Good for after hours use	1
Causes more distractors (text, unwanted alerts)	8
Good to have in conjunction with another method	2
Prefer land line/duty room phone	1
Inefficient, takes too long, doesn't get entire crew moving simultaneously	4

(CurrentPractices2d) Knock on the door

THEMES	TOTALS
N/A or Entire Response Disregarded	0
Other	0
positive	7
Negative	6
Effective	3
Not Effective	3
Preffered Method	4
Not Preferred Method	2
No preference	1
No experience with this method	1
Difficult to hear call/missed alert/ worried about missing an alert	4
Like how it varies volume and vibration level	0
Disorienting/startling	2
Not for passing voice information	0
Good to have at multi airframe units	0
Not disoritenting/less aggressive	1
Good for after hours use	0
Causes more distractors (text, unwanted alerts)	0
Good to have in conjunction with another method	4
Prefer land line/duty room phone	0
Inefficient, takes too long, doesn't get entire crew moving simultaneously	6
This method supports Crew Rest	1
Not alerting enough	2

(CurrentPractices2e) Other/Please Specify:

THEMES	TOTALS
N/A or Entire Response Disregarded	1
Other	0
Positive	0
Negative	0
Hand Held Radios/Walkie Talkie/Room to room radio system	3
No Preference/Just need to wake up somehow	2
Anouncement other than alarm, such as reading the weather	1

(Recommendations1) Based on your understanding of fatigue, rest, and sleep inertia; what would you change to your units duty room/spaces/policies to improve sleep conditions and/or reduce sleep inertia?

THEMES	TOTALS
N/A or Entire Response Disregarded and RWAI responses	6
Other	5
Positive	0
Negative	0
Better appointed rooms/Furniture improvements/Rehab/refurb/housekeeping	9
Separated from MX/other work spaces	9
Individual Temp/climate controls/Remove motion detector/quieter HVAC	30
Improve lighting: Black out curtains/Better curtains/make room darker/use natural lighting	24
Better air quality/ventilation/airflow	23
Respect Sleeping Crews/No announcements/through policy/SAR alarm during normal rest hours	6
No desk work on duty/only stand duty/late rack policy, alert people of members sleeping late	4
Better mattresses/bedding/Make sheets fit bed/Better pillows/Bedding available	27
Prevent door slamming	7
noise reduction insulation/soundproofing	25
Improve cleanliness/deep clean more frequently	8
Method of a more gentle wake up	3
Reduce noise level of nearby phones (ODO, OOD, Ready room, Common spaces, Wardroom)	8
Duty rooms are adequate as is	8
Evening meal availability/Galley availability	1
Food Prep/Storage	1
Duty Room Only structure	10
Larger bed	1
White noise machine/make asthetically pleasing	4
Adjust Schedule/Consistent Duty periods throughout the entire week/ Do not adjust duty times on weekends & holidays/night training flight mgnt	9
Adjust Duty for no sleeping duty	1
Light and noise control in hallways	3
Hypoallergenic Bedding	1
Ammenities closer to duty rooms such as wifi/coffee/snacks/etc.	2

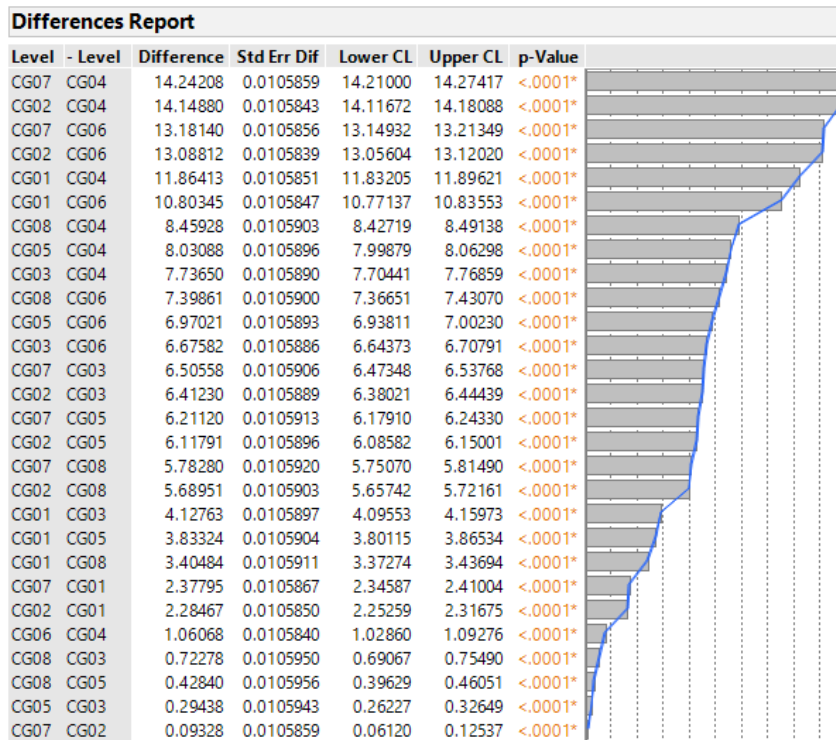
(Recommendations2) Please enter any other comments or suggestions you have regarding this study.

THEMES	TOTAL
N/A or Entire Response Disregarded	11
Other	4
Positive	0
Negative	0
Adjust duty period/maintain constant relief time 7days/wk/How we manage random recall	12
Replace bedding more frequently	1
Sleep management & Scheduling/Wake crews more appropriately	7
Follow on research for RWAI	3
Follow on research for aircrew	1
More sleep awareness in the USCG as a whole	18

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APPENDIX F. ANOVA POST HOC REPORTS

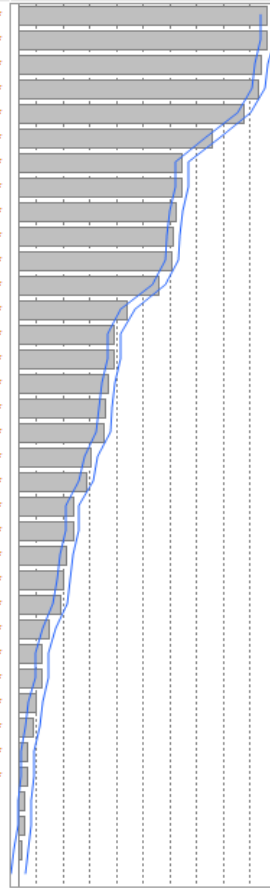
Air Station Sacramento Post Hoc Report (Sound)



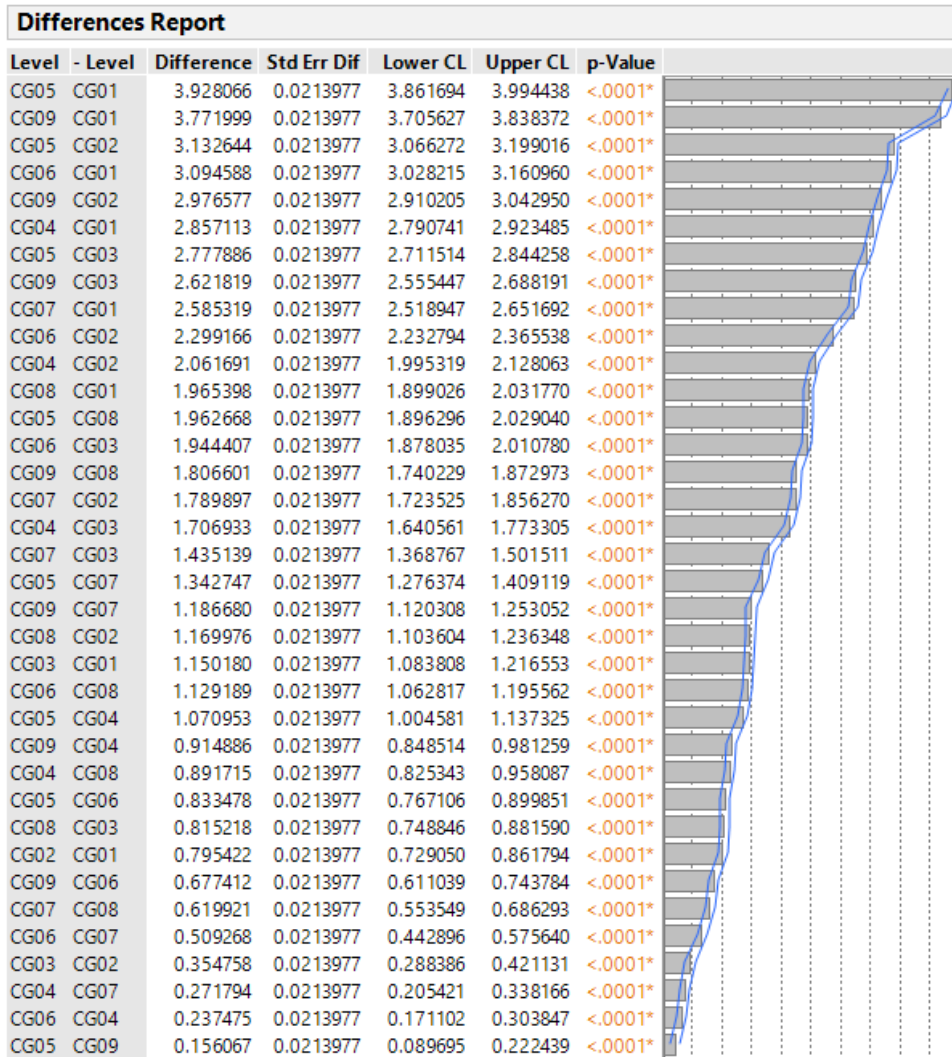
Air Station Sacramento Post Hoc Report (Light)

Ordered Differences

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
CG05	CG06	16.37814	0.1414149	15.9395	16.81679	<.0001*
CG05	CG04	16.37239	0.1414149	15.9337	16.81103	<.0001*
CG05	CG03	15.95798	0.1414149	15.5193	16.39663	<.0001*
CG05	CG02	15.77134	0.1414149	15.3327	16.20998	<.0001*
CG05	CG01	14.80305	0.1414149	14.3644	15.24170	<.0001*
CG05	CG08	12.79133	0.1414149	12.3527	13.22998	<.0001*
CG09	CG06	10.77911	0.1414149	10.3405	11.21776	<.0001*
CG09	CG04	10.77336	0.1414149	10.3347	11.21200	<.0001*
CG09	CG03	10.35895	0.1414149	9.9203	10.79760	<.0001*
CG09	CG02	10.17231	0.1414149	9.7337	10.61095	<.0001*
CG05	CG07	10.05070	0.1414149	9.6121	10.48935	<.0001*
CG09	CG01	9.20402	0.1414149	8.7654	9.64267	<.0001*
CG09	CG08	7.19230	0.1414149	6.7537	7.63095	<.0001*
CG07	CG06	6.32744	0.1414149	5.8888	6.76609	<.0001*
CG07	CG04	6.32168	0.1414149	5.8830	6.76033	<.0001*
CG07	CG03	5.90728	0.1414149	5.4686	6.34593	<.0001*
CG07	CG02	5.72063	0.1414149	5.2820	6.15928	<.0001*
CG05	CG09	5.59903	0.1414149	5.1604	6.03768	<.0001*
CG07	CG01	4.75235	0.1414149	4.3137	5.19099	<.0001*
CG09	CG07	4.45167	0.1414149	4.0130	4.89032	<.0001*
CG08	CG06	3.58681	0.1414149	3.1482	4.02546	<.0001*
CG08	CG04	3.58105	0.1414149	3.1424	4.01970	<.0001*
CG08	CG03	3.16665	0.1414149	2.7280	3.60530	<.0001*
CG08	CG02	2.98000	0.1414149	2.5414	3.41865	<.0001*
CG07	CG08	2.74063	0.1414149	2.3020	3.17928	<.0001*
CG08	CG01	2.01172	0.1414149	1.5731	2.45036	<.0001*
CG01	CG06	1.57509	0.1414149	1.1364	2.01374	<.0001*
CG01	CG04	1.56934	0.1414149	1.1307	2.00798	<.0001*
CG01	CG03	1.15493	0.1414149	0.7163	1.59358	<.0001*
CG01	CG02	0.96829	0.1414149	0.5296	1.40693	<.0001*
CG02	CG06	0.60681	0.1414149	0.1682	1.04545	0.0006*
CG02	CG04	0.60105	0.1414149	0.1624	1.03970	0.0007*
CG03	CG06	0.42016	0.1414149	-0.0185	0.85881	0.0729
CG03	CG04	0.41440	0.1414149	-0.0242	0.85305	0.0816
CG02	CG03	0.18665	0.1414149	-0.2520	0.62529	0.9257
CG04	CG06	0.00576	0.1414149	-0.4329	0.44440	1.0000

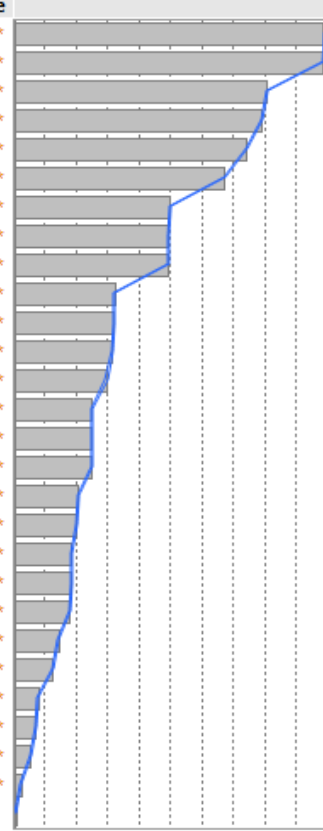


Air Station Sacramento Post Hoc Report (Temperature)



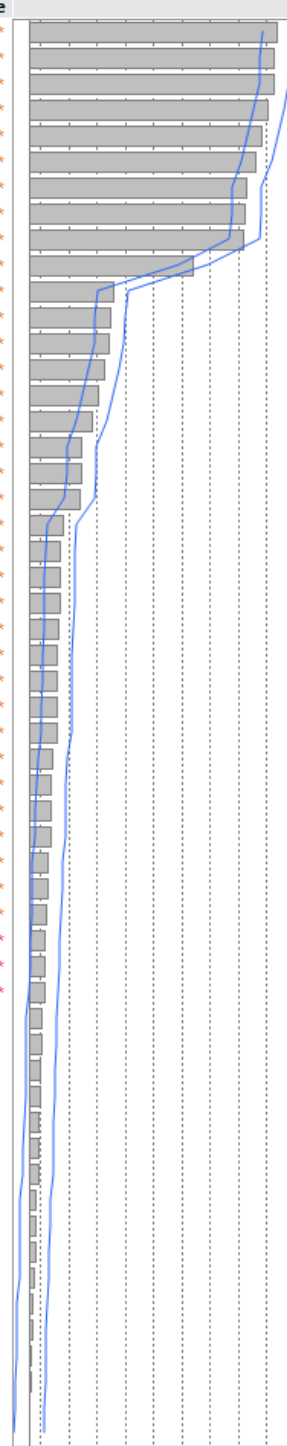
Air Station San Francisco Post Hoc Report (Sound)

Differences Report						
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
CG08	CG06	11.88824	0.0118790	11.8522	11.92425	<.0001*
CG08	CG02	11.85995	0.0118664	11.8240	11.89592	<.0001*
CG08	CG01	9.71379	0.0118679	9.6778	9.74977	<.0001*
CG08	CG04	9.49030	0.0118740	9.4543	9.52629	<.0001*
CG08	CG03	8.92626	0.0118717	8.8903	8.96224	<.0001*
CG08	CG05	8.06266	0.0118762	8.0267	8.09866	<.0001*
CG08	CG07	5.98440	0.0118776	5.9484	6.02040	<.0001*
CG07	CG06	5.90385	0.0118730	5.8679	5.93983	<.0001*
CG07	CG02	5.87555	0.0118604	5.8396	5.91150	<.0001*
CG05	CG06	3.82558	0.0118716	3.7896	3.86156	<.0001*
CG05	CG02	3.79729	0.0118590	3.7613	3.83323	<.0001*
CG07	CG01	3.72940	0.0118619	3.6934	3.76535	<.0001*
CG07	CG04	3.50590	0.0118680	3.4699	3.54187	<.0001*
CG03	CG06	2.96199	0.0118671	2.9260	2.99796	<.0001*
CG07	CG03	2.94186	0.0118657	2.9059	2.97782	<.0001*
CG03	CG02	2.93370	0.0118545	2.8978	2.96963	<.0001*
CG04	CG06	2.39794	0.0118694	2.3620	2.43392	<.0001*
CG04	CG02	2.36965	0.0118568	2.3337	2.40559	<.0001*
CG01	CG06	2.17445	0.0118633	2.1385	2.21041	<.0001*
CG01	CG02	2.14616	0.0118507	2.1102	2.18208	<.0001*
CG07	CG05	2.07826	0.0118702	2.0423	2.11424	<.0001*
CG05	CG01	1.65113	0.0118605	1.6152	1.68708	<.0001*
CG05	CG04	1.42764	0.0118665	1.3917	1.46361	<.0001*
CG05	CG03	0.86359	0.0118643	0.8276	0.89955	<.0001*
CG03	CG01	0.78754	0.0118560	0.7516	0.82347	<.0001*
CG03	CG04	0.56405	0.0118621	0.5281	0.60000	<.0001*
CG04	CG01	0.22349	0.0118583	0.1876	0.25943	<.0001*
CG02	CG06	0.02829	0.0118618	-0.0077	0.06424	0.2485



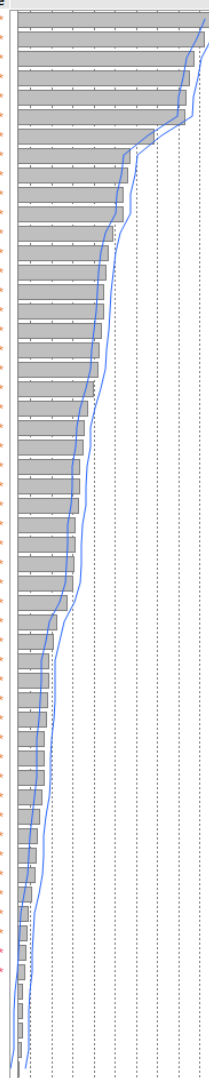
Air Station Francisco Post Hoc Report (Light)

Differences Report						
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
CG09	CG10	92.70532	1.720751	87.1667	98.24398	<.0001*
CG09	CG04	91.67109	1.720751	86.1324	97.20975	<.0001*
CG09	CG06	91.40525	1.720751	85.8666	96.94391	<.0001*
CG09	CG08	89.22952	1.720751	83.6909	94.76818	<.0001*
CG09	CG02	87.07993	1.720751	81.5413	92.61859	<.0001*
CG09	CG03	84.68736	1.720751	79.1487	90.22602	<.0001*
CG09	CG01	81.12354	1.720751	75.5849	86.66220	<.0001*
CG09	CG11	80.96777	1.720751	75.4291	86.50643	<.0001*
CG09	CG05	80.26305	1.720751	74.7244	85.80171	<.0001*
CG09	CG07	61.33749	1.720751	55.7988	66.87615	<.0001*
CG07	CG10	31.36783	1.720751	25.8292	36.90649	<.0001*
CG07	CG04	30.33360	1.720751	24.7949	35.87226	<.0001*
CG07	CG06	30.06776	1.720751	24.5291	35.60642	<.0001*
CG07	CG08	27.89203	1.720751	22.3534	33.43069	<.0001*
CG07	CG02	25.74244	1.720751	20.2038	31.28110	<.0001*
CG07	CG03	23.34987	1.720751	17.8112	28.88853	<.0001*
CG07	CG01	19.78605	1.720751	14.2474	25.32471	<.0001*
CG07	CG11	19.63028	1.720751	14.0916	25.16894	<.0001*
CG07	CG05	18.92556	1.720751	13.3869	24.46422	<.0001*
CG05	CG10	12.44227	1.720751	6.9036	17.98093	<.0001*
CG11	CG10	11.73755	1.720751	6.1989	17.27621	<.0001*
CG01	CG10	11.58178	1.720751	6.0431	17.12044	<.0001*
CG05	CG04	11.40804	1.720751	5.8694	16.94670	<.0001*
CG05	CG06	11.14220	1.720751	5.6035	16.68086	<.0001*
CG11	CG04	10.70332	1.720751	5.1647	16.24198	<.0001*
CG01	CG04	10.54755	1.720751	5.0089	16.08621	<.0001*
CG11	CG06	10.43748	1.720751	4.8988	15.97614	<.0001*
CG01	CG06	10.28171	1.720751	4.7430	15.82037	<.0001*
CG05	CG08	8.96647	1.720751	3.4278	14.50513	<.0001*
CG11	CG08	8.26175	1.720751	2.7231	13.80041	<.0001*
CG01	CG08	8.10598	1.720751	2.5673	13.64464	0.0001*
CG03	CG10	8.01796	1.720751	2.4793	13.55662	0.0002*
CG03	CG04	6.98373	1.720751	1.4451	12.52239	0.0024*
CG05	CG02	6.81688	1.720751	1.2782	12.35555	0.0036*
CG03	CG06	6.71789	1.720751	1.1792	12.25655	0.0045*
CG11	CG02	6.11216	1.720751	0.5735	11.65083	0.0168*
CG01	CG02	5.95639	1.720751	0.4177	11.49505	0.0229*
CG02	CG10	5.62539	1.720751	0.0867	11.16405	0.0428*
CG02	CG04	4.59116	1.720751	-0.9475	10.12982	0.2144
CG03	CG08	4.54216	1.720751	-0.9965	10.08082	0.2283
CG05	CG03	4.42431	1.720751	-1.1144	9.96297	0.2639
CG02	CG06	4.32532	1.720751	-1.2133	9.86398	0.2963
CG11	CG03	3.71959	1.720751	-1.8191	9.25825	0.5325
CG01	CG03	3.56382	1.720751	-1.9748	9.10248	0.5982
CG08	CG10	3.47580	1.720751	-2.0629	9.01446	0.6349
CG08	CG04	2.44157	1.720751	-3.0971	7.98023	0.9440
CG03	CG02	2.39258	1.720751	-3.1461	7.93124	0.9510
CG08	CG06	2.17573	1.720751	-3.3629	7.71439	0.9746
CG02	CG08	2.14959	1.720751	-3.3891	7.68825	0.9767
CG06	CG10	1.30007	1.720751	-4.2386	6.83873	0.9996
CG04	CG10	1.03423	1.720751	-4.5044	6.57289	1.0000
CG05	CG01	0.86049	1.720751	-4.6782	6.39915	1.0000
CG05	CG11	0.70472	1.720751	-4.8339	6.24338	1.0000
CG06	CG04	0.26584	1.720751	-5.2728	5.80450	1.0000
CG11	CG01	0.15577	1.720751	-5.3829	5.69443	1.0000



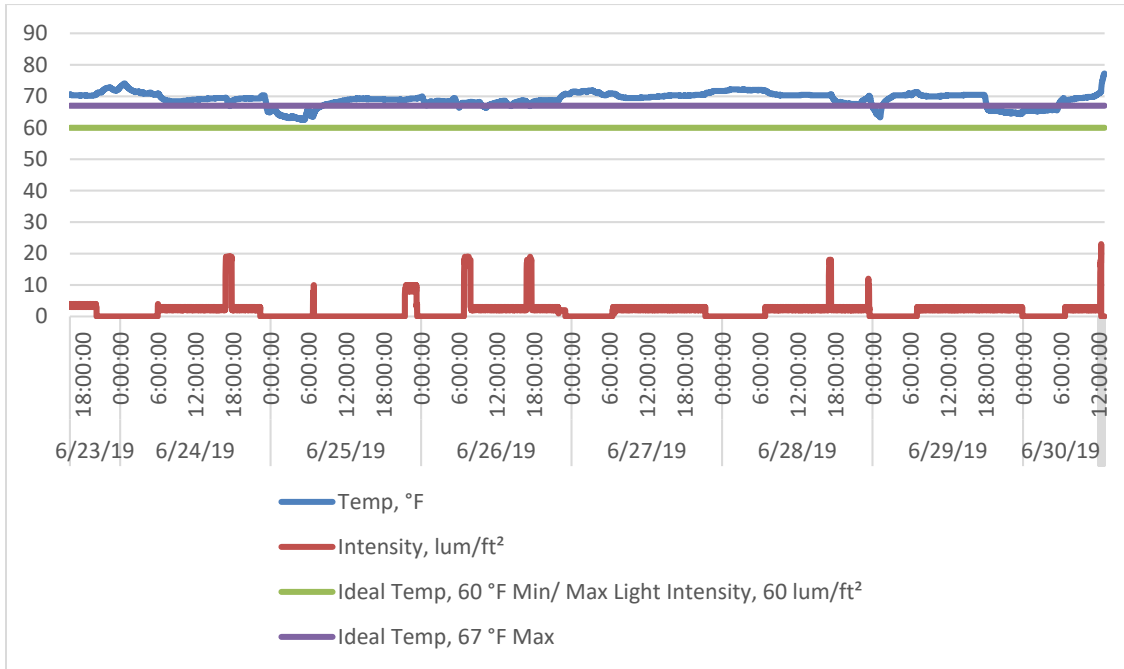
Air Station San Francisco Post Hoc Report (Temperature)

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
CG09	CG11	2.832506	0.0326942	2.72727	2.937740	<.0001*
CG09	CG02	2.723593	0.0326942	2.61836	2.828828	<.0001*
CG09	CG07	2.570955	0.0326942	2.46572	2.676189	<.0001*
CG09	CG10	2.514617	0.0326942	2.40938	2.619851	<.0001*
CG09	CG06	2.450299	0.0326942	2.34506	2.555533	<.0001*
CG09	CG01	2.436617	0.0326942	2.33138	2.541851	<.0001*
CG09	CG05	1.996739	0.0326942	1.89150	2.101974	<.0001*
CG08	CG11	1.645953	0.0326942	1.54072	1.751187	<.0001*
CG09	CG04	1.612305	0.0326942	1.50707	1.717539	<.0001*
CG09	CG03	1.546869	0.0326942	1.44164	1.652104	<.0001*
CG08	CG02	1.537040	0.0326942	1.43181	1.642274	<.0001*
CG08	CG07	1.384401	0.0326942	1.27917	1.489636	<.0001*
CG08	CG10	1.328063	0.0326942	1.22283	1.433298	<.0001*
CG03	CG11	1.285637	0.0326942	1.18040	1.390871	<.0001*
CG08	CG06	1.263746	0.0326942	1.15851	1.368980	<.0001*
CG08	CG01	1.250064	0.0326942	1.14483	1.355298	<.0001*
CG04	CG11	1.220201	0.0326942	1.11497	1.325436	<.0001*
CG09	CG08	1.186553	0.0326942	1.08132	1.291788	<.0001*
CG03	CG02	1.176724	0.0326942	1.07149	1.281958	<.0001*
CG04	CG02	1.111289	0.0326942	1.00605	1.216523	<.0001*
CG03	CG07	1.024085	0.0326942	0.91885	1.129320	<.0001*
CG03	CG10	0.967747	0.0326942	0.86251	1.072982	<.0001*
CG04	CG07	0.958650	0.0326942	0.85342	1.063884	<.0001*
CG03	CG06	0.903429	0.0326942	0.79820	1.008664	<.0001*
CG04	CG10	0.902312	0.0326942	0.79708	1.007546	<.0001*
CG03	CG01	0.889748	0.0326942	0.78451	0.994982	<.0001*
CG04	CG06	0.837994	0.0326942	0.73276	0.943229	<.0001*
CG05	CG11	0.835767	0.0326942	0.73053	0.941001	<.0001*
CG04	CG01	0.824312	0.0326942	0.71908	0.929547	<.0001*
CG08	CG05	0.810186	0.0326942	0.70495	0.915420	<.0001*
CG05	CG02	0.726854	0.0326942	0.62162	0.832088	<.0001*
CG05	CG07	0.574215	0.0326942	0.46898	0.679450	<.0001*
CG05	CG10	0.517877	0.0326942	0.41264	0.623112	<.0001*
CG05	CG06	0.453560	0.0326942	0.34833	0.558794	<.0001*
CG03	CG05	0.449870	0.0326942	0.34464	0.555104	<.0001*
CG05	CG01	0.439878	0.0326942	0.33464	0.545112	<.0001*
CG08	CG04	0.425751	0.0326942	0.32052	0.530986	<.0001*
CG01	CG11	0.395889	0.0326942	0.29065	0.501123	<.0001*
CG04	CG05	0.384435	0.0326942	0.27920	0.489669	<.0001*
CG06	CG11	0.382207	0.0326942	0.27697	0.487442	<.0001*
CG08	CG03	0.360316	0.0326942	0.25508	0.465550	<.0001*
CG10	CG11	0.317890	0.0326942	0.21266	0.423124	<.0001*
CG01	CG02	0.286976	0.0326942	0.18174	0.392210	<.0001*
CG06	CG02	0.273294	0.0326942	0.16806	0.378529	<.0001*
CG07	CG11	0.261551	0.0326942	0.15632	0.366786	<.0001*
CG10	CG02	0.208977	0.0326942	0.10374	0.314211	<.0001*
CG07	CG02	0.152639	0.0326942	0.04740	0.257873	0.0002*
CG01	CG07	0.134338	0.0326942	0.02910	0.239572	0.0020*
CG06	CG07	0.120656	0.0326942	0.01542	0.225890	0.0102*
CG02	CG11	0.108913	0.0326942	0.00368	0.214147	0.0352*
CG01	CG10	0.078000	0.0326942	-0.02723	0.183234	0.3757
CG03	CG04	0.065435	0.0326942	-0.03980	0.170670	0.6480
CG06	CG10	0.064318	0.0326942	-0.04092	0.169552	0.6720
CG10	CG07	0.056338	0.0326942	-0.04890	0.161572	0.8239
CG01	CG06	0.013682	0.0326942	-0.09155	0.118916	1.0000

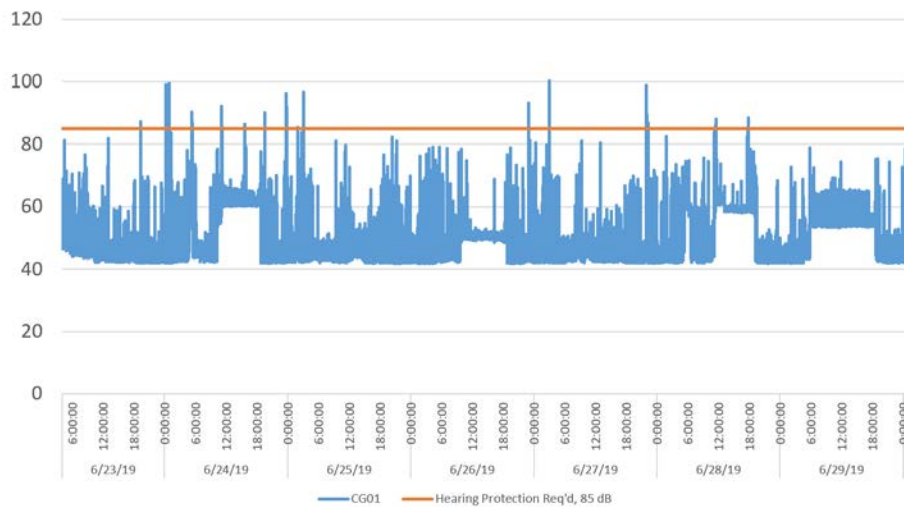


APPENDIX G. AIR STATION SACRAMENTO LIGHT, SOUND, AND TEMPERATURE PLOTS

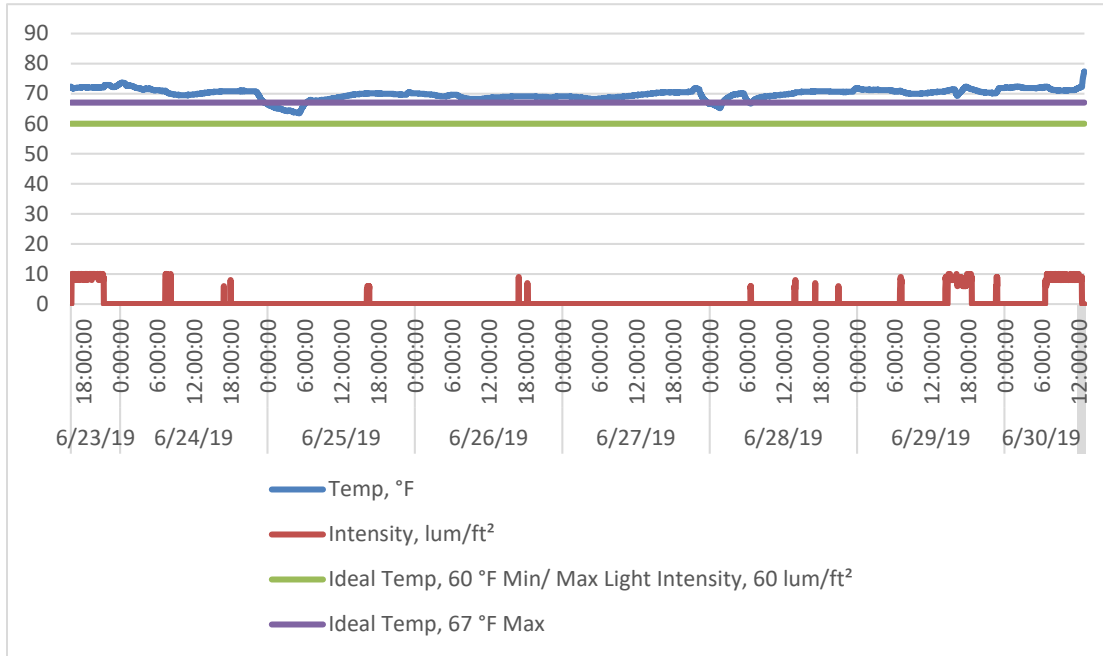
Pilot (CG01) Room Light and Temperature Plot



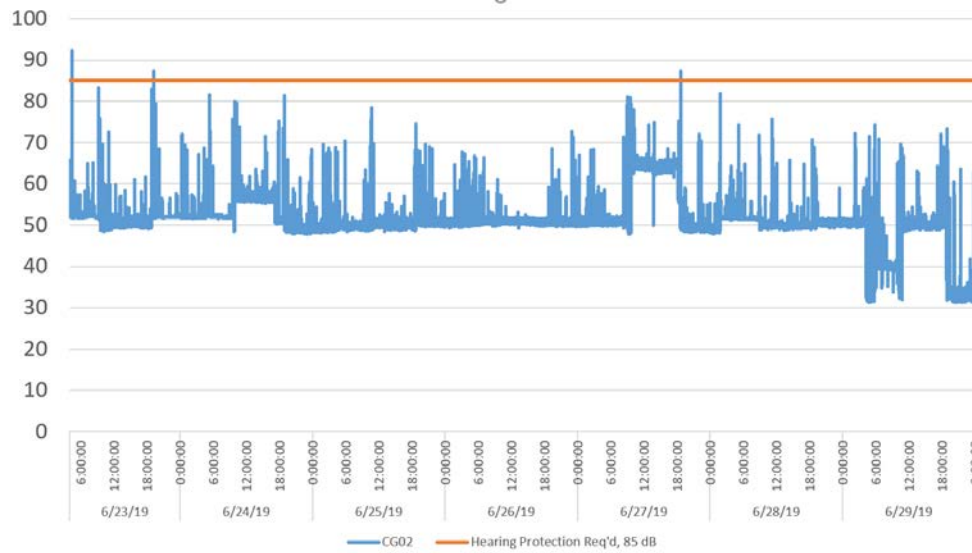
Pilot (CG01) Room Sound Plot (in decibels)



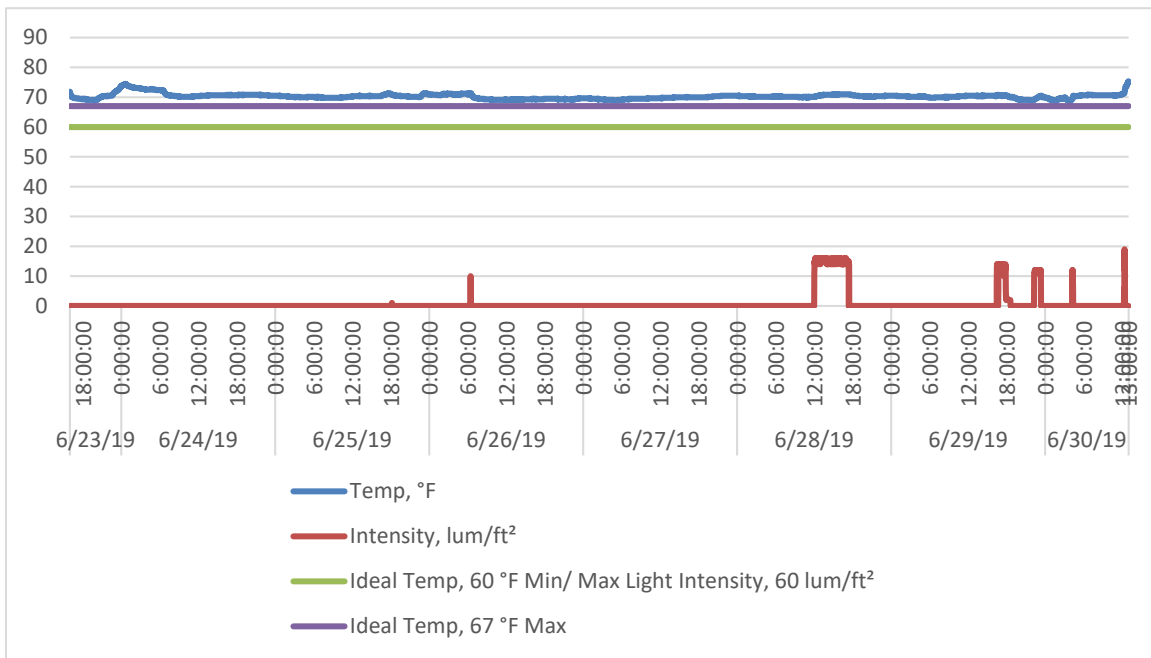
Co-Pilot (CG02) Room Light and Temperature Plot



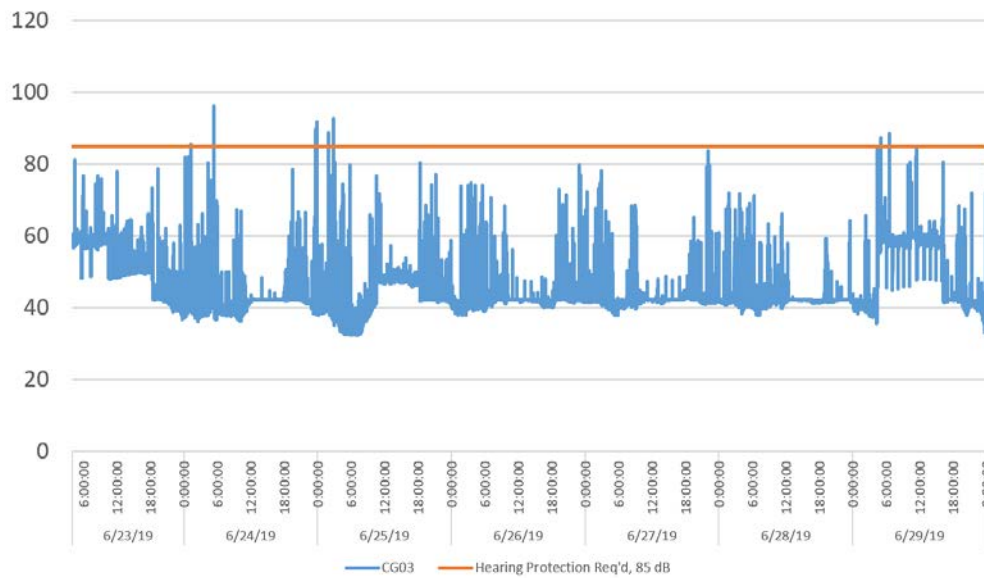
Co-Pilot (CG02) Room Sound Plot (in decibels)



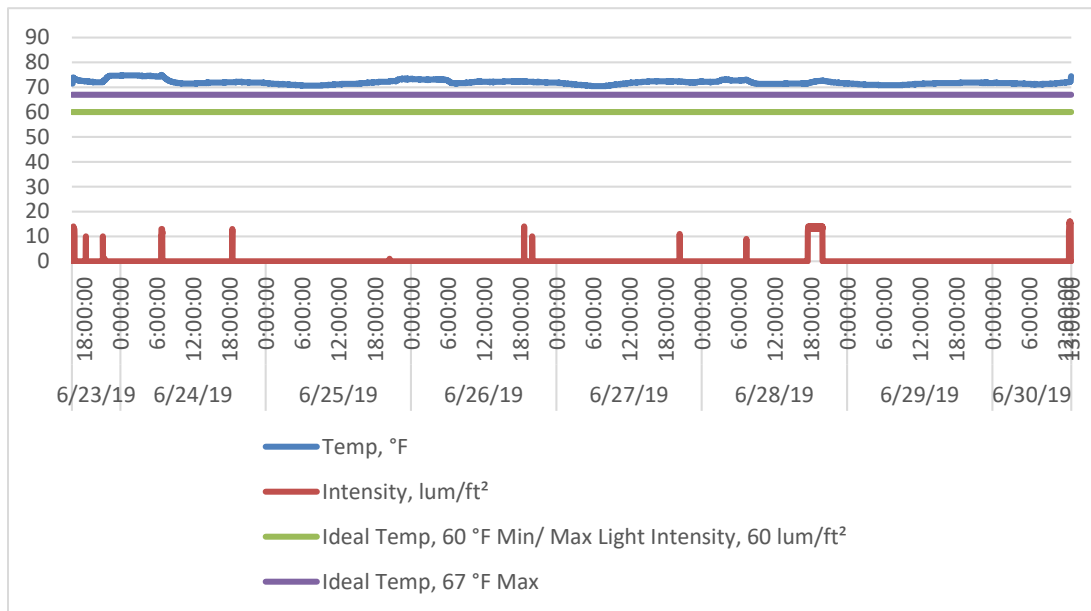
ODO (CG03) Room Light and Temperature Plot



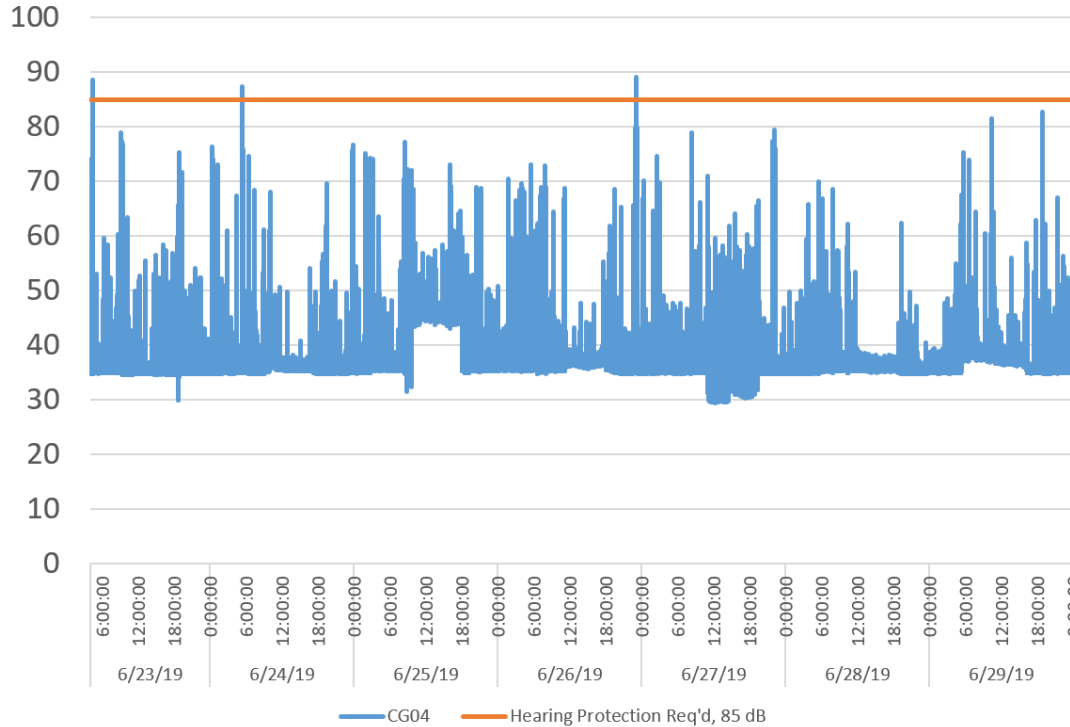
ODO (CG03) Room Sound Plot (in decibels)



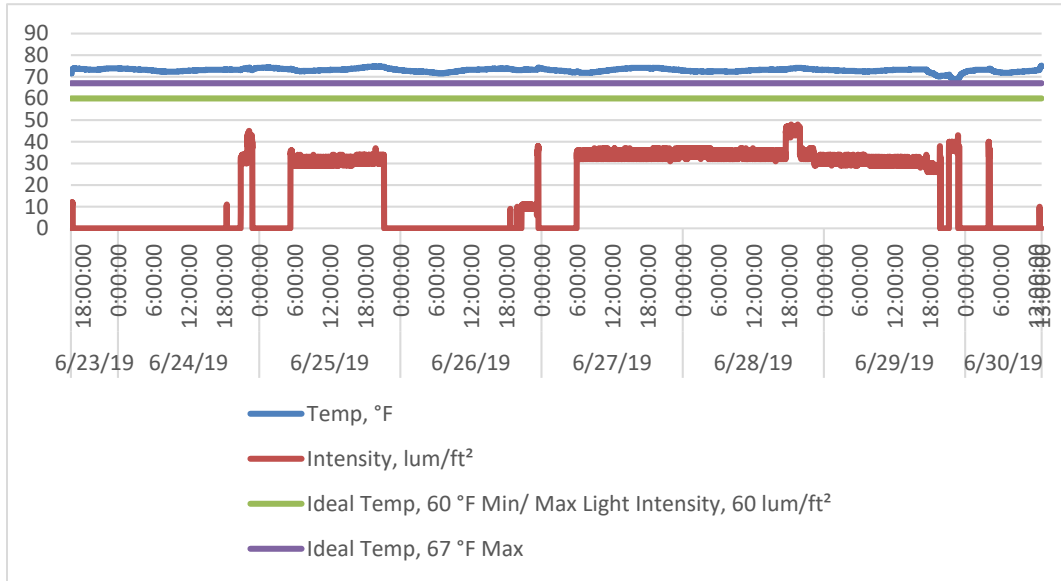
Radio (CG04) Room Light and Temperature Plot



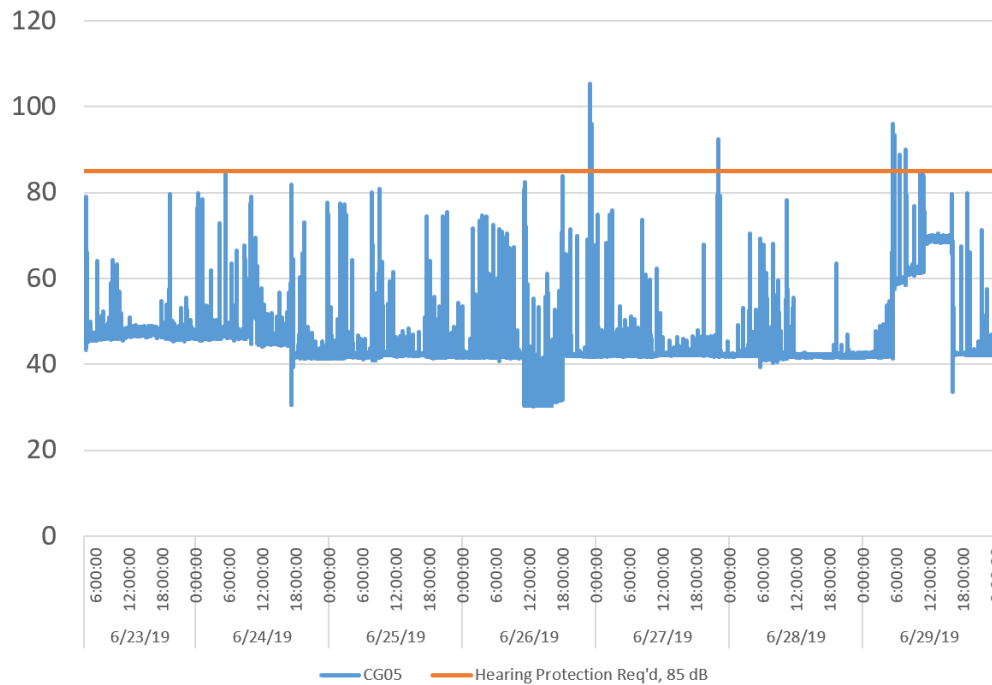
Radio (CG04) Room Sound Plot (in decibels)



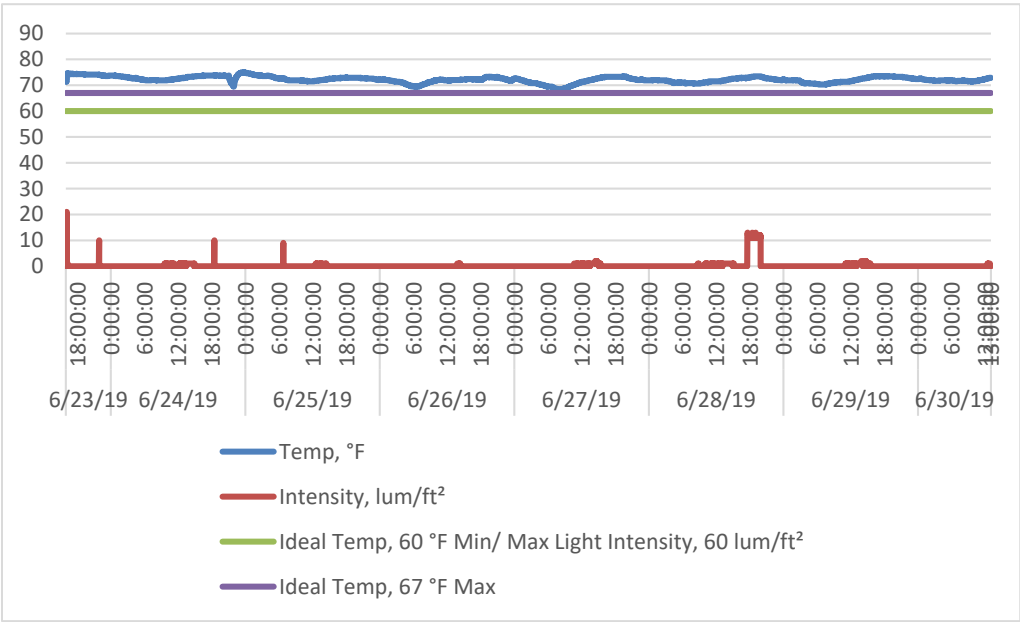
Watch Capt. (CG05) Room Light and Temperature Plot



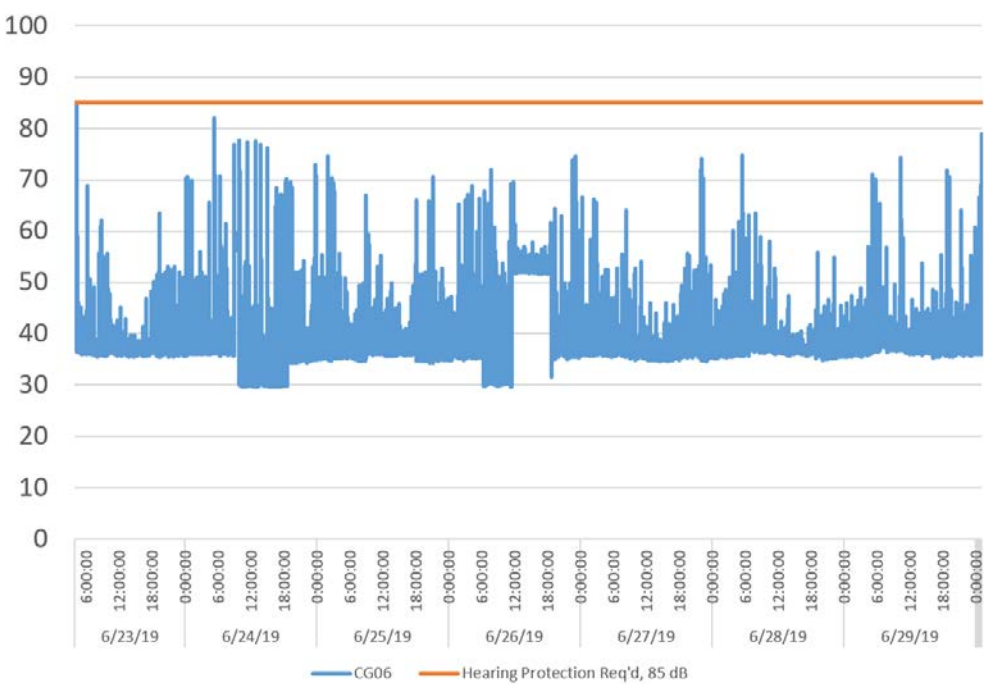
Watch Capt. (CG05) Room Sound Plot (in decibels)



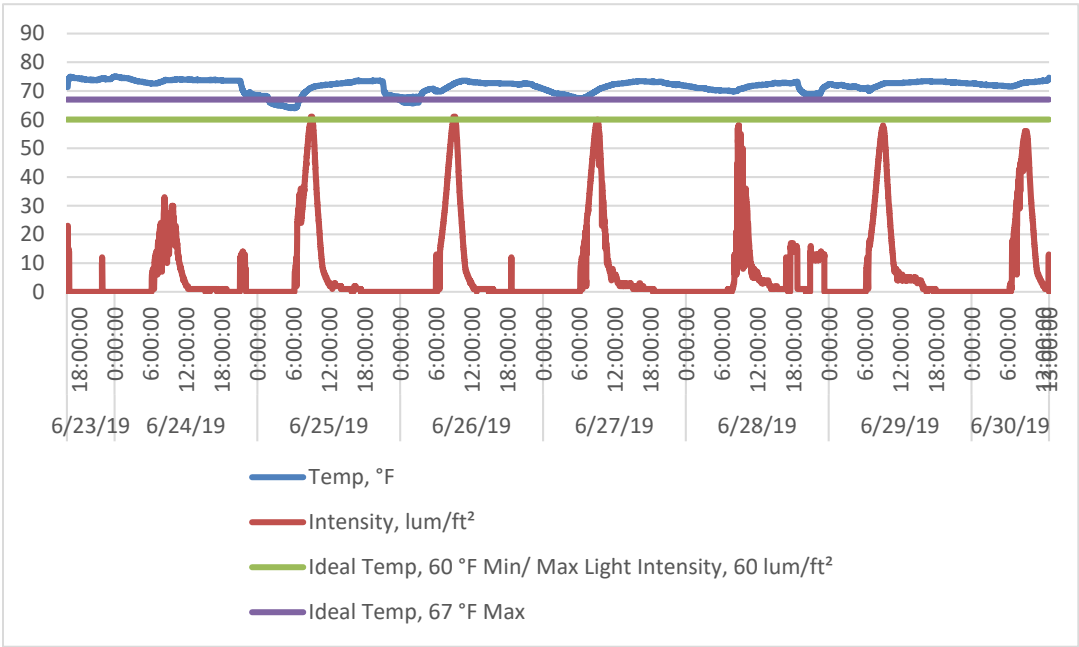
Extra Room 1 (CG06) Room Light and Temperature Plot



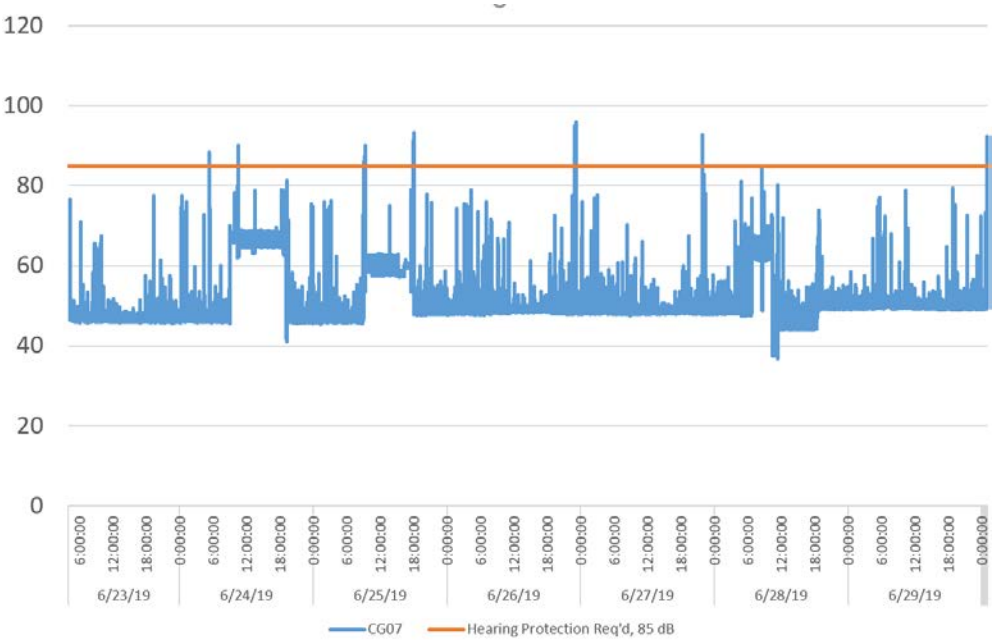
Extra Room 1 (CG06) Room Sound Plot (in decibels)



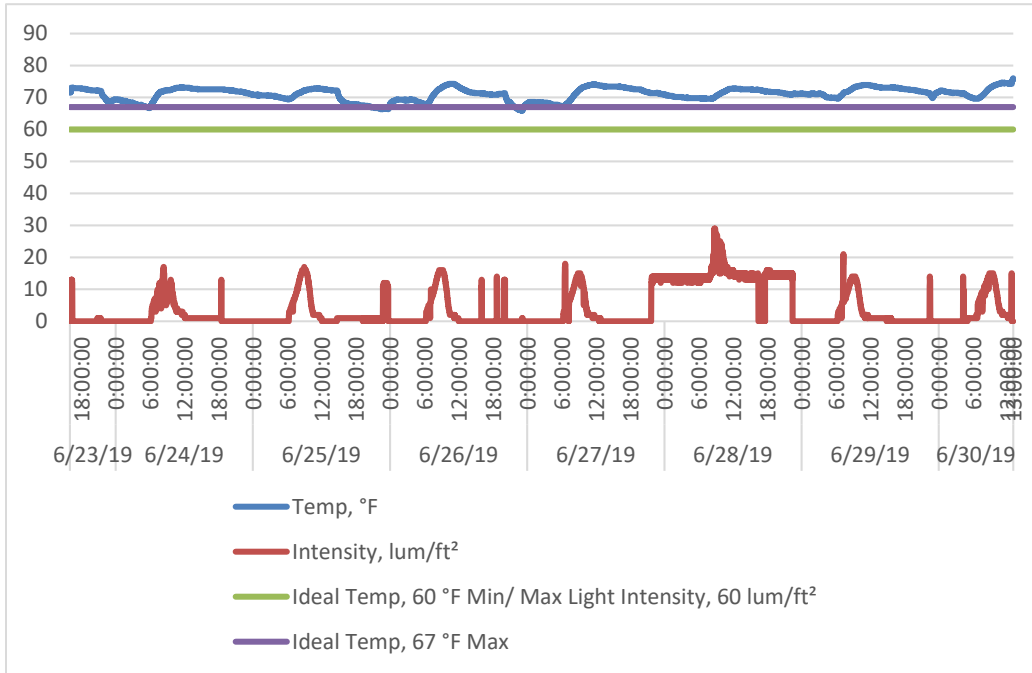
Extra Room 2 (CG07) Room Light and Temperature Plot



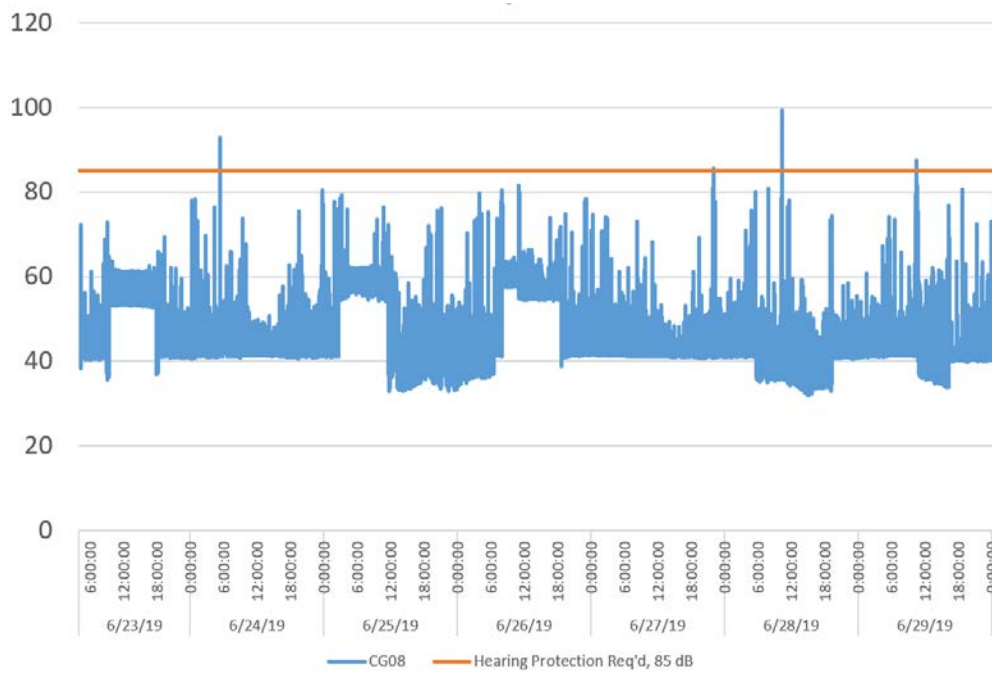
Extra Room 2 (CG07) Room Sound Plot (in decibels)



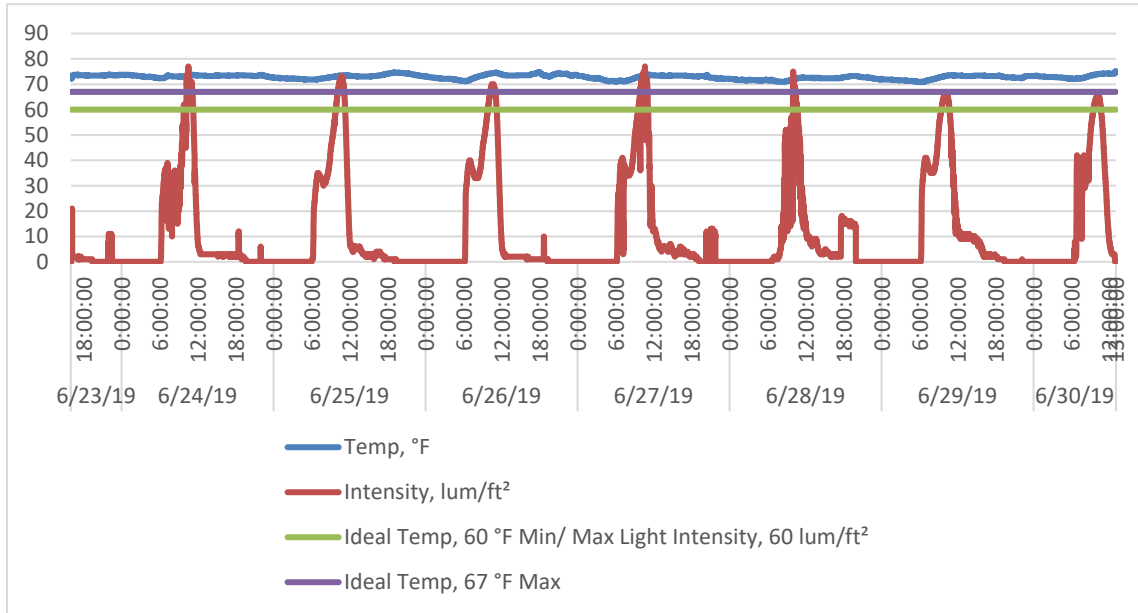
Drop Master (CG08) Room Light and Temperature Plot



Drop Master (CG08) Room Sound Plot (in decibels)



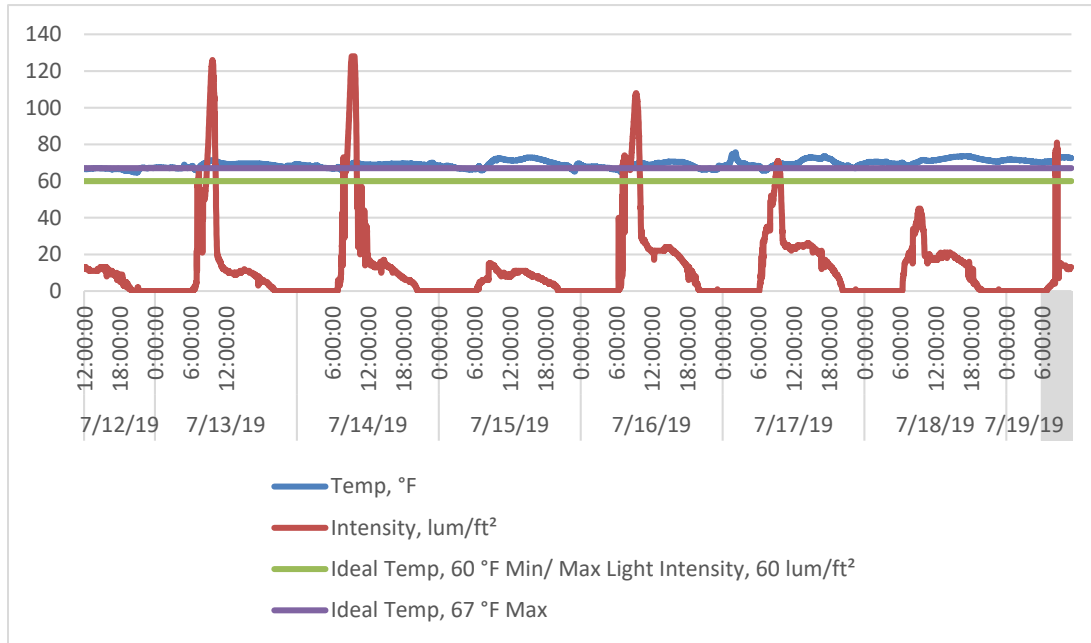
Drop Master 2 (CG09) Room Light and Temperature Plot



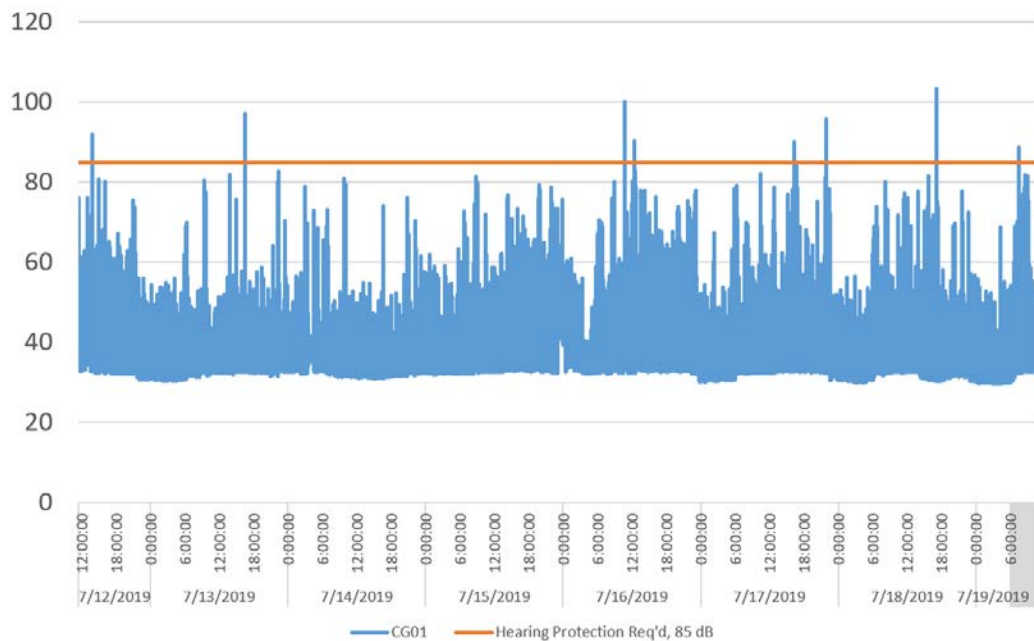
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APPENDIX H. AIR STATION SAN FRANCISCO LIGHT, SOUND, AND TEMPERATURE PLOTS

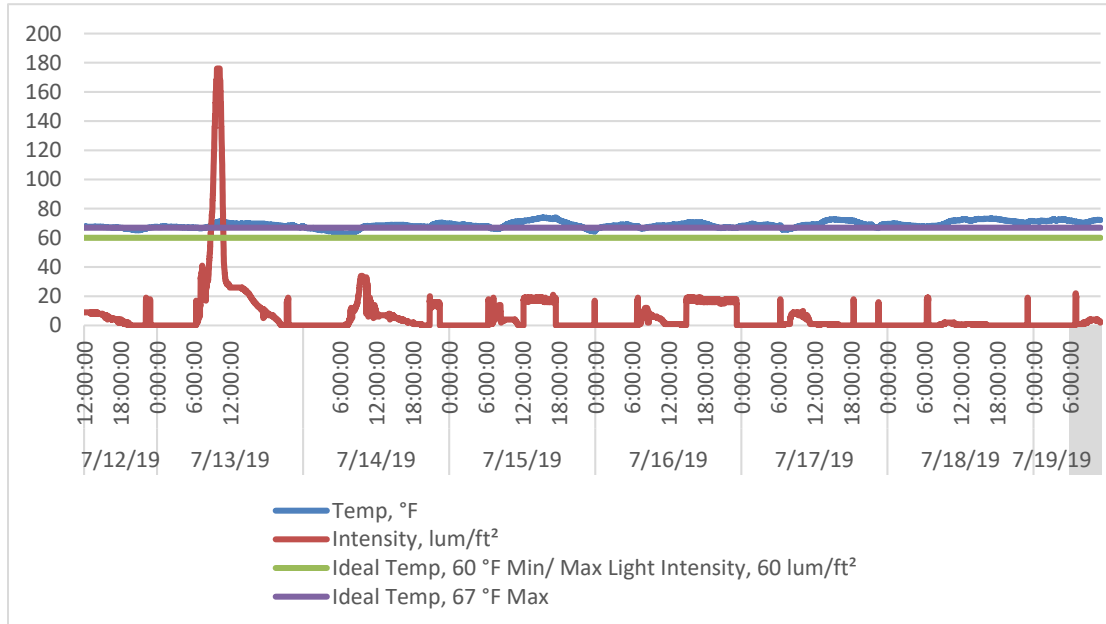
Pilot (CG01) Room Light and Temperature Plot



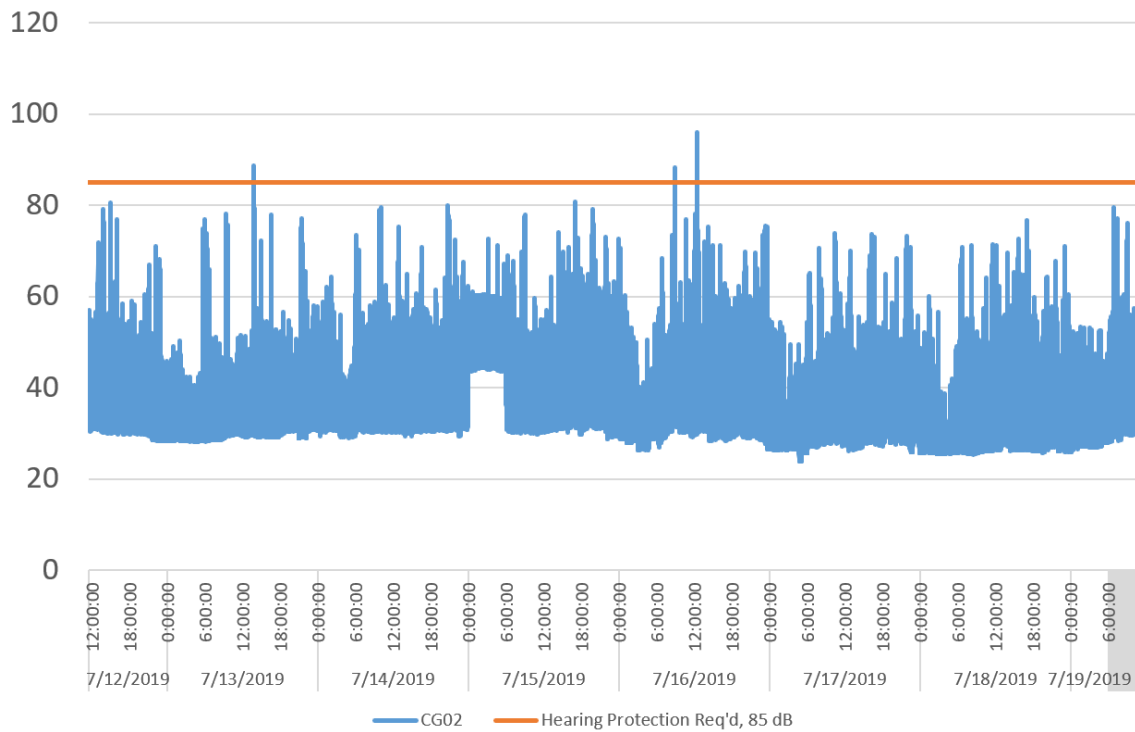
Pilot (CG01) Room Sound Plot (in decibels)



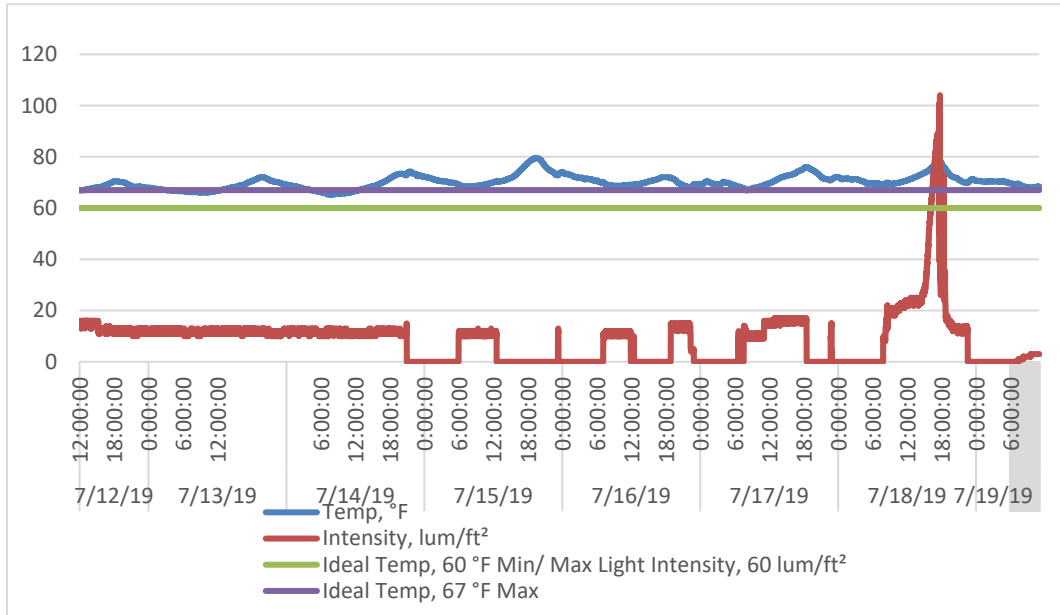
Co-Pilot (CG02) Room Light and Temperature Plot



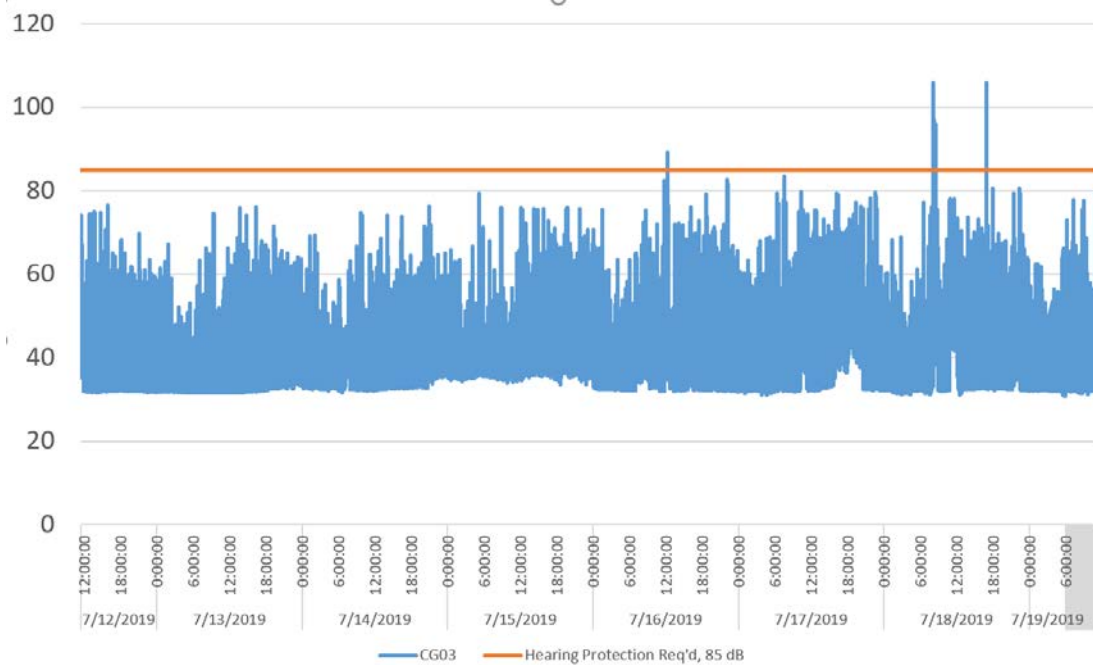
Co-Pilot (CG02) Room Sound Plot (in decibels)



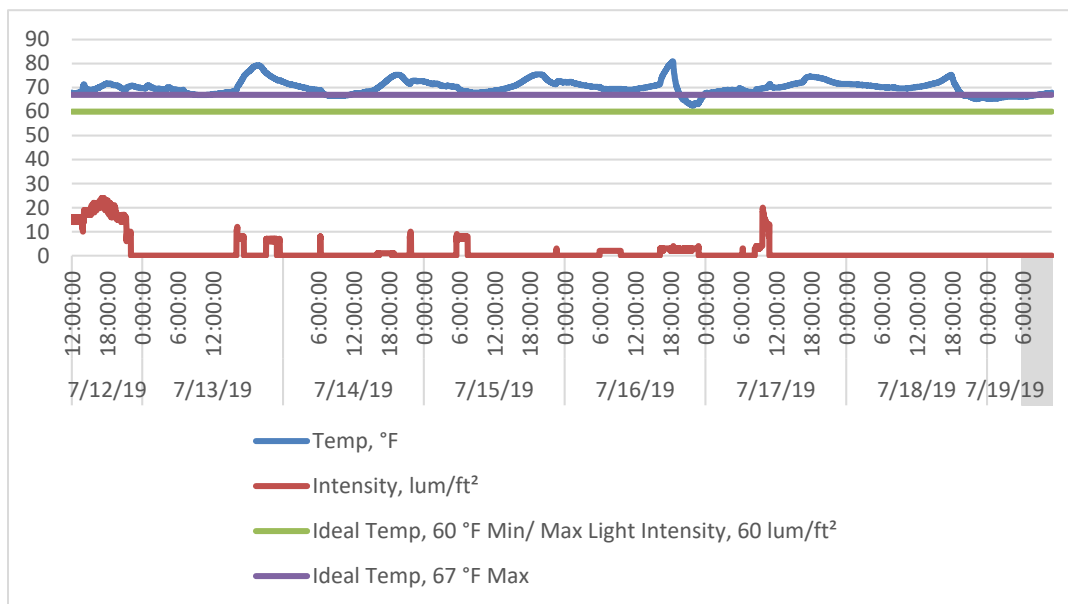
RS (CG03) Room Light and Temperature Plot



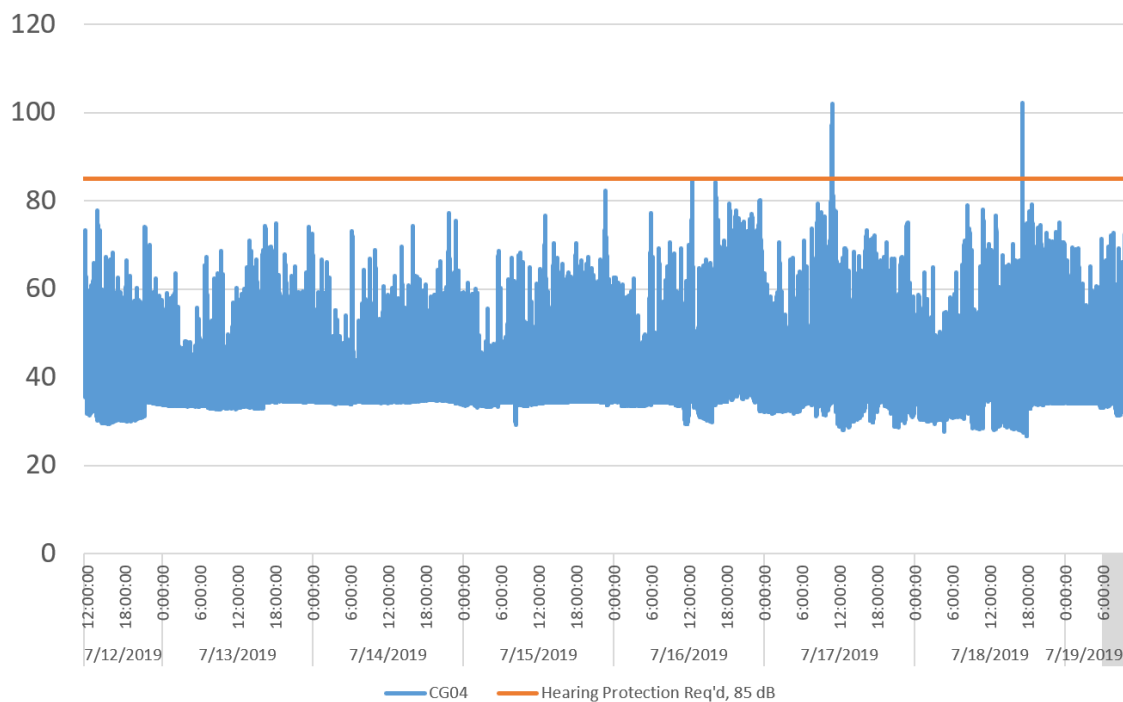
RS (CG03) Room Sound Plot (in decibels)



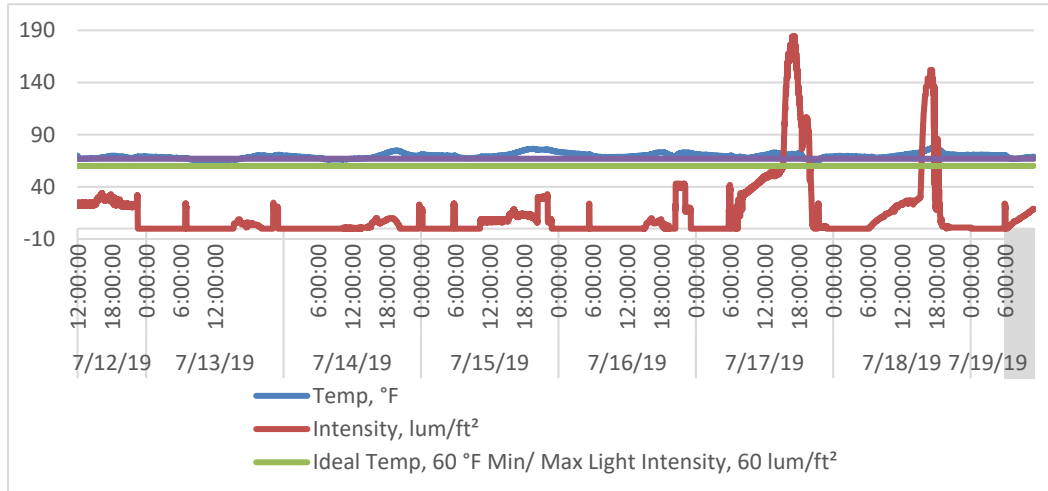
FM (CG04) Room Light and Temperature Plot



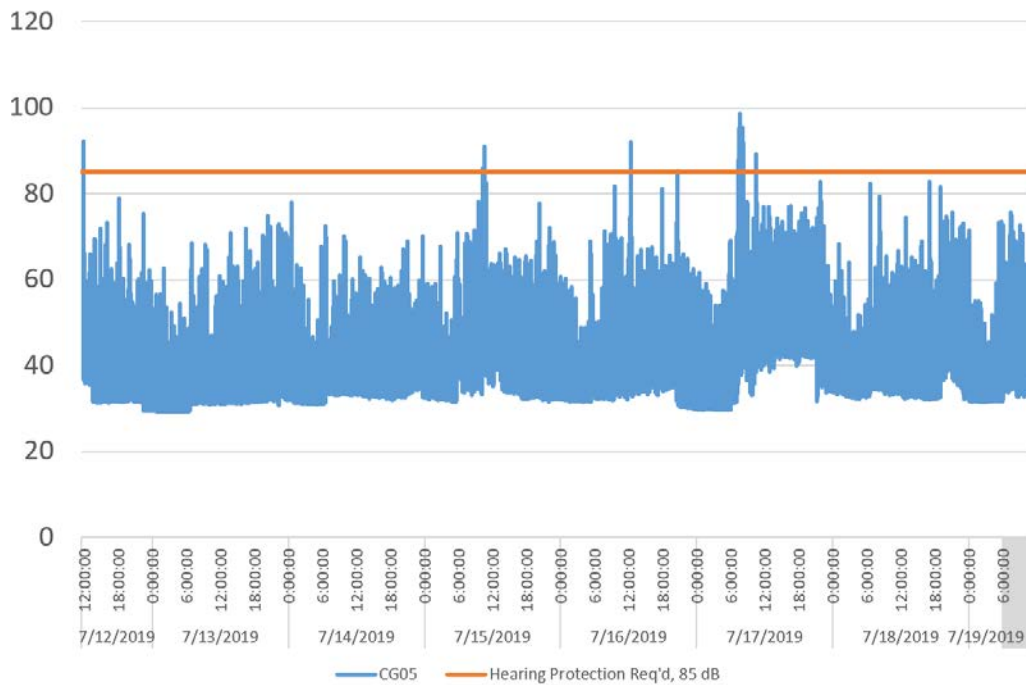
FM (CG04) Room Sound Plot (in decibels)



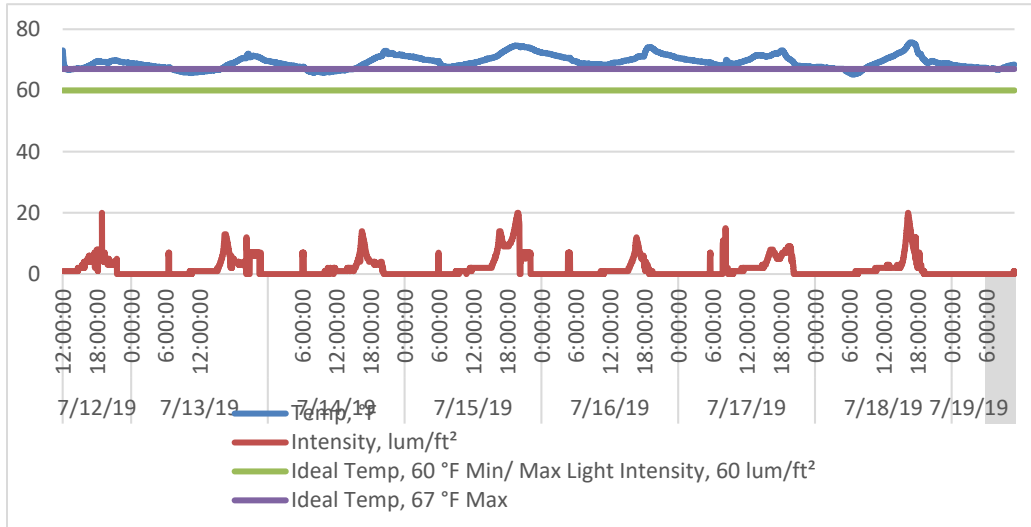
Watch Capt. (CG05) Room Light and Temperature Plot



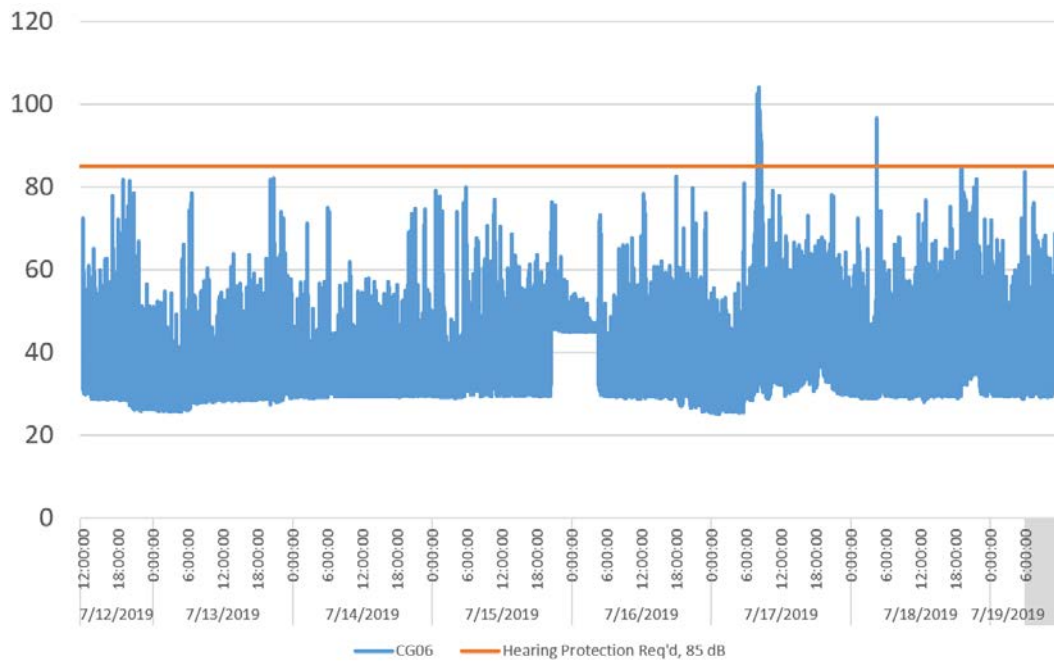
Watch Capt. (CG05) Room Sound Plot (in decibels)



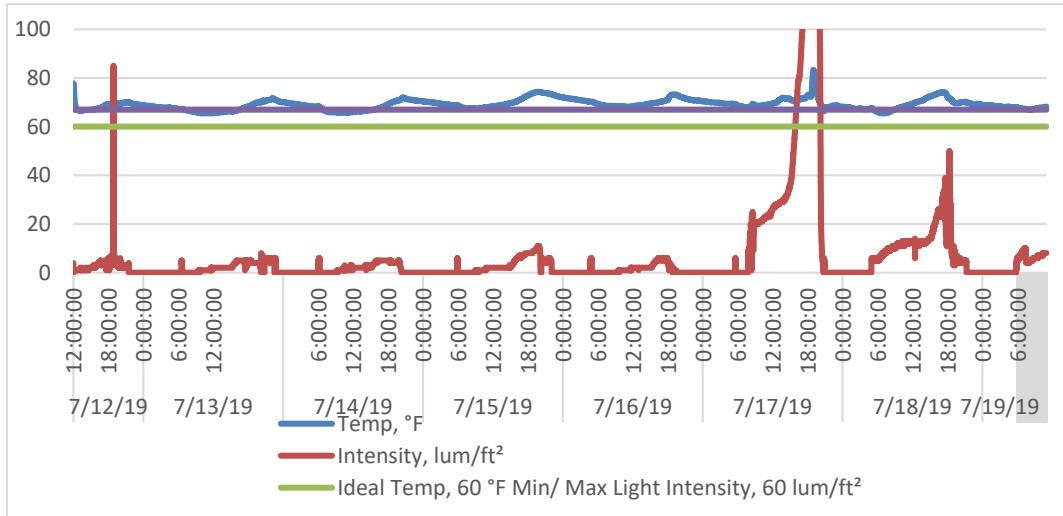
Line Crew (CG06) Room Light and Temperature Plot



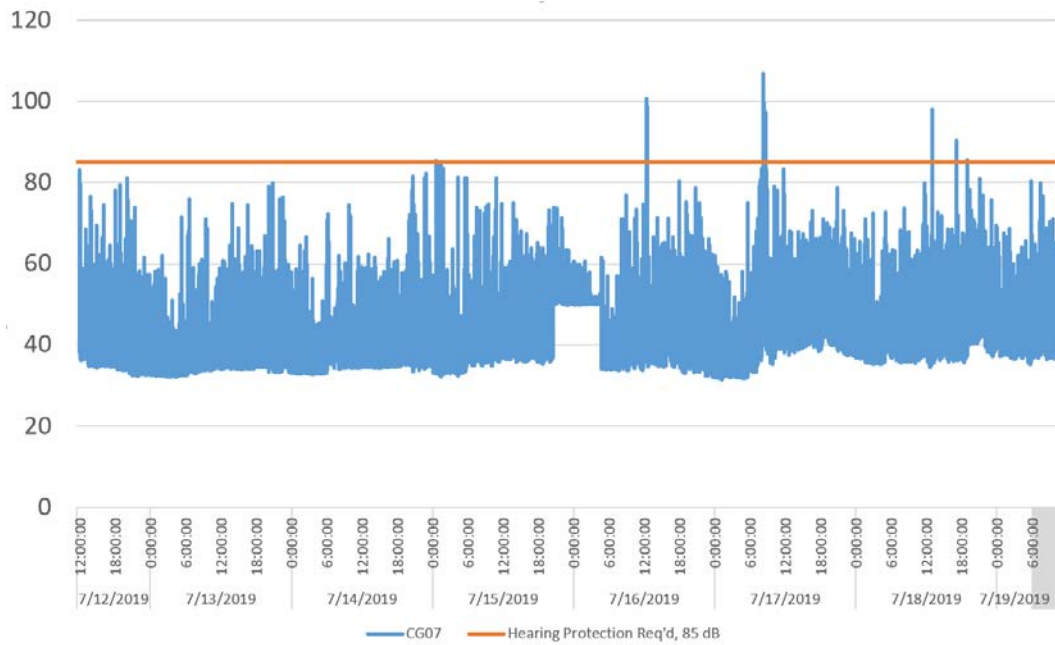
Line Crew (CG06) Room Sound Plot (in decibels)



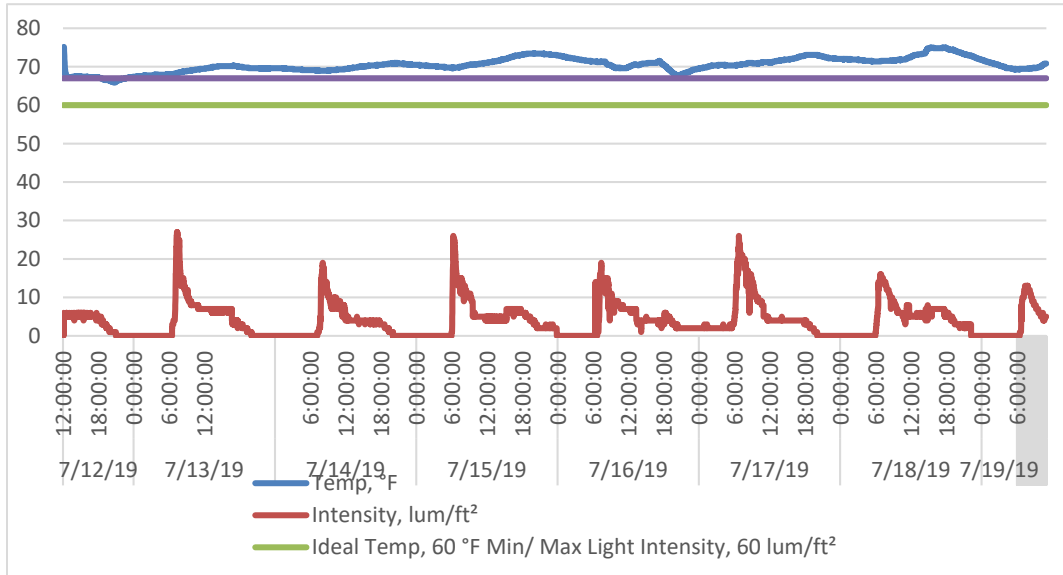
Line Crew 2 (CG07) Room Light and Temperature Plot



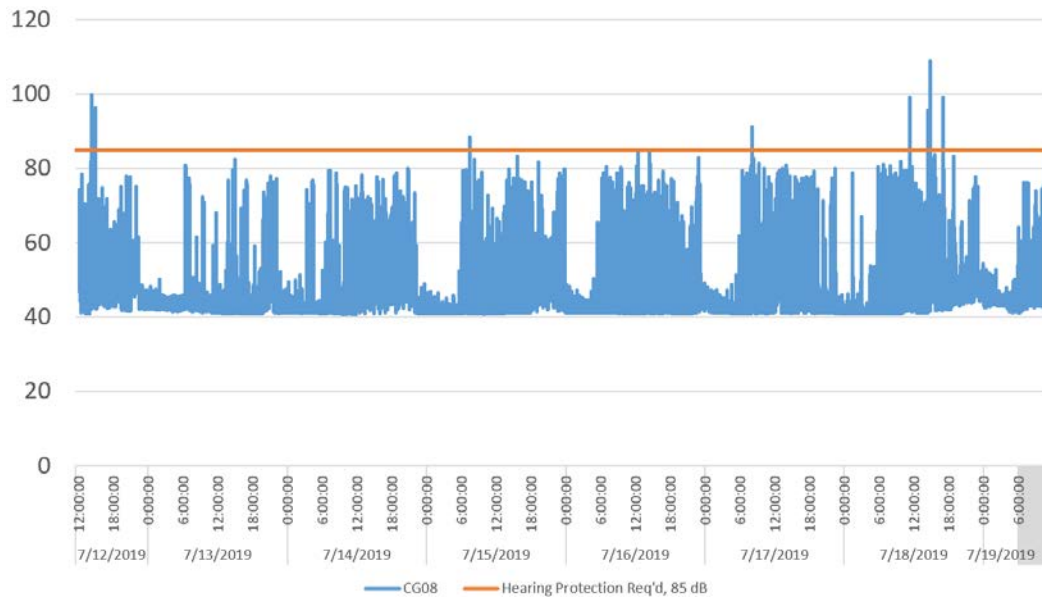
Line Crew 2 (CG07) Room Sound Plot (in decibels)



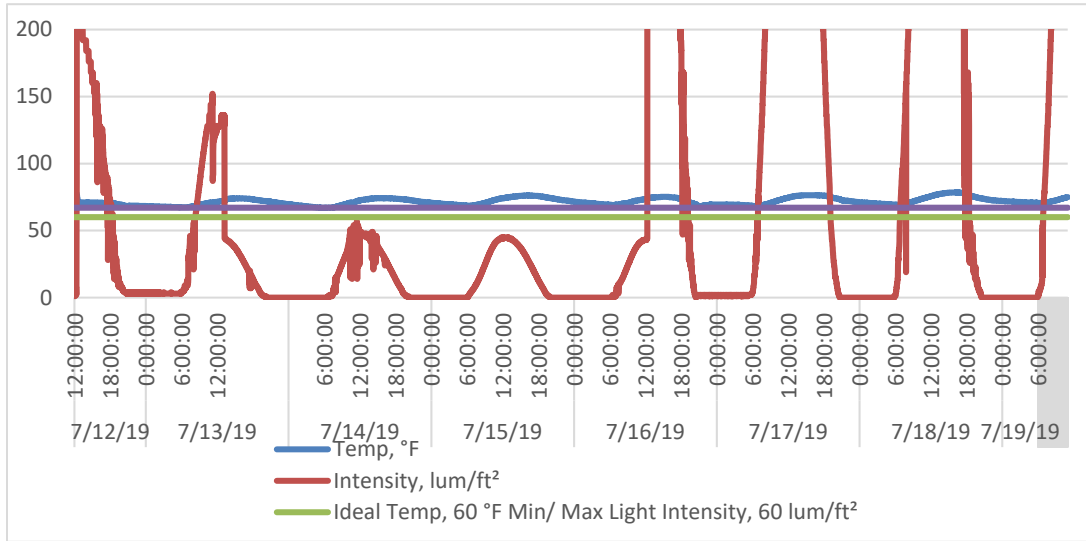
Wardroom(CG08) Room Light and Temperature Plot



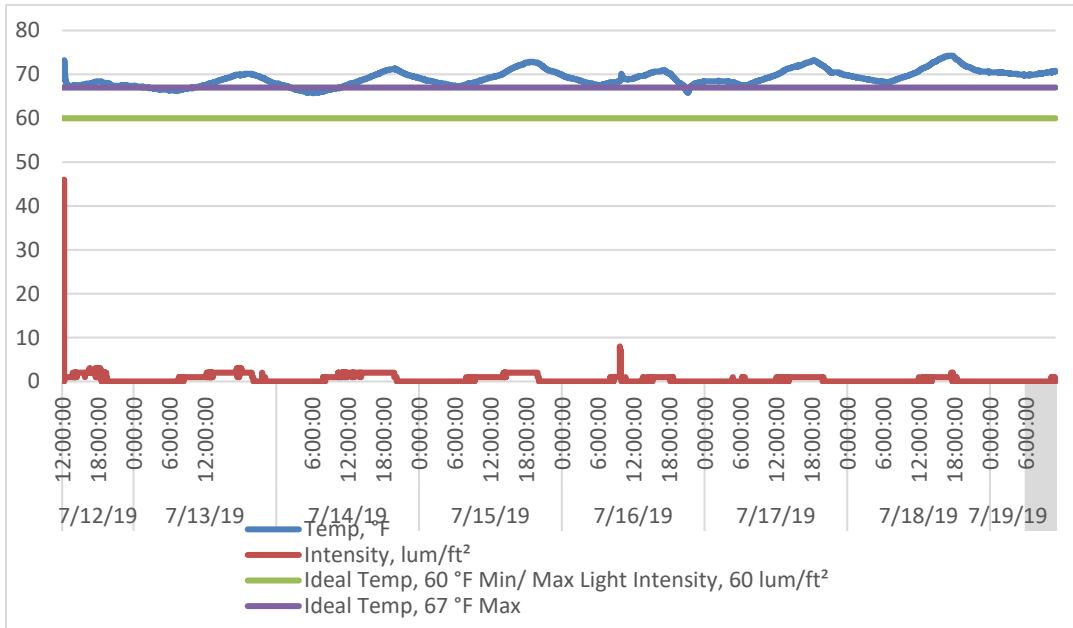
Wardroom (CG08) Room Sound Plot (in decibels)



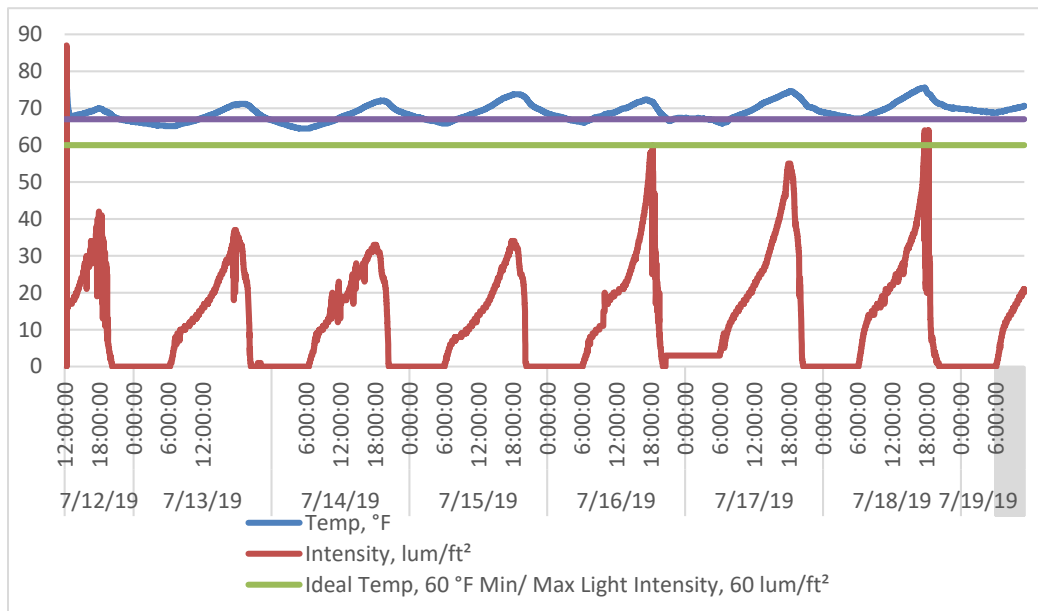
Crew Lounge 1(CG09) Room Light and Temperature Plot



Crew Lounge 2 (CG10) Room Light and Temperature Plot



Crew Lounge 3 (CG11) Room Light and Temperature Plot



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