Sleep Across Military Environments

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This focus of this discussion panel is on the effect of sleep on human performance in different military environments or contexts. Panelists will discuss a wide range of topics including how to address fatigue among Air Force pilots, the impact of sleep on performance in Army Advanced Individual Training, the effects of adjusting Army and Navy recruits' sleep schedules during training, the existing gaps in addressing sleep needs on naval vessels, the impact of sleep loss and other stressors on dismounted warfighter performance, and the effects of chronic inadequate sleep on cognitive readiness. It is important to understand both the differences in the effects of sleep in these environments, as well as the commonalities that can be applied to multiple environments and operators. Our panelists include some of the foremost sleep experts of today, as well as others who examine sleep in their human performance research. Participation in this panel will include discussing their latest research, offering practical applications, and engaging the audience in discussions of cross-disciplinary applications, including areas for collaboration across military and civilian services and environments. Finally, panelists and audience members will and share ideas about directions for future sleep-related research.

INTRODUCTION

All human beings require sleep. Some individuals require more sleep than others in order to perform optimally in their day to day life. Not getting enough sleep can have profound effects on human performance and can even be harmful to one's health.

Fatigue is a major factor influencing our military's performance. A military analyst discussing the numerous accidents that occurred in the initial stages of Operation Iraqi Freedom stated,

"Fatal mishaps soon will 'level out.' They are apt to rise again with 'fatigue and combat stress,' as the war gets longer and tougher. *The biggest killer is fatigue, and right now we have a whole Army running toward Baghdad on zippo hours of sleep* (Miller, Matsangas & Shattuck, 2008).

In combat operations, getting an adequate amount of sleep is critical to mission performance. However, combat conditions make it such that it is difficult if not impossible to do so. For example, Air Force pilots often have to go for extended periods of time without sleep. Pilots and other military service members cannot suffer as a result of their sleep deprived state, as their mission, their own life and the lives of others, depend on their ability to perform their tasks well.

There are human factors implications of sleep deprivation, including the design of equipment, systems, or processes using knowledge of sleep deprivation and its effects on human performance. For instance, in a highly complex task environment, where the operator user is in a condition that puts him or her at risk for continued periods of sleep deficit, and importantly where the consequences of error are dire, design features such as automation, shared task load, and built in task redundancy are critical to prevent accidents.

This panel will give attendees the opportunity to see and hear about the latest sleep research being conducted by the U.S. Air Force, Army, and Navy. Attendees will also have an opportunity to discuss practical applications relating to sleep, including appropriate measures for fatigue avoidance, and the importance of getting more sleep. The panel environment will also allow for engaging discussions both within and between military services, and between the military and civilian sectors. New ideas for research may stem from this collaborative environment made up of the foremost sleep experts across the services, as well as individuals conducting important sleep-related military research.

Lynn Caldwell: US Air Force Research Laboratory

Addressing Fatigue in Military Aviation

Air Force pilots have a unique mission compared to commercial pilots. Many of the aircraft are either dual pilot or single pilot aircraft. For example, the B-2 has a crew of two pilots, a pilot in the left seat and mission commander in the right. In support of Operation Enduring Freedom, the B-2 flew one of its longest missions to date from Whiteman to Afghanistan and back – 44 hours. The F-117 is a single-pilot aircraft. On their first trip, the F-117s flew non-stop from Holloman AFB, NM, to Kuwait, a flight of approximately 18.5 hours. Even though crew rest for pilots is mandated as in the civilian community, during wartime, pilots and crew do not have the luxury of turning down a mission. If the mission isn't completed, the safety and lives of people will suffer.

Because of these unique missions and aircraft, fatigue countermeasures available to military pilots are different from the ones available to commercial pilots. For example, many military pilots are allowed to use prescription alertness-enhancing medication such as modafinil and dextro-amphetamine during certain types of missions. In addition, prescription sleeping aids are also allowed during certain situations to help pilots obtain adequate sleep prior to missions.

These unique military activities lead to unique research involving fatigue countermeasures for military aviation. Researchers investigate the impact countermeasures available under current policies, but they also investigate countermeasures not currently authorized in order to determine whether pilots and crew could benefit from additional options for maintaining alertness and performance. The outcome of this research is then made available to policy makers who evaluate and recommend potential changes in policy.

Panel attendees will hear examples of research conducted to address specific military problems associated with long missions and countermeasures research to help alleviate or reduce alertness problems associated with these missions.

Discussions may include differences among military missions and appropriate countermeasures for various missions.

Harris Lieberman: U.S. Army Research Institute of Environmental Medicine

Impact of Sleep Loss and other Stressors on Dismounted Warfighter Performance

The adverse effects of sleep loss on cognitive performance are well-documented in laboratory studies. However, in the operational environment of dismounted warfighters, sleep loss is just one of many stressors that degrade cognitive performance. During military operations designed to simulate the operational combat environment, as well as laboratory studies, we have used a standardized battery of cognitive performance and mood tests designed to assess operationally-relevant aspects of cognitive state.

While sleep loss is a key stressor degrading cognitive performance and mood, other operational stressors, including heat, cold, high altitude and dehydration, substantially contribute to what, in aggregate, is a devastating level of impairment in all cognitive functions assessed, including vigilance, reaction time, working memory and reasoning. Most aspects of mood state, including fatigue, vigor, confusion and depression, are also severely degraded. Decrements in cognitive performance observed in simulations of multistressor operational combat environments substantially exceed those resulting from severe sleep deprivation alone, alcohol intoxication and clinical hypoglycemia. Decrements in mood exceed or equal those associated with disease states such as narcolepsy, sleep apnea and chronic fatigue syndrome. Decrements in cognitive function induced by multistressor environments, field and laboratory studies can be compared to exposure to single stressor environments including sleep deprivation, dehydration, food deprivation and cold.

The likely operational consequences of the multistressor environments inherent in dismounted warfare cannot be underestimated and must be considered when training and planning for such military operations.

Panagiotis Matsangas: US Naval Postgraduate School

Sleep at sea: The need for appropriate research and corresponding guidance

A naval vessel's sustained operational readiness and effectiveness is closely related to the ability of the human element to perform effectively for prolonged periods of time.

While underway the crew faces two major, albeit contradicting, needs, the physiological need for rest and sleep, and the operational need including work or maintenance, watch-standing, training, attending meetings, etc. The quality and quantity of sleep deteriorates due to the ship's motion and the increased workload, leading to inadequate rest periods.

The following issues affecting crew performance at sea have been identified in a series of studies conducted by the Naval Post Graduate School: a) Personnel workload while at sea increases significantly in comparison to shore duty while in port; b) The workload of several departments is disproportionate; c) Lower ranks and echelons of command may have the advantage of sleep time; d) Personnel while underway average 20% less sleep than the physiologically acceptable norm.

Sustaining crew performance is a challenge that the Commanding Officer has to deal with in an optimized manner. Nevertheless, regulations such as the Navy Standards Workweek (regarding crew endurance through an optimized daily schedule) need further elaboration in order to more effectively address the impact of naval operations on crew performance.

On the other hand, existing knowledge on the effect of motion on sleep is merely based on anecdotal data or subjective evaluations of sleep related problems. This is due to a lack of appropriate data concerning the possible connection

between ship motion and increased sleep disturbances. This is clearly indicated by the absence of sleep-related standards at the level of ship design.

In summary, the responsibility of this panel is to focus its attention on the following two issues: a) The findings of the studies conducted at Naval Postgraduate School, b) The absence of sleep-related standards in the ship design process.

Nita Lewis Miller: US Naval Postgraduate School

Adjusting sleep schedule of Army and Navy recruits

Military training often includes some degree of sleep deprivation, either by design or unintentionally. A plethora of recent scientific studies indicate that this sleep deprivation may have important implications for Soldier physical health, well-being, and performance. This panel discussion addresses two studies of the effects of sleep on performance in military recruits. The studies were conducted to determine if adjusting scheduled sleep periods to better complement age-specific biologically driven sleep patterns would improve sleep and performance in the participants. One study focused on U.S. Navy Recruits at Great Lakes Training Center, IL while the other focused on Army Recruits completing basic combat training (BCT) at Fort Leonard Wood, MO.

In the Great Lakes Study, USN Recruits were given an additional two hours of sleep per night (8 hours) for the entirety of their 9-week training period. Performance of standardized tests scores demonstrated significantly higher scores when compared to their counterparts who received only 6 hours of sleep per night.

In the Fort Leonard Wood study, a total of 394 Army recruits and instructor cadre were enrolled in the study, approximately half assigned to a treatment (optimized sleep regimen) and control (standardized sleep regimen) groups. Results show that a 2.5-hour phase delayed sleep schedule improved sleep relative to the standard BCT schedule, resulting in more than 30 minutes of extra sleep per night. Besides schedule, personal factors such as age and gender also influenced recruits' average total daily sleep, with younger and female recruits tending to obtain more sleep. While the schedule modification was shown to be effective in improving sleep, increased nightly sleep during the training of marksmanship skills was shown to result in greater improvements over subsequent serial marksmanship performance assessments. This finding is in line with other studies that show higher skill acquisition following adequate sleep. Hence, schedule modifications that improve sleep can be expected to result in improved marksmanship performance during BCT. Importantly, such benefits may be obtained with no change to the content or length of the training program, nor are investments required in any new technologies or facilities

Valerie Rice: US Army Research Laboratory

The Impact of Sleep on Performance During Advanced Individual Training

Sleep deprivation can impair cognitive performance. "Well-placed" sleep, such as sleeping soon after learning, can enhance mental performance, such as in the consolidation of motor skill procedural memories (Fenn, Nusbaum, and Margoliash, 2003) and preventing memory decay, fixating declarative memories (Ellenbogen, et. al., 2006). Sleep has also been linked to student grades.

At the US Army Medical Department Center and School, we have examined sleep in several ways. First, we examined relationships between questionnaire data on student sleep with student performance during advanced individual training (AIT) and with personal risk factors thought to be related to academic performance. Student performance includes academic grades, pass rates, and scores on the Army Physical Fitness Test. Personal risk factors thought to be related to academic performance include self-reported basic demographics, education level, past academic history, various measures of motivation, stress, tiredness, health status, smoking history, coping methods, learning styles, and self esteem. The initial questionnaire was administered following the first two weeks of AIT.

Second, we interviewed and surveyed students who performed well during training and those who failed their training, as well as a 'battle-buddy' or friend of each (those who did well or failed their training) (Rice, DeVilbiss, Laws, and Butler, in press). These interviews took place later during training, many at the mid-point or toward the end of training.

During this panel, we will discuss some of our findings, as well as the similarities and differences between our results and the results of others examining sleep and performance in other military and civilian venues. One intriguing question for discussion is whether sufficient information is available about the benefits of sleep for adolescents and young adults to warrant adjustments in educational programs.

Nancy Wesensten: Walter Reed Army Institute of Research

The effects of chronic inadequate sleep on cognitive readiness

The deleterious effects of acute, total sleep deprivation on alertness, mood, and neurobehavioral performance are well characterized (see recent review by Goel et al., 2009). Less well documented – but far more common – are the effects of chronic, inadequate sleep (defined as anything less than the optimal 8 hours per 24 hours). Results from laboratory studies show a predictable "dose-response" effect, with performance and alertness degrading to a greater degree and more rapidly with less daily sleep. In contrast, and unlike recovery from total sleep deprivation (which appears to be complete for most aspects of neurobehavioral performance after 1-2 nights of 8-10 hours), recovery from chronic inadequate sleep requires at least several nights of 8 hours per night.

At the center of any fatigue risk management program is the ability to accurately predict the effects of different sleep/wake schedules on cognitive readiness. The Department of Defense has funded research to develop mathematical models to predict cognitive readiness based on sleep/wake history; these models are being refined to better predict the effects of chronic inadequate sleep. Panel attendees will be provided with (a) an overview of the effects of chronic inadequate sleep and recovery and (b) current tri-service efforts underway to develop user-friendly and platform-specific fatigue risk management tools.

Disclaimer

The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Army, the Department of the Navy, the Department of the Air Force, the Department of Defense, or the U.S. Government.

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