

Psychophysiological Profiles of Sleep Deprivation and Stress during Marine Corps Training

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Introduction

U.S. Marine Corps troops experience combined stressors including sleep deprivation, physical exertion and threat of enemy fire that can impair vigilance and decision-making with potentially dangerous consequences. This study explored the utility of psychophysiological assessment of fatigue in a USMC operational environment.

Methods

USMC battalion/platoon leaders (n=17) were evaluated with continuous actigraphy during 28-day, live-fire training exercises and weekly with wireless EEG and heartrate(HR/HRV) acquired during performance of a 20-minute, 3-Choice-Vigilance-Test(3C-VT). Self-reported stress, fatigue and mood were assessed with Profile of Mood States, Stanford/Karolinska sleepiness scales, Brief Fatigue Inventory and Perceived Stress Scale.

Results

B-Alert® algorithms classified one-second EEG epochs as High-Engagement, Low-Engagement, Distracted or Drowsy. The total percentage of epochs in each class was calculated for each 5-minute segment of the 3C-VT. Reaction-time(RT), percent-correct and percent-missed(lapses) were computed by 3C-VT segment.

Mean sleep duration measured by actigraphy was 5.3 hours/day(SEM=20mins). A 4(Week)x4(Quartile) RMANOVA revealed significant interaction effects ($p<.0001$) across quartiles over time in the 3C-VT for all EEG classes with increasing Distraction/Drowsiness and decreasing High-Engagement across weeks of training accompanied by increasingly impaired 3C-VT performance. A 1(HR)x4(Week) RMANOVA showed HR decreased significantly ($p<.0001$) across weeks of training. These data indicate that EEG and HR measures were able to assess the fatigue indicated by the significantly increased errors and inattention ($p<.0001$) found during 3C-VT. Significant changes in self-report measures included only decreased POMS-Vigor. POMS-Anger scores $>60^{\text{th}}$ percentile suggested greater anger in Marines than the average population.

Conclusion

EEG/HR/HRV assessed during the 20-minute-3C-VT provided quantitative measures of fatigue easily obtained in operational environments. Fatigue is a serious problem during USMC convoy operations, and with 35%-50% of US casualties in Iraq occurring during attacks on convoys, assessment of fatigue coupled with appropriate interventions could save lives. These data indicate that Marines do not self-report issues related to fatigue, thus more objective measures would be highly beneficial.

Support

This research was supported by the Defense Advanced Research Projects Agency (DARPA) program "Preventing Sleep Deprivation", and by the Office of Naval Research via the Space and Naval Warfare Systems Command (SPAWAR). DARPA has approved this manuscript for public release, distribution unlimited.