# THE EFFECTS OF LIGHT EXPOSURE ON FLIGHT CREW ALERTNESS LEVELS

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## Background

**Fatigue is a threat to aviation safety because of the impairments in alertness and performance it creates. It has significant physiological and performance consequences because it is essential that all flight crewmembers remain alert and contribute to flight safety by their actions, observations, and communications (Strauss, 2006). According to the National Sleep Foundation's (NSF) 2012 Sleep in America® poll "Pilots and train operators are most likely to report sleep-related job performance and safety problems". One in five pilots (20%) admits that they have made a serious error and say that they have had a "near miss" due to sleepiness, and limited effective fatigue countermeasures available in the operational setting.**

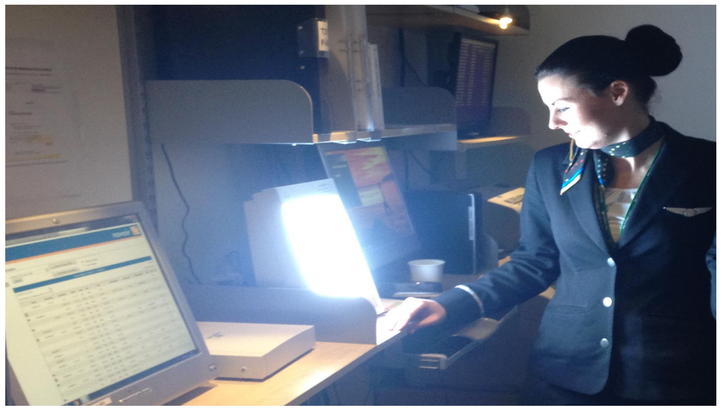


**Figure 1. Flight Crew Room light 'bar' in Arlanda**

**The function of blue light (460nm) to improve alertness and cognitive function "via non-image forming neuropathways has been suggested as a non-pharmacological countermeasure for drowsiness across a range of occupational settings" (Beaven and Ekstrom, 2013). As shown in research conducted by Leger et al., (2008), "bright light could be an effective countermeasure" and warrants further study.**

**The study aimed to investigate the efficacy of blue light therapy to improve behavioral alertness in flight crew-members. Western Michigan University, College of Aviation, Jeppesen (a Boeing Company), Nature Bright Company, Airline participants, and a leading sleep researcher Schoutens, of FluxPlus, BV, The Netherlands, collaborated to examine whether timed blue light could improve flight crewmember alertness.**

## Research Methodology

**Fourteen flight crew members, working as pilots or flight attendants, participated in the 30 day study under the Western Michigan University HSIRB approved protocol. All participants were nonsmoking, active flight crew. The crewmembers were based in Sweden and maintained flight schedules to the Mediterranean and the Canary Islands, as well as long-haul flights to Thailand, India and Vietnam.**

**The Nature Bright Square One light provides blue (λmax = 465 nm) light intervention and is currently one the smallest light therapy devices on the market, with an advanced optical lens and a wakeup light alarm. The Square One (Figure 1.) was selected due to the small portable size, ideal for crewmembers, as it was easy to place in a flight bag, handbag or luggage.**


**Figure 2. Tools used in the study**

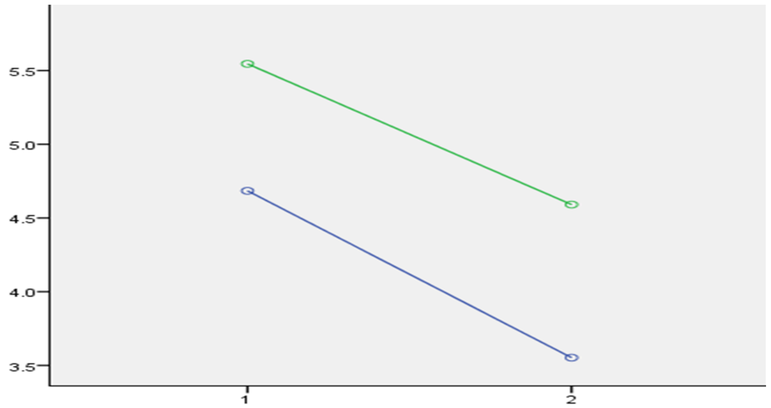
**During the 30 day study, the crewmembers wore CamNtech waterproof Motion8 acti-graph wrist bands, to record sleep/wake behaviors. Self-assessed levels of sleepiness with the Karolinska Sleepiness Scale (KSS) daily. Daily self-assessed fatigue was recorded using the Samn-Perelli Fatigue Scale (SP), and they completed daily psychomotor vigilance tests (PVT) using the Jeppesen (Boeing) CrewAlert iOS application using the Boeing alertness model (BAM).**

**The first two weeks were recorded as a baseline pre-light intervention, followed by two weeks of daily, 30 minute light intervention followed by the KSS, SP, and PVT recordings, in addition to the control group without light intervention for 30 days. On the third and fourth weeks, the study flight crew-members were exposed to blue light (BL) in occupational-based treatment with short wavelength (460nm) light therapy.**

## Results

**A repeated measures multivariate analysis of variance (MANOVA) was conducted, using IBM SPSS Statistics 20 software, to test the intervention effect of blue light (IV) on both flight and cabin crew alertness, measured by the 4 DVs; KSS, SP, PVTR, and PVTL.**

**A one-way MANOVA revealed a significant multivariate within-subject main effect for time (pre and post light intervention), Wilks' λ = .609, F (4,55) = 8.843, p <. 001, partial eta squared = .391, and the power to detect the effect was .999. The analysis also revealed a significant multivariate between-subject main effect for position (pilot/flight attendant), Wilks' λ = .506, F (4,55) = 13.429, p <. 001, partial eta squared = .494, and the power to detect the effect was 1.000.**




**Graph 1. Estimated Margin of Means KSS by position**

**The results show that there was a significant difference in alertness between pre-intervention and post-intervention for each crew member, and that 39.1% of the variance is explained by time (pre/post intervention). There is also a significant difference in alertness between flight crew and cabin crew, and 49.4% of the variance is explained by position (flight/cabin crew).**

**A review of literature and results of this study show the acute alerting effect of blue light to be a potentially useful countermeasure to reduce physiological, perceived, and cognitive fatigue, where conditions allow its use. Results garnered can be used to develop innovative light therapies and preventive strategies for industries with shift workers such as aviation, maritime, rail, nuclear and medical.**

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