



RESEARCH ARTICLE

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## Mindful Space: Mixed Methods Study

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### ABSTRACT

An investigation of the utility of mindfulness delivered by Virtual Reality (VR) was conducted as an analogy to possible use in space flight or at the International Space station by astronauts. Undergraduate students from a midwestern university were invited to participate in a study of one week using VR delivery of a mindfulness script dictation, accompanying music and VR scenes of relaxing landscapes. Results of the investigation indicate satisfaction with using the VR delivery and the mindfulness script. The sample size of three was analyzed in terms of the pre to post VR delivery of mindfulness and their sleep quality. Positive changes were noted in all three participants. Future directions for this methodology are discussed.

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Mindfulness, Astronaut sleep, Sleep Quality, Relaxation, Stress Management.

### Background

To address ways to provide rest and relaxation to astronauts at the International space station or in space travel, a program was planned as a part of their daily routine. Astronauts at zero gravity complete work responsibility in a traditional eight workday [1,2]. Many astronauts work as engineers and scientists gathering data using complicated instrumentation during space travel which necessitates high concentration. Usually, specific workload is indicated with space travel [3,4]. With the zero gravity of space, astronauts have the added step of securing themselves in a position for working, meals and relaxation. Breaks, bathroom times and sleep times are scheduled and entail tethering oneself in a position to control for the zero gravity [5]. The sleep interval is a step into a sleeping bag in the standing position with cables to tether oneself using cables and sleep in a sleeping bag, standing up. While dissatisfaction has not been leveled about this arrangement, studies have identified a decrement in sleep quality while traveling to/from in the space station [6,7].

Mindfulness relaxation practices prompt the individual to pause in cognitive, social and physical activities to become more aware of their registering of sensory experiences [8]. Mindfulness has been empirically validated as a treatment for mental health symptoms [9-12]. The mindfulness techniques of becoming more aware in the movement encourages the individual's registering external events around themselves to a focus on their physical inner states of breathing and their attentional (cognitive) focus and emotional sensation. This self "dashboard" is examined in a slowed, measured fashion with the intent to "dial down" and balance all levels of processing. The process of mindfulness relaxation is commonly conducted by a focus on one's breathing. The literature has identified an

ideal pattern of inhalation to the count of four, a pause for two seconds then an exhalation for a four count. This is commonly called the "4-2-4" method. The slowed, deep breathing along with the focus on the breathing decreases physiological and psychological arousal. VR provides an immersive environment where visual and auditory stimuli from the VR delivery occupies the participant's mind [13,14]. And, for some an accompanying kinesthetic sensation from suggested movements occurs as well [13]. It is possible that VR works as an effective vehicle for mindfulness delivery given the immersive component [15,16]. Extended space missions pose a significant threat to the overall health of astronauts. Sleep quality is crucial to persevering through difficulties and reaching mission goals. This project sought to improve the mental well-being of astronauts during the Artemis Mission by improving their sleep quality using a virtual reality mindfulness relaxation.

Landon, Slack and Sala [17] reported astronauts having an average of 4.6 awakenings with an average wake time of 6.5 minutes. This fragmentation of sleep results in the individual's sensation of poor restfulness and irritability of mood. Research findings have identified the reduced sleep in astronauts while on missions [1,16]. For an adult, the seven hours and fifteen minutes optimal average is not often obtained.

The study aimed to explore the utility of VR delivered mindfulness to the impact on users' sleep quality.

### Method

#### Participants

Participants from a small midwestern university were invited to participate in the research study in exchange for a gift

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card. Following the description of the study, each participant completed an informed consent form as a part of this IRB approved study. One male and two females between 18-26 years old participated in the study.

**Measures/Instruments**

The participants received instruction on the use of the sleepmax unit that recorded their sleep and the salimetrics unit they were to use for salvia samples. The participants were requested to download the app for the sleepmax unit so that the sleep data appeared on their cell phone and went to the Principal Investigator in a confidential computer file. All participants completed self-report measures about their sleep, their knowledge of sleep, sleep hygiene, activity level, and activation style. The VR of mindfulness was composed of visual arrays of landscapes with an auditory of the mindfulness script by female narrator with music accompaniment.

**Procedure**

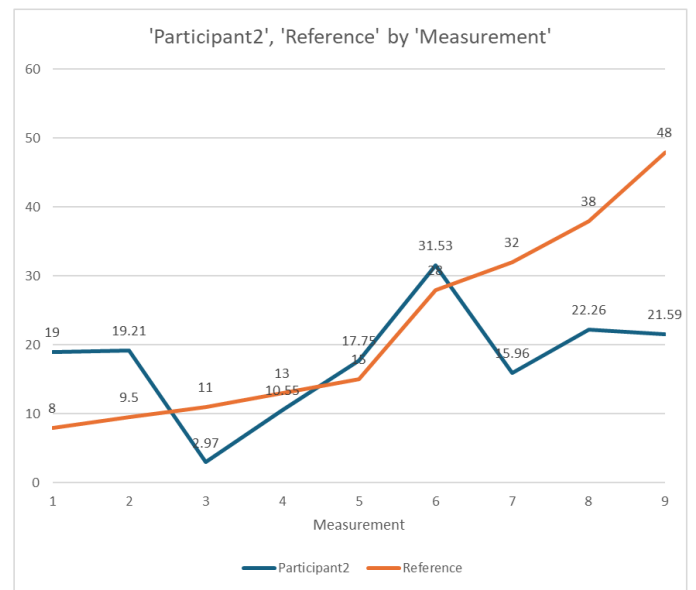
Following the descriptions and setup of the sleep score max and completion of all measures, the participants were to follow their typical sleep schedule and add a fifteen minute interval before going to sleep of the VR delivery of mindfulness. They rated their level of relaxation before and after the VR delivery of mindfulness using a five item rating scale were 1=not relaxed, 2=not very relaxed, 3=neutral, 4=somewhat relaxed, 5-relaxed. Seven days of recording were requested of the participants for using the VR delivery of mindfulness, sleepscore max and providing saliva samples every thirty minutes for the two hours before their bedtime. Three participant volunteers trialed a VR delivery of mindfulness dictated script with music background in their home settings. The VR device presented users with an omnidirectional video of a peaceful landscape that accompanied the verbal mindfulness dictation with instrumental background delivered by a female narrator. Ratings before and after the assigned at a bedtime interval of 10-12 minutes of VR Mindfulness use were provided for a before and after VR Mindfulness interval rating by all participants.

**Results**

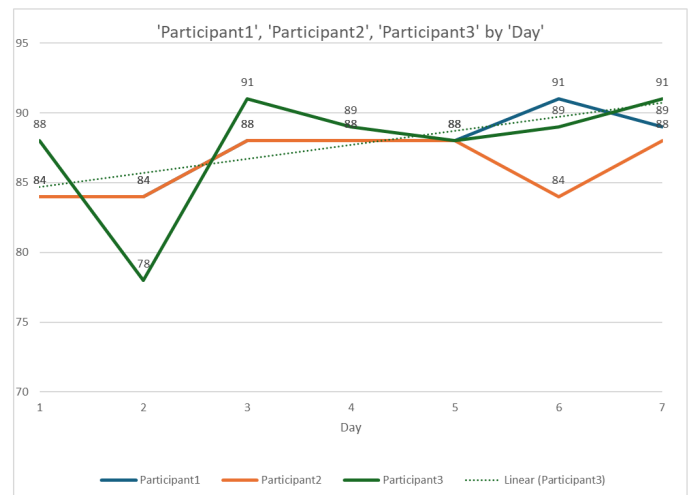
All results from the self-report measures and sleep score max were summarized. The salvia samples were sent to the Salimetrics laboratory and analyzed using an ELISA test for melatonin levels. All responses were treated as separate variables and tabulated. Graphic representation of the data was also conducted for visual analysis. There were insufficient data points for non-parametric analyses.

The participants had above average knowledge of good sleep habits with total scores ranging from 63% to 71%. In contrast, the participants sleep hygiene practices overall scores reflected poor to no implementation of good practices to aid sleep quality with total scores ranging from 25% to 42%. The participants were neither a morning nor an evening activation type. In general, the participants had poor sleep quality, while not in the clinical range for a disorder, their overall scores were at 42 to 57% reflecting a low level of sleep quality. The home environment, bedroom environment was inadequate for

relaxation to sleep for half of the participants due to external disruptions. One participant had a low to moderate level of internal disruption from cognitive activity of worry about academic performance. The participants were very active with 14 to 16 hours days typically. And some 60% of the lighting they were exposed to was bright LED lights of classrooms, work settings and laboratories. There was considerable variability in the melatonin levels. The relationship between subjects compared to a same age standard is presented in Figure 1. Sleep efficiencies as measured by the sleep score max is presented in Figure 2 and reflect a positive change in sleep quality after the onset of the VR delivery of mindfulness. The pre to post ratings of relaxed state increased for each participant.



**Figure 1:** Melatonin level by measurement interval.



**Figure 2:** Sleep Quality by Day.

Participants reflected the common variable sleep pattern of young adults-different bedtimes and waketimes depending on the day of the week, social schedules due dates of assignments and other external factors [12,18]. The participants were knowledgeable of sleep health and sleep hygiene but were below average, in general in the application of practices to preserve sleep health.

## Conclusions

The aim of the study was qualitatively and quantitatively supported in that satisfaction with the VR delivery, satisfaction with the mindfulness script, increased ratings of calmness and increases in sleep quality were measured in this study. Further, the participants did not report negative side effects of VR delivery (i.e., nausea, headaches). Figure 1 depicts one participant's melatonin levels as compared to the standard. The reduction in level, comparatively and increased variability of the melatonin samples collect reflect the participants irregular sleep, overall, with varying bedtime start times (i.e., late and typical bedtimes depending on how settled the two dogs and three children under 6 years old are that evening as well his homework level). The other two participants' melatonin was not used in the study for these reasons: one participant inadequately provided the salvia measures, and the other participant revealed that she had been taking 10mg of Melatonin nightly for seven months and stopped a few weeks before the study so, thus, residual melatonin alterations from this modulated her values. Figure 2 represents improvement in sleep quality during and following the intervention days (i.e., days 3-4-5). We feel a state of mindfulness was achieved by the participants. All participants rated the mindfulness script and relaxing scene as very good and relaxing.

Future study of VR delivery of mindfulness is planned with additional participants. Additional metrics of Mindfulness scales are planned along with the sleep score max measurement of sleep as it is the most precise telemetric device. The findings of our study have several productive implications for the application of VR delivery of mindfulness in space. The daytime schedule of the astronaut entails important measurements of several instruments thus requiring not only their intellectual skills but their focus which could be affected by poor sleep. An investment in providing a means for daytime breaks to relax as well as bedtime activity to induce sleep, we think, will help to mitigate the stressful effects and provide more mindful space.

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