# IMPACT OF VIRTUAL NATURE WITH OLFACTORY STIMULI ON ASTRONAUT BEHAVIORAL HEALTH

R. (Woodruff) Abbott[1], A. Diaz-Artiles[2]
[1,2]Department of Aerospace Engineering, Texas A&M University, College Station TX 77843
[1]renee.woodruff@tamu.edu, [2]adartiles@tamu.edu

## ABSTRACT

There are many psychophysiological stressors present on long-duration missions, including sensory deprivation, sleep loss, and periods spent in isolated, confined, and extreme (ICE) environments. These stressors place astronauts at an increased risk of developing adverse behavioral health conditions. Consequently, deterioration of behavioral health can decrement performance and endanger mission success. As mission destinations continue to grow farther from Earth, our current countermeasures will become increasingly difficult to utilize. VR technologies have shown their promise as a potential solution to part of this issue. However, most VR environments primarily incorporate audio-visual stimuli, and the addition of other sensory stimuli could enhance the benefits of the VR intervention. Furthermore, the benefits of added sensory stimuli could be heightened for astronauts by counteracting the negative effects of sensory deprivation. Therefore, we are developing a multi-sensory virtual reality (VR) environment as a potential tool to maintain behavioral health.

Our nature-inspired VR environment incorporates digital scent technology (Olorama Technology Ltd., Valencia, Spain) to ambiently disperse scents when the user is near a key area. For example, a honey scent is dispersed by a beehive, and lavender and rose scents are dispersed near a field of flowers. We hypothesize that the incorporation of scents into our VR environment will increase the user's sense of immersion and presence and improve any behavioral health benefits of the VR environment on its own.

We are using a within-subjects, counterbalanced experimental design, where subjects are exposed to a VR only condition and a VR + scents condition. Participants will first be exposed to a stressor (i.e., public speaking task) and then receive a 15-minute VR intervention. This is then repeated with the other VR condition. We are recording blood pressure, electrodermal activity, respiration, and ECG throughout the experiment to monitor physiological responses. In addition, we are collecting self-reported levels of state affect and anxiety through the Positive and Negative Affect Schedule (PANAS) and the 6-item State-Trait Anxiety Inventory (STAI-6). Results from a pilot study (n=4) indicated that the VR environment was successful in reducing feelings of anxiety, and subjects tended to report lower anxiety in the VR + scents condition than in the VR only condition. In future testing, we will explore the relationship between additional sensory stimuli in VR and behavioral health benefits.

***Figure 1**: Nature inspired VR environment with localized digital scents*

## ACKNOWLEDGEMENTS

This work is supported by a NASA Space Technology Graduate Research Opportunity. We would also like to acknowledge Dr. Suzanne Bell for her guidance and feedback, as well as the support of Olorama Technology in this research effort.