

## Abstract

Previous literature surrounding virtual reality and aromas suggest a link between them that can change human psychophysiology. In the current study, participants currently attending a small liberal arts college were recruited for an in-person study in which they viewed neutral, calming, thrilling, and scary virtual reality simulations while being exposed to either lavender, ammonia inhalants, or smelling salts. Participants then rated how scary, thrilling, boring, calming, and enjoyable each simulation was. During each simulation, galvanic skin response, heart rate, and oxygen saturation were recorded. After all simulations, they completed a State-Trait Anxiety Index for Adults. Results showed that participants had higher galvanic skin responses and oxygen saturation during the calming virtual reality than the thrilling and scary simulations. However, the aroma had no impact on any physiology measures. These findings suggest that virtual reality can successfully manipulate human physiology, but aroma effects might not be as effective as previous research had found.

## Background

- ❖ Stress
  - ❖ Stress is defined as “time pressure” because individuals may not have the time to perform tasks within a given period, triggering sets of physiological reactions. The stress responses activate throughout the hypothalamic-pituitary-adrenal axis whereby the neurons release hormones within the brain (Lupien, 2013). Studies have shown stress can be reduced as “mindfulness” whereas having the ability to purposefully bring one’s attention to present experiences with acceptance, non-judgement, and non-reactivity (Sagui-Henson, Levens, & Blevins, 2018).
- ❖ Virtual Reality
  - ❖ Stimulated experiences that can be similar or related to the real world
  - ❖ Research about virtual reality is used to help phobias, allowing exposures to be used in real life situations without space restrictions (Hong et al., 2017). Virtual reality is also correlated with exercises being performed at home than outside, associated with psychological and stress reducing benefits (Plante, et al., 2006).
- ❖ Aromatherapy
  - ❖ Essential oils extracted from plants treated for physical and psychological health.
  - ❖ Studies shown conducted by Herz (2009) where essential oils can be uplifting and helpful for reducing stress.

## Hypotheses

- ❖ Based on this research, the study sought to explore the relationship between smell and virtual reality by looking at the physiological property of each participant during a virtual reality experience with and without smell.
  - ❖ We hypothesized that excitatory Virtual Reality simulations will increase physiological arousal from the baseline whereas calming Virtual Reality simulations will decrease physiological arousal from the baseline
  - ❖ We also hypothesized that excitatory smells would increase physiological response arousal from the baseline where as calming smells will decrease physiological response arousal from baseline
  - ❖ Participants who experience excitatory smells will have overall higher physiological arousal in the calm & excitatory conditions than participants in the calming smell condition

## Participants

- ❖ 45 Students at Albright College
  - ❖ 12 male; 33 female
  - ❖ Mean age = 20 years old
  - ❖ Participants were divided up by smell
    - ❖ 15 participants were lavender
    - ❖ 15 participants were smelling salts
    - ❖ 15 participants were control
  - ❖ Demographic breakdown
    - ❖ 22% Caucasian, 53% African American, 16% Hispanic/Latino, 7% Asian/Pacific Islander, 2% Other
    - ❖ Participants were volunteers and participated in the study after being sent an email to participate in the study for an extra credit opportunity
  - ❖ Each participant received informed consent
  - ❖ Duration of study lasted about 45 minutes

## Materials

- ❖ Galvanic Skin Response Electrodes
- ❖ Heartrate Monitor
- ❖ Oculus Rift
  - ❖ AFFECTED: The Manor
  - ❖ Guided Mediation VR
  - ❖ Thrills & Chills Roller Coaster
- ❖ Lab Scribe
- ❖ Qualtrics Survey
- ❖ Debriefing Form
- ❖ Inform Consent



## Design

### 2 Independent Variables:

- ❖ 4 Virtual Reality Conditions
  - ❖ Neutral
  - ❖ Calming
  - ❖ Excitatory
    - ❖ Thrilling
    - ❖ Scary
- ❖ 3 Smell Conditions
  - ❖ No smell
  - ❖ Calming
  - ❖ Excitatory

### 3 Dependent Variables:

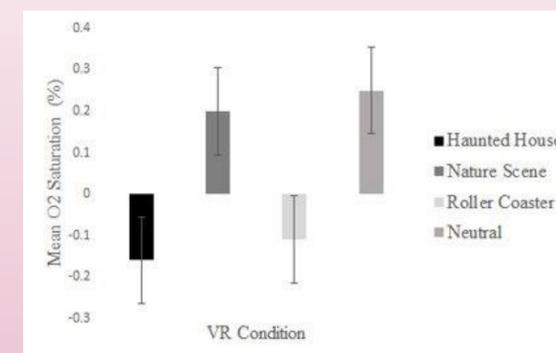
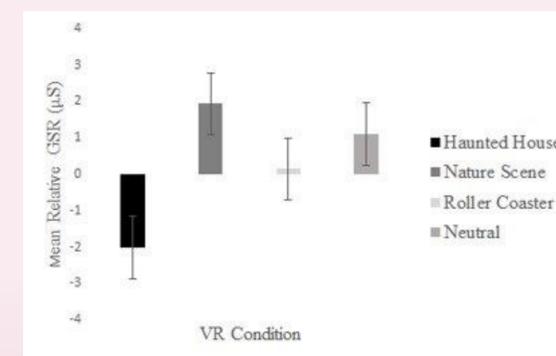
- ❖ Human Physiology
- ❖ Galvanic Skin Response (Conductance)
- ❖ Heartrate (Beats per Minute)
- ❖ O2 Saturation (Percentage)
  - ❖ Calming
  - ❖ Excitatory

## Procedure

- ❖ Participants were attached to the iWorx electrodes and heartrate monitor and lightly stabilized to the chair
- ❖ Participants then had their baseline read for one minute prior to simulation
- ❖ Participants were exposed to their assigned aroma conditions across all four simulations
- ❖ After each simulation, participants were asked a set of perceived arousal questions
- ❖ After the entire study, participants were given a demographics and stress questionnaire followed by a debriefing

## Results

- ❖ Analyzed using a 2-Way Mixed Model ANOVA
  - ❖ Mean BPM
    - ❖ No main effect of VR:  $F(3, 126) = 0.95, ns$
    - ❖ No main effect of aroma:  $F(2, 42) = 1.47, ns$
    - ❖ No interaction effect:  $F(6, 126) = 1.39, ns$
  - ❖ Mean O2 Saturation
    - ❖ Main effect of VR:  $F(3, 126) = 3.90, p < .05, \eta^2 = .085$
    - ❖ No main effect of aroma:  $F(2, 42) = 0.09, ns$
    - ❖ No interaction effect:  $F(6, 126) = 0.62, ns$
  - ❖ Relative mean GSR:
    - ❖ Main effect of VR:  $F(3, 126) = 4.14, p < .01, \eta^2 = .090$
    - ❖ No main effect of aroma:  $F(2, 42) = 1.07, ns$
    - ❖ No interaction effect:  $F(6, 126) = 0.71, ns$
  - ❖ Perceived Arousal
    - ❖ Main effect of VR:  $F(3, 126) = 143.20, p < .001, \eta^2 = .773$
    - ❖ No main effect of aroma:  $F(2, 42) = 0.83, ns$
    - ❖ No interaction effect:  $F(6, 126) = 1.81, ns$



## Discussion

- ❖ Hypothesis 1 : Main effect of Virtual Reality was partially supported
- ❖ There was a change in physiological arousal, but in the opposite direction that we expected
- ❖ Hypotheses 2 and 3: Not supported
  - ❖ Participants experienced higher physiological responses during the calm VR simulation that both excitatory conditions
- ❖ Implications
  - ❖ Virtual Reality is an effective and safe alternative, compared to real life experiences, for manipulating human physiology within exposure-based therapy.
  - ❖ Aromatherapy may not be as effective as past research suggests, possibly due to a cognitive component.

## Future Directions

- ❖ Change in smell stimuli
  - ❖ Peppermint instead of smelling salts
  - ❖ Citrus instead of lavender
- ❖ Auditory stimuli:
  - ❖ White noise and nature sounds for calming
  - ❖ Alarming sounds for excitatory
- ❖ Targeting certain fears, mental disorders, and natural phobias within VR exposure therapy
- ❖ Incorporating the cognitive component of aromatherapy
- ❖ Changing from GSR, BPM, and O2 measures to Salivary Cortisol levels
- ❖ Incorporate active movement within VR to increase presence, measure long term stress changes.

## References

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