Effect on Cognitive Skills of Stress in Real Life vs Virtual Reality

Alexander Baldasare, Elaine Poppe, Vasudha Sarvagya, Eliana Washam; Elizabeth Pettit, Mackenzie Trevethan, and Dr. Joseph Johnson

Introduction

With the growing number of companies producing virtual reality products and an increasing consumer base interested in purchasing them, the use of virtual reality is on the rise. This prevalence lead to our objective of determining if these virtual realities produce the same responses in humans as real life scenarios.

Objectives:

- To determine if encountering **real** vs **virtual** spiders results in a similar stress response as measured by **self reports** and **salivary cortisol levels**.
- To determine whether real life and virtual reality (VR) will affect **cognitive performance** differently as measured by logical syllogisms and semantic fluency tasks.
- To determine if there is a correlation between **gender** and the effect of stress on **cognitive performance.**

Hypotheses:

- Participants' **cortisol levels** will **increase** when exposed to spiders.
- **Cognitive performance** will **decrease** after being exposed to spiders.
- Participants' **cortisol levels** will **increase** more when exposed to real spiders as opposed to virtual spiders.
- **Self reported stress** measurements **will correspond** to stress levels measured via salivary cortisol.
- Women will have a **greater increase in stress** when exposed to spiders.

Background

Cortisol and Stress Levels: In our research, we used cortisol levels to measure stress induced by real life and virtual spiders. Research shows that salivary cortisol levels are proportional to stress levels (Wolf et al., 2001).

Effect of Stress on Cognitive Skills: Using two tests, we measured cognitive performance before and after stress-inducing stimuli. It was found that stress hormones, such as cortisol, affect human cognitive function. Cortisol is a glucocorticoid; glucocorticoids can cross the blood brain barrier and affect learning by binding to specific receptors in the brain (2007).

Stress in Real Life vs Virtual Reality: We tested stress levels of participants who were exposed to either real spiders or virtual spiders. There is not significant data surrounding whether VR produces similar effects on stress as does real life; however, there is one study that suggests stress induced by public speaking is similar in VR as in real life (Kothgassner et al., 2016).

Fear of Spiders in Men and Women: We compared the stress in males to the stress in females. Previous studies indicate that females are more likely to have stress caused by spiders than males. Females reported experience with spiders as more unpleasant, showed more tension when around spiders, and had a higher reluctance to be close to spiders than males. (Cornelius et al., 1983).

Methods

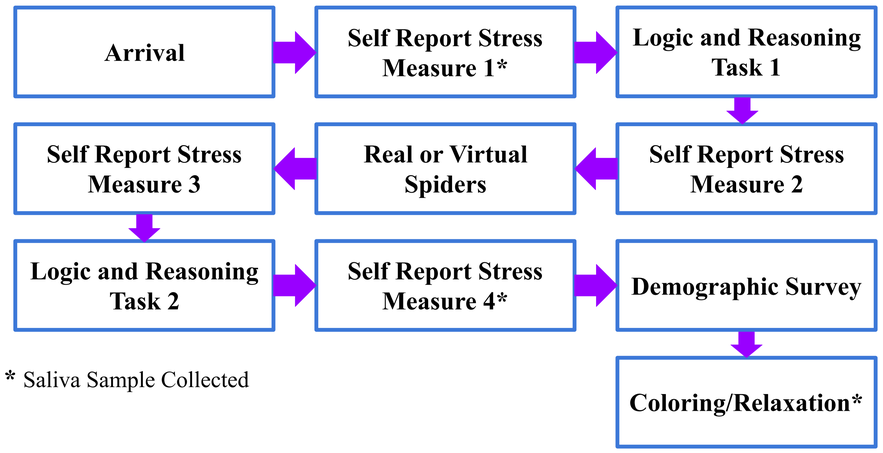
Sample: 28 undergraduate students. **Phobic** and **Non-Phobic** individuals. (46% male, 54% female)

Variable Conditions: Real life spiders and virtual spiders. 'Real' condition included exposure to four wolf spiders. 'Virtual' condition employed the use of the Spider Phobia VR application with VR goggles.

Stress Measurements: Three **salivary cortisol levels** were collected for each participant. The first sample was collected as a **baseline** measurement. Following the **stress-inducing stimulus**, a second measurement was collected to analyze stress induced by spiders. The third and final salivary cortisol level was collected to ensure the participants' stress levels returned to **normal**.

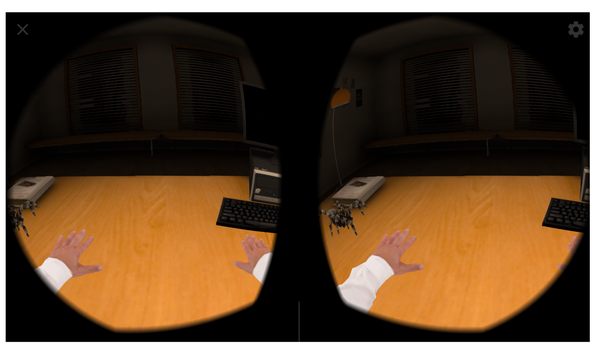
Self Reported Stress: Participants also self-reported their stress levels **four times** throughout the study. This self-report occured **before and after** each cognitive task. These four self-reported stress levels were compared to determine how their **stress levels were affected by exposure to spiders**.

Cognitive Task: Each participant completed **two logic and reasoning tests**, one preceding and one subsequent to exposure to real or virtual spiders. These tests included **syllogisms and a cloze passage**. Two similar tests were prepared and which test was taken first was counterbalanced among participants.

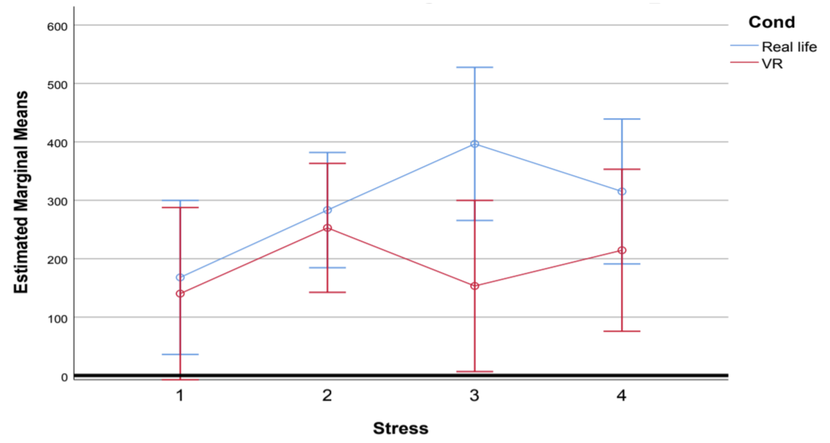


* Saliva Sample Collected

To the right is an example of what the participants saw in the VR experience with spiders.



Results



- Self-reported stress levels increased
- More logically-minded people handle stress better
- Individuals with more fear of spiders showed higher stress levels
- There was no statistically significant difference between the self reported stress of males and females

Discussion

- While we hypothesize that the cognitive performance of each participant will decrease, it is possible that their cognitive performance will increase or remain the same. This could happen if they became more familiar with the testing format by the second test or if our stress-inducing stimulus was not as effective.
- Participants' increased stress reports could be due to the spider stimulus or it could be due to an aversion to test taking; each participant reported levels of stress before and after each cognitive test.
- We also hypothesize that individuals' stress will increase more when exposed to real spiders instead of virtual spiders; however, an increase in stress could be related to our methods of exposure.
  - Future research could emphasize more similar real and virtual conditions.

Special thanks to the Family Fund and the Psychology Department!