<u>Fight or Flight Instinct in Virtual Reality versus Non-Immersed Simulation</u>

Thejus Poruthikode Unnivelan

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Introduction

The fight or flight instinct is a response that transcends time, is still imbedded into the core of our brain, and determines the actions one take when faced by danger. It is a naturally occurring defense system that increases blood pressure, releases hormones, and takes control of the body.

This instinct is often triggered by emotions such as fear or sadness, and is enhanced by self-awareness. The ability to fear is genetically transferred; however, only through experience do animals learn to fear certain objects, also called fear conditioning. The brains defense mechanism recognizes a threat by a unique signal and an associated source of pain. Once learnt the brain recognizes the signals and responds without having to learn the signal again. The defense mechanism can also be weakened by signaling a threat but not delivering any pain but will quickly be relearned by experiencing pain. The defense mechanism is also responsible for other behaviors and instincts such as aversion of the signal completely.

In the brain, fear conditioning involved the right amygdala, the region of the brain associated with fear and anxiety, and this region can be observed to assess the amount of fear the recipient experiences. Many fear disorders see an increase in activity in the amygdala such as post-traumatic stress disorder (PTSD), phobia, depression, and schizophrenia. By studying fear conditioning we can shed light on these disorders (Debiec & LeDoux, 807-815). Fear conditioning, often performed on lab rats for experimentation, is commonly utilized in horror videogames to repeatedly scare players at a consistently high level. By repeatedly scaring after a signal and giving an empty signal the game is able to keep the events unexpected and the fear high. In addition, during an emotional experience, such as a fearful one, the brain loses the function to analytically respond to a situation (Goslin & Morie, 97). However, the emotional response dulls as the experience becomes increasingly immersive. This was tested by testing the research participants' response to emotional stimuli. Participants who played more immersive videogames were less sensitive to pain and also responded less emotionally to pictures of people in displeasure that participant who spent less time playing videogames (Loughnan & Weger).

Currently, because more immersive videogame technologies exist such as the Google Cardboard, Oculus Rift, PlayStation VR, HoloLens, the level of immersion of videogames have drastically increased from the previous generation of non-immersive technology, such as television hosted videogames and computer hosted videogames. In addition, the graphics levels of these videogames have to also be considered as increased immersion because increased graphics have given developers the utility to spur stronger emotions in their player base by depicting images and audio more clearly. Virtual and Augmented reality have an upper hand in spurring emotions because they have the ability to take involuntary data of the player's movement and give another dimension of immersion to the game developer.

Objective

To assess the level of immersion of a player who uses a virtual reality device compared to a player who uses a non-immersive device. The player who uses the virtual reality device will not experience a significantly different Beta wave spike from the player who uses the non-immersive device.

Materials

- Electroencephalogram (EEG) Emotiv
- Android Device
- Android Horror Game
- Participant
- Google Cardboard or other VR Device
- Computer
- VR Horror Game
- Game recording software

Methods

We will use the Emotiv headset for this study for a variety of reasons. The optimum EEG headset would be the 32 channel 256 Hz EEG Cap; however, this cap will be used by other teams and would provide little time for experimentation. This project also does not need to be region precise and does not need frequent data collection which would make data from many channels redundant. In addition set up time for the Emotiv would be significantly less than the set up time for other caps and will allow for more trials. The Emotiv also makes sense from a consumer standpoint because the small setup time and the easier setup method models the expectations of consumers.

The participant will constantly be wearing the Emotiv EEG headset and will experience both the VR and the Android game. After placing the EEG cap, the participant will place the VR

Device with the loaded android device on the head. The game should be recorded parallel to the recording of the brain waves from the EEG. After the first “game over”, the participant will immediately repeat the game two more times to observe the level of Mu and Beta waves from the participant each repeated trial.

After a week the participant will again wear the EEG headset but will instead experience the Android game, removing the dimensions of the immersion of the player. The EEG and the game will again the recorded congruently, and will also be played five times. This way we can observe the level of the Mu and Beta waves after each trial.

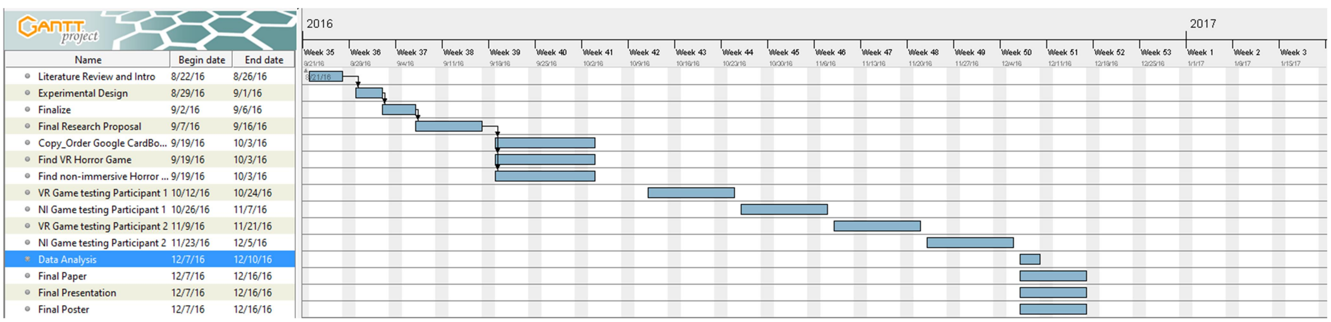
From the raw EEG data we will have to filter out the miscellaneous data. OpenVibe will be used in this process to filter and analyze the data. From the electronic within the room we will have to filter out the 69Hz frequency from the data. Due to the close proximity of the VR headset the strength of these signals will be amplified. In addition any bodily movements—eye blinking, jaw clenching, screaming, etc.—will also have to be filtered out. Any background data from the autonomic nervous system—heart beating, breathing, etc.—will also be filtered out if need be.

Using Fourier analysis the data will be separated into the Mu (9 – 11 Hz) and Beta (12.5 – 30 Hz) waves. Using a Power Spectral analysis the data will be able to read the amplitude spike and dip in Beta and Mu waves respectively. We will take a sample reading from before the test as the control to determine what constitutes as an abnormal spike in the Mu and Beta Wave amplitude. Using a 2-sample T-Test, calculate whether there is a statistical significant difference between the Beta waves recorded during the VR and the AR.

Extension: Create a VR game using Unity that utilizes signals and Beta wave recognition to efficiently deliver fear to the user. Use the data from the experiment to scare the user when the fight or flight instinct is at its lowest.

Experimental Design	
Title	Fight or Flight Instinct in Virtual Reality versus Non-Immersed Simulation
Independent Variables	Virtual Reality hosted game vs. non-immersive game
Dependent Variables	The Beta waves detected by the EEG during pivotal moments in the gameplay
Trials	3 trials
Test	Use 2-sample T-test to find a statistically significant difference between the Beta waves recorded in the VR game and non-immersive game. P-value less than .05 would indicate a significant difference.

Gantt Chart



Conclusion

By using an EEG we will measure the changes in the Beta waves to see if the difference in the level of the fight or flight instinct experienced by players playing VR games and non-immersive games is statistically significant.

References

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