Comparative Analysis of Emotional Responses in Virtual Reality and In-Person Interactions

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UMBC

INTRODUCTION

Social anxiety disorder, characterized by a fear of social situations and negative judgments, affects many individuals globally. Not officially recognized as a psychiatric disorder until the DSM-III in 1980, its understanding has expanded significantly through subsequent research. Despite advances, gaps remain, particularly in comparing emotional responses in Virtual Reality (VR) versus in-person interactions among those self-reporting social anxiety. The rising prevalence of social anxiety (Slee, 2023), exacerbated by the COVID-19 pandemic (Kindred et al. 2023), as well as the increasing use of VR technology by consumers (Meta Quest Blog, 2023), further emphasizes the relevance of this study. This paper investigates how emotional responses differ in the context of social anxiety during interactions across different modalities.

By integrating physiological data, self-reported surveys, and behavioral analysis, we aim to construct a picture of how virtual environments mirror or diverge from emotional responses in real-world interactions.

BACKGROUND & MOTIVATION

Social anxiety did not receive extensive attention in psychological research until it was recognized as a distinct psychiatric condition in the DSM-III (American Psychiatric Association, 1980). Subsequent research has elucidated the prevalence and impact of social anxiety, noting it affects up to 28.8% of the population at some point in their lives, with implications for social and occupational functioning (Voinescu & Davidson, 2023). The VR environment allows for the safe exploration of social interactions, which is crucial for this demographic. Recent studies have demonstrated VR's efficacy in reducing anxiety symptoms by allowing controlled exposure to anxiety-inducing scenarios, which can be gradually intensified according to therapeutic needs (Anderson et al., 2020). Studies indicate that VR can trigger significant emotional and physiological responses similar to real-life experiences due to its immersive nature (Riva et al., 2019).

However, gaps remain in the literature, particularly regarding the direct comparison of physiological and emotional responses in VR versus real-world settings among those self-reporting social anxiety. We aim to address these gaps by exploring the emotional responses in across two interaction modalities, and how this could benefit individuals with moderate anxiety.

Research Question

How do emotional responses differ between in-person and virtual reality (VR) interactions in individuals who self-report to have social anxiety?

METHOD

Participant Setup: 2 participants, who were strangers, took two surveys (the Liebowitz Social Anxiety Scale Test and a pre-discussion survey) individually before wearing the Empatica E4 wristband to monitor the heart rate and EDA. The baseline HR and EDA data was attained through a 4-minute video. Participants then engaged in a 5-minute in-person discussion with each other (as strangers), then completed a post-in-person survey.

Next, a virtual call was initiated through the VR platform where one participant communicated with a stranger in VR through their avatars in the virtual environment. After a 5-minute VR interaction, the participant filled our the post-VR survey.
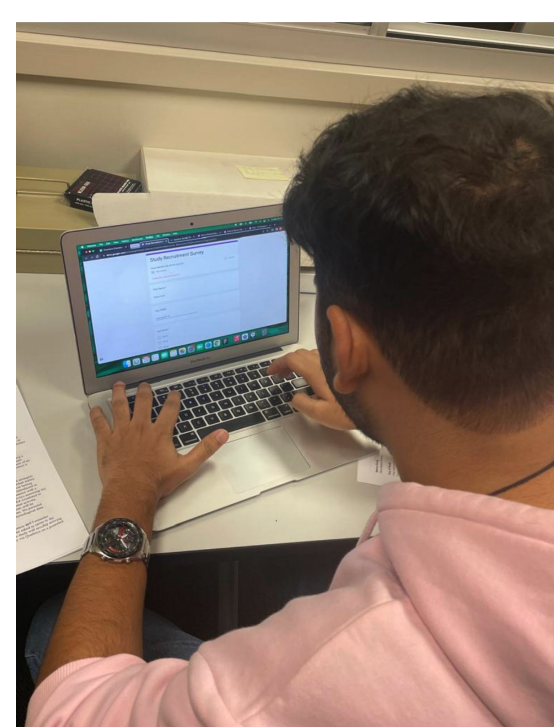

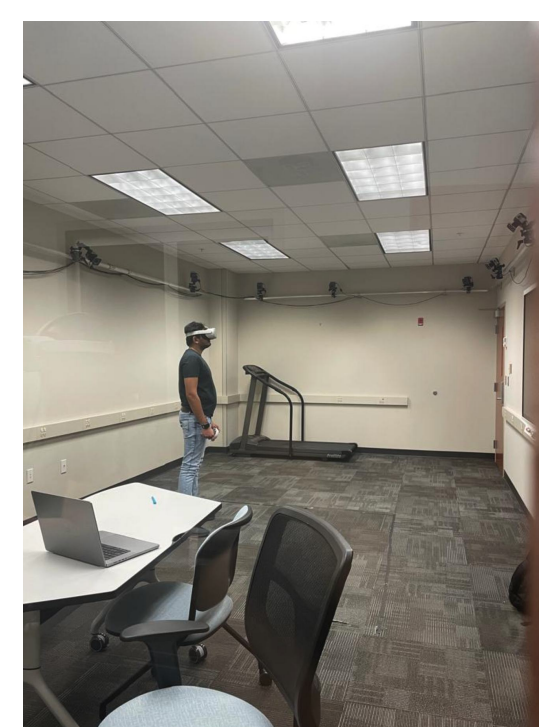Fig 1: Participant taking the LSAS survey.
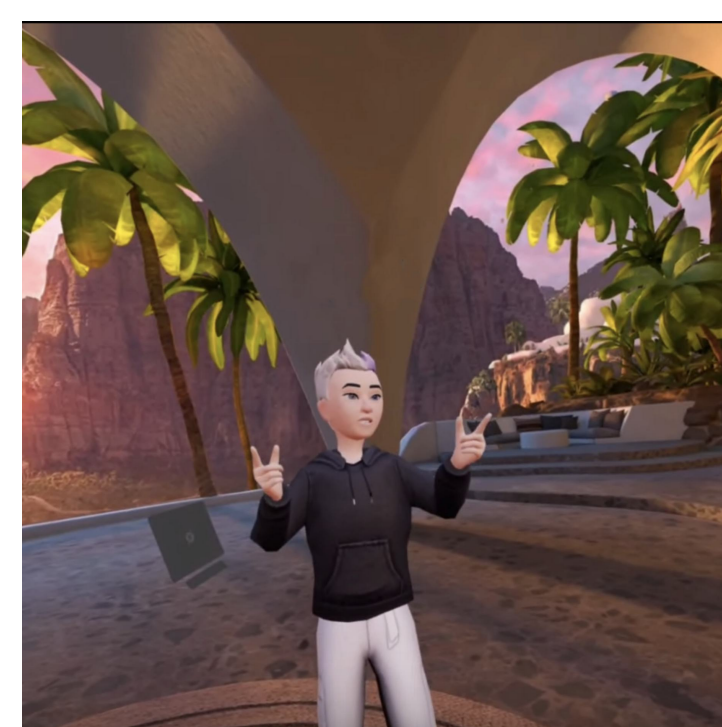

Fig 2: Participant wearing the VR headset.

Fig 3: Participant's POV in the VR environment.

Data Collection: Observational notes, Audio recordings, Heart Rate (HR), Electrodermal Activity (EDA), Surveys

Data Analysis:

- Collected and normalized physiological data using Empatica E4, complemented by surveys, audio, and notes.
- Used FigJam to synchronize and graph physiological responses with audio recordings.
- Analyzed patterns and compared responses between VR and in-person sessions.
- Conducted T-Tests on normalized heart rates.
- Drew conclusions from integrated qualitative and quantitative analysis.

FINDINGS

- Comparing the two scenarios, the in-person sessions did show higher levels of HR and EDA than the VR sessions. However, T-Test results showed that there is not a *statistically significant* difference between the average heart rates in in-person and VR settings.

Observations and Trends:

- Participants who scored as "little to no social anxiety" on the Liebowitz scale self-reported to be "somewhat comfortable" prior to the in-person discussion. Those who had higher Liebowitz scores (Marked and Moderate) self reported to be "Somewhat uncomfortable" prior to in-person discussion.
- Across both scenarios, heart rate and EDA increase when discussing stressful topics, but also when discussing exciting topics. We detected physiological data synchrony between the two participants when discussing common or exciting interests.
- Although there were spikes in heart rate, based on audio analysis, self-reporting results, and observational notes, many spikes were linked to moments of positive valence.
- During the VR scenario, when the participant was listening to the stranger speak, their heart rate was typically reducing, indicating that it was less stressful for them to be listening than to be speaking.
- Some participants pointed out that the lack of facial expression and body language in the VR instance made it less enjoyable to interact with the stranger in VR.
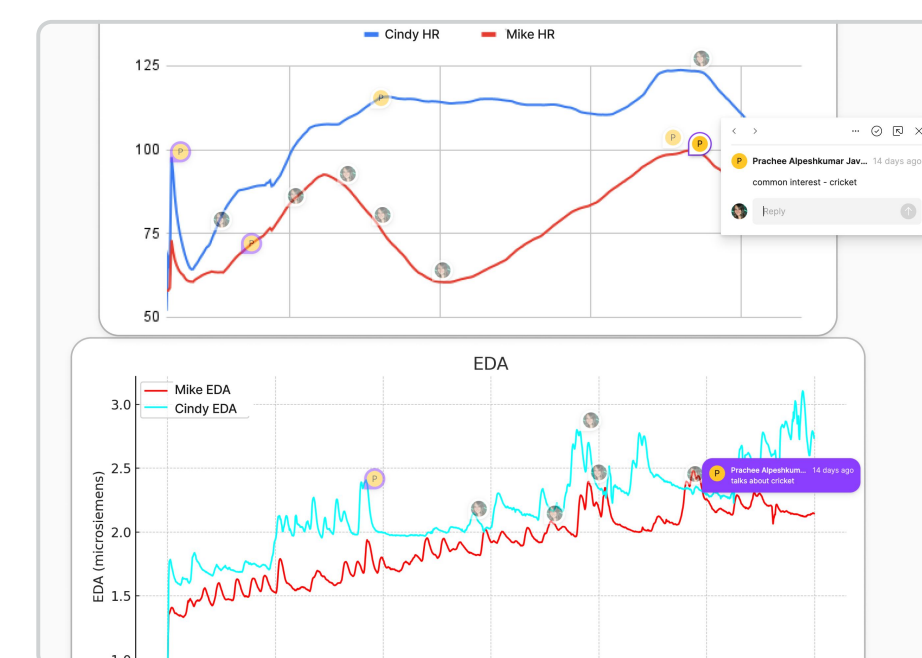

Fig 4: Used FigJam to align to timeline and annotate topics while analyzing audio and non-verbal notes.
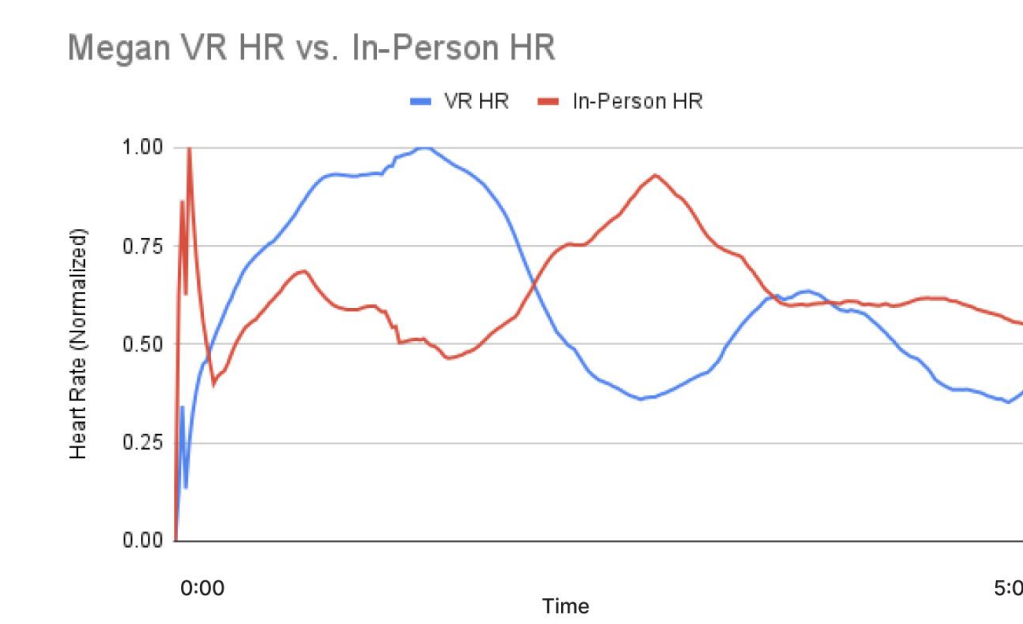

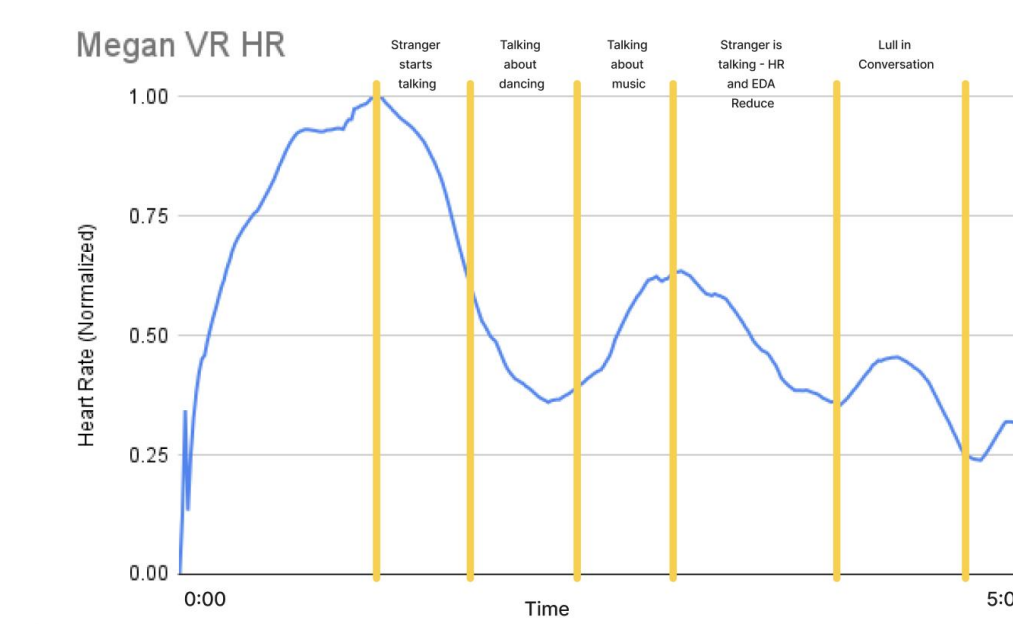Fig 5: We compared each participant's in-person and VR physiological data.

Fig 6: For our audio analysis, we examined physiological data in relation to specific topics of conversation during each session, visually segmenting the data by these thematic windows.

DISCUSSION

In this study, we established a semi-controlled virtual reality (VR) environment, simulating social interactions without the direct influence of facial expressions and body language. Our findings are summarized as follows:

- While the in-person sessions did show higher levels of HR and EDA than the VR sessions, the T-Test revealed no significant differences in physiological responses between in-person and VR scenarios.
- Subjective reports indicated variations in comfort and emotional reactions, underscoring the inadequacy of relying solely on physiological measures to evaluate emotional states during social interactions.
- Despite spikes in heart rate and EDA, observations, audio analysis, and self-reports frequently suggested a positive emotional valence, highlighting the complex interplay between physiological arousal and perceived emotions. Our results advocate for a comprehensive approach that integrates physiological data with subjective insights and observational notes to better understand the impacts of VR on social anxiety.
- VR offers distinct advantages for individuals with social anxiety by allowing them to control their engagement levels, thereby reducing anxiety and enhancing the potential for therapeutic outcomes.
- By eliminating typical communication barriers found in standard social settings, VR provides a unique platform that reduces discomfort and focuses on the essence of interaction, positioning it as a valuable tool for therapeutic interventions.

FUTURE WORK & CONCLUSIONS

By utilizing HR and EDA data, we were able to effectively compare the emotional responses of participants engaged in both types of interactions. Through mixed method analysis, our findings showed that physiological data alone isn't enough to understand a participant's emotional state. Self-reported data, audio analysis, and non-verbal observation were essential to understand emotional valence.

Our findings suggest that while the overall valence of the interactions varied depending on the content of the conversation, participants generally exhibited similar patterns of emotional arousal in VR and in-person settings. Normalization and graphical representations of the data allowed for a clear visualization of the emotional responses, highlighting both similarities and differences between the two modalities.

For future work, we suggest:

- Enhanced Data Collection: Future studies should consider expanding the dataset to include a more diverse population to better generalize the findings.
- Incorporate VR instances more advanced avatar facial features and body language to create scenarios that at more 1:1 with in-person interactions.
- More long-term studies to better understand the similarities and differences between in-person vs. VR interactions.
- Interventional studies in order to understand how using VR can differ from or be more beneficial than in-person therapy.

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