USING VIRTUAL REALITY SIMULATION TO REDUCE STAGE FRIGHT DURING PUBLIC APPEARANCES

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ABSTRACT

Past applications of virtual reality (VR) and related research have provided evidence that VR technology is helpful for educational and training purposes and that it can be used as a therapeutic measure. Virtual reality exposure therapy (VRET) may, therefore, be beneficial in reducing public speaking anxiety (PSA), which is a very common phenomenon. In this preliminary study, we conducted an experiment to investigate the psychological and physiological response to stressors experienced when speaking in public by creating a virtual audience displaying worst-case-scenario behavior (gossiping, shaking their heads, pointing at the speaker, standing up, and even leaving the room). In addition, other potential stressors were introduced (standing on an elevated platform, jumping off the platform, blocking someone's path, approaching a door that opens automatically, and throwing objects). To measure the responses of participants to these stimuli, we asked them to complete a questionnaire and monitored their heart rate. Our findings suggest that people's anxiety increases when they interact with other people in a virtual world, and when they are exposed to certain stimuli, which may be reduced with the repeated application of VRET.

KEYWORDS

VR, Public Speaking, Stage Fright, Simulation, Education, VRET.

1. INTRODUCTION

Virtual reality (VR) has been used to reduce anxiety, traumata, and phobias (e.g., acrophobia, the fear of heights, or arachnophobia, the fear of spiders) for twenty years (Puscher, 2019). One form of anxiety, public speaking anxiety (PSA), affects the majority of the population. More than 70% of US citizens feel uncomfortable about appearing in public (Montopoli, 2017). As Asher et al. (2017) found, this problem can have a negative effect on the income, career, and quality of life of those affected. Virtual reality exposure therapy (VRET) can, therefore, be a useful resource in this context.

This paper adds to the existing knowledge on the topic of VR in healthcare. The experiment we conducted on the stressors of public speaking using a virtual world provides empirical evidence on factors affecting anxiety in VR by conducting a VR experiment in the context of public speaking.

2. LITERATURE REVIEW

Stress is omni-present and, according to Fink (2017), unavoidable as it is a unspecific response of the body to any external stimuli. Even basic bodily functions such as breathing or the consumption of energy (Selye and Selye, 1982). The concept of stress was investigated by Gebel (2012) who distinguished models of stress based on situation (stimuli), reaction, and transaction. The situational approach is linked to stressors such as noise, pain, and situations requiring performance (Seiffge-Krenke, 2007). Reaction-based models date back to Selye (1936), who further differentiated between "eustress" (negative stress) and "distress" (positive stress) (Selye and Selye, 1982). Lazarus (1966) expanded on this earlier work by creating a transactional model, in which the interpretation of the stressor and an analysis of the resources enable individuals to cope with stress, which leads to adaptation and learning.

A common form of anxiety is stage fright, also known as public speaking anxiety (PSA), which can, incidentally, also be present when videoconferencing (Pelletier, 2002). According to Reeves et al., "PSA is a prevalent condition with disabling occupational, educational, and social consequences" (2021a, p. 1). This fear is believed to have a prevalence ranging from 20 % (Leary and Kowalski, 1995) up to 85 % (Motley, 1995). Individuals suffering from PSA may even develop social anxiety disorder (SAD) (Blöte et al., 2009).

Symptoms of stage fright include nausea, dizziness, and heart palpitations (Abromeit, 2014). While these symptoms may not be noticeable to others, others such as sweating, or a trembling voice are. According to a study on the topic (Bippus and Daly, 1999), the top three factors contributing to feeling anxiety during public speaking are fear of making mistakes (M=7.04, S.D.=1.26), the unfamiliar role (M=6.61, S.D.=1.25), and fear of humiliation (M=6.6, S.D.=1.49) on a 9-point Likert scale. An overview of all factors is presented in Table 1.

Past research has shown that 360° videos (Reeves et al., 2021b) as well as training in virtual worlds can reduce anxiety (Wallach et al., 2009). Acoustic and physiological reactivity during a VR simulation can even predict the effectiveness of mitigating PSA (von Ebers et al., 2020).

Empirical evidence leans towards positive effects of VR training on PSA (Nazligul et al., 2017; Sakib et al., 2019; Yadav et al., 2020, 2019). Meta-analysis (Reeves et al., 2021a) and systematic literature reviews (Daniels et al., 2020) support these findings. Cognitive behavior therapy (CBT) and virtual reality exposure therapy (VRET) help treat PSA (Daniels et al., 2020). Daniels et al. (2020) even highly recommended the use of VR to treat PSA and reported reduction of PSA levels ranging from 7.8 % up to 54.7 %. This finding is backed by the meta-analysis conducted by Reeves et al. (2021a), who found significant effects for in-vivo exposure therapy (IVET) and VRET in marginal favor of IVET compared to VRET. In this context, self-led exposure seems to be as efficient as therapist-led exposure (Lindner et al., 2019).

Table 1. Ranking of factors based on averaged item ratings (Bippus and Daly, 1999)

Factor	*M*	*SD*	*N*
1. Mistakes	7.04	1.26	192
2. Unfamiliar Role	6.61	1.25	192
3. Humiliation	6.60	1.49	189
4. Negative Results	6.59	1.63	192
5. Rigid Rules	6.08	1.40	192
6. Personality Traits	6.07	1.74	192
7. Preparation	5.50	1.65	192
8. Audience Interest	4.86	1.78	192
9. Physical Appearance	4.75	2.05	192

Note. Ratings are based on a 9-point scale, with 1 representing "not very likely" and 9 representing "very likely" as a cause of stage fright.

VR training in medical education has been proven to have a positive effect on learning outcomes (Cohen et al., 2005). This finding is backed by meta-analysis concluding that VR and AR (augmented reality) can have a positive effect on motivation and learning success (Garzón et al., 2019; Tekedere and Göke, 2016) and can be applied in continuous education, for instance, in the form of edutainment (Fritz, 1997). Furthermore, VR training can be used to deliver speech training to children, who readily accept this form of training and been shown to benefit as a result (Liu et al., 2017, 2013).

The concepts also have limitations, however. Health and safety issues (Hicks, 2016), such as the risk of cybersickness (Meeri, 2019), are a possible obstacle in VR simulation and training.

Because prior research has shown positive effects of VR on PSA, we conducted a preliminary, initial study to implement a prototype incorporating not only a traditional setting of public speaking but also measuring the physiological responses and comparing them to self-reported measures. This study compares different stimuli or stressors and sheds light on physical and psychological responses. The contribution of this research is, therefore, initial exploratory insights.

3. METHOD

This study uses an exploratory approach to gain first insights into how people respond to different stressors in a virtual environment in the context of public speaking. The virtual environment was generated by an HTC Vive HMD (2160x1200 px) and a VR system running Windows 10, an AMD Ryzen 5 2600 CPU, and an AMD Radeon RX580 GPU.

The virtual scenario was modelled with 50 virtual people in a lecture hall (see Figure 3). Some sat and listened, others talked to each other, stood up or even left the room to distract the person speaking.

The degree of realism was high (see Figure 1, Figure 2, and Figure 3). Unity was used as software to implement the immersive and realistic environment. The scene was built on a Unity asset, and objects such as laptops, books, pens, and bottles were imported from Unity's asset store. Noises were used To add further to the degree of realism since, according to Beqiri and Barnard (2019), this fosters immersion. In addition to a high degree of realism, haptic feedback (vibration of the controllers) was introduced because, according to Gutiérrez et al. (2008), this can also foster the degree of immersion experienced by participants.

Stressors were introduced to the scenario to exacerbate the speaker's stage fright in a scenario that could potentially be used to train participants and reduce their anxiety. According to Abromeit (2014), humiliation as the most common fear was also used. Stressors such as laughter (sound) and people shaking their heads (gesture) were added to contribute to the feeling of humiliation (Bippus and Daly, 1999). Distractions can lead to stress when holding a speech as they shift the mind from the current task (Priem and Solomon, 2009). The ringing of mobile phones, individuals talking to each other in the audience, and laughter are common stressors (Sherman, 2013). Furthermore, the size of the audience can contribute to anxiety (McKinney et al., 1983). In our experiment, therefore, we used people talking as well as laughing, shaking their heads, and pointing at the speaker as stressors. Some individuals even got up and left the room. Furthermore, a platform which was able to ascend and descend was another distraction. A real lecture hall environment was simulated with the sounds of people laughing, typing, and gossiping, and a school bell. Finally, objects such as cubes and balls were placed in reach of the speaker to further distract him or her.

In other words, to expose the speaker to stressors, five actions were part of their experience:

1. Using the platform to ride up and down
2. Jumping off the elevated platform
3. Blocking the path of the person leaving the room
4. Approaching the door to activate the opening of the door animation
5. Throwing a cube and a ball into the room

The levels of stress were measured using a questionnaire as well as monitoring the subjects' heart rate with a Polar H10 heart rate sensor. The completed questionnaire was compared to the heart rate recorded.

The questionnaire consisted of two parts. The first part contained questions regarding quality perception and the second part to self-reported degree of stress experience (see Table 2).

Table 2. Items contained in the questionnaire

Quality aspect (5-point Likert scale)	**Perceived stress level aspect (5-point Likert scale)**
Quality 1 (Degree of realism)	Perceived Stress Level 1 (Riding the platform)
Quality 2 (Image quality)	Perceived Stress Level 2 (Jumping from platform)
Quality 3 (Usability)	Perceived Stress Level 3 (Opening door)
Quality 4 (Degree of concentration needed)	Perceived Stress Level 4 (Blocking person leaving)
Quality 5 (Degree of interaction)	Perceived Stress Level 5 (Throwing an object)

Figure 1. Screenshot of environment

Figure 2. Screenshot of first-person view

Figure 3. Screenshot of scene (lecture hall) in Unity

4. RESULTS, DISCUSSION, IMPLICATIONS, AND LIMITATIONS

An abrupt increase in the heart rate indicate stress, negative feelings (Van Deusen, 2021), and is a reaction to a stimulus (Schubert et al., 2009), while a medium-range, stable heart rate can be a sign of health and wellbeing (Kim et al., 2018).

In our experiment, the data logged by the heart rate sensor indicated where an interaction took place in the virtual world (see Figure 4 and Figure 5). A raised heart rate was, therefore, used to identify the stimuli used (riding the platform, jumping off the elevated platform, approaching a door opening automatically, blocking people, and throwing objects) as stressors. As a result, we propose that the scenario we developed can be used to train public speakers and, eventually, reduce their anxiety levels.

Jumping from the platform showed the largest self-reported responses, followed by riding the platform, approaching the door that then opened automatically as well as blocking someone’s way (‘door’ and ‘blocking’ showed the same levels), and throwing objects.

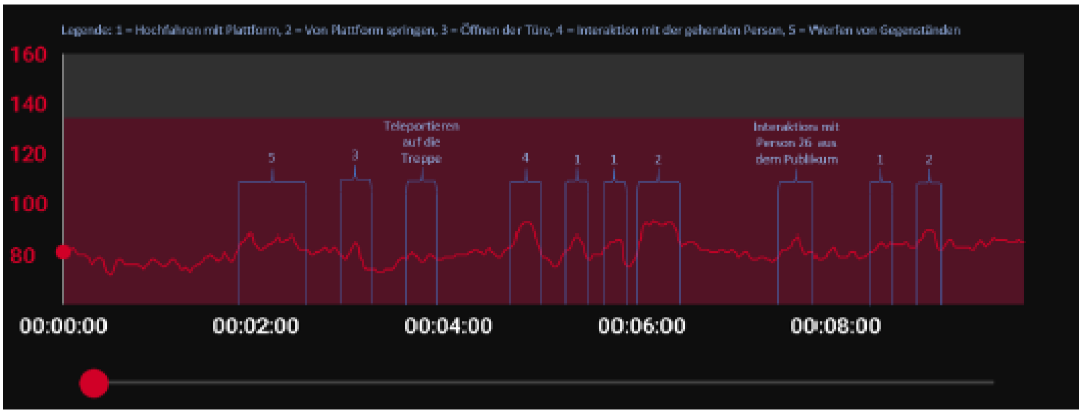

Figure 4. Heart rate analysis for Subject 1
(1 = ride platform, 2 = jump from platform, 3 = open door, 4 = interaction with person, and 5 = throwing an object)

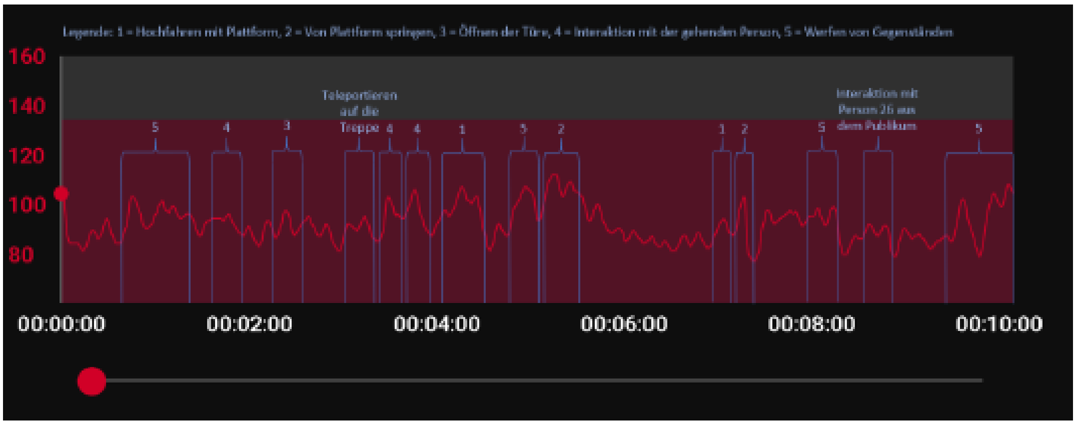

Figure 5. Heart rate analysis for Subject 2
(1 = ride platform, 2 = jump from platform, 3 = open door, 4 = interaction with person, and 5 = throwing an object)

The experiment was conducted using only six subjects and must, therefore, be considered early-stage, initial, and preliminary research. Nevertheless, the results show that responses can be observed as an impact on the heart rate of individuals exposed to public-speaking-related stimuli. Further research with a larger sample size needs to be conducted to confirm and expand on the findings of our study.

5. CONCLUDING REMARKS

The results presented in this paper indicate that anxiety levels can be deliberately manipulated in virtual environments and that these virtual events have an impact in the real world. The heart rate data collected indicates that responses to the stimuli provided have an effect (e.g., they cause stress and add to anxiety). This result contributes to the work of Pelletier (2002) finding PSA present in videoconferencing. Furthermore, this extends the work of Fink (2017) stating that stress is omni-present and an unavoidable unspecific response of the body conducted offline as the results in this paper suggest that this holds true in a virtual environment too.

Further, work on situational approaches (Seiffge-Krenke, 2007) or reaction based models differentiating between "eustress" and "distress" (Selye and Selye, 1982) are confirmed as well as extended as the results of this experiment suggest that they too, hold true in VR settings.

Symptoms of PSA (e.g., heart rate) found by Abromeit (2014) can be confirmed in the virtual world too. This knowledge may be helpful in training public speakers as symptoms of PSA can be triggered by VR training and thus, enabling public speaking simulation. Furthermore, according to Wallach et al. (2009) or Daniels et al. (2020), VR can help reduce this anxiety too and thus we imply that virtual worlds are used to reduce PSA by using the stimuli identified in this study.

Additionally, events and activities that involve a change of elevation and blocking people have the strongest impact. As described in the previous sections, the stressors presented in this paper can be used to raise anxiety levels for training purposes (VRET) (see Reeves et al., 2021b; Wallach et al., 2009) and subsequently reduce them permanently. This is rather relevant in the light of previous research into PSA (Leary and Kowalski, 1995;Motley, 1995). Consequently, our research can be considered as a contribution towards reducing PSA prevalence by providing stimuli for reducing PSA by VR training.

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