How level of realism influences anxiety in virtual reality environments for a job interview

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A B S T R A C T

This study describes how the level of graphical realism required in a virtual social simulation setting can be therapeutically useful in reducing job interview anxiety through exposure. We developed a virtual job interview simulation at a university career service to help student populations faced with the prospect of their first job interview. The virtual job interview simulation can deliver a realistic mock job interview within a high-quality immersive system that is similar to professional virtual reality (VR) systems. We conducted two experimental studies with a common theme: the role of graphical reality of the virtual interviewer and the immersive visual display in the virtual job interview simulation. The results are presented in this study based on a psycho-physiological approach, revealing variation in the distribution of participants′ anxiety state across various VR conditions. The overall conclusion of this study is that the sense of anxiety is less correlated to the graphical realism in VR environment even though the more graphically detailed the virtual human was, the more it provoked a sense of presence. In addition, at least some degree of physical immersion is needed to maintain anxiety levels over the course of VR exposure.

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1. Introduction

One form of social anxiety that is widespread in any community is fear related to job interviews. This is particularly true among students who are close to finishing their degrees and facing the prospect of a first job interview that could well determine their future careers. Career services at universities are inundated with requests for mock job interviews to help students gain some interview experience. A virtual job interview that is sufficiently 'real' to provoke anxiety comparable to the real situation can give students valuable experience at a time convenient to them, while at the same time relieving the burden on career services personnel.

Virtual reality (VR) technology has been successfully applied to help individuals who are anxious in certain social situations (North et al., 1998). VR as a therapeutic intervention, sometimes called virtual reality exposure therapy (VRET), generates an immersive virtual world that can simulate anxiety-provoking situations by integrating real-time graphics, visual displays, body trackers, and other sensory input devices (Krijin et al., 2004). The key concept of VRET is based on its characteristic of perceptual illusion – the sense of presence – as a fear-activating system (Riva and Wiederhold, 2002). The main advantage of VRET is that

individuals can be exposed to a simulated anxiety-provoking situation in a controlled manner so they can learn to handle rejection or criticism and gradually become more comfortable in situations that make them worry (Botella et al., 2005).

North et al. (1995) devised the world′s first virtual reality system for therapeutic purposes and successfully demonstrated its potential benefits in psychotherapy. Since then, Parsons and Rizzo (2008) have reported 21 case studies confirming the value of virtual exposure for phobic disorders such as spider phobia (Garcia et al., 2002), public speaking phobia (Garau et al., 2003; Slater et al., 2006), agoraphobia (Coelho et al., 2006; Botella et al., 2007), and flying phobia (Baños and Botella, 2002). Surprisingly, only one previous study (Grillon et al., 2006) in an academic setting has established a VR scenario for social anxiety associated with job interviews. Grillon et al. evaluated VR exposure to evaluate participants′ avoidance behaviors in job interviews, small talk in cafeterias, and public speaking situations. Although this study was not solely concerned with the fear of job interviews, it demonstrates that a VR-based therapeutic intervention has potential benefits for individuals with job interview anxiety.

A greater understanding of the relationship between anxiety and the factors causing the sense of presence in virtual environments could provide insights into a future flexible therapeutic virtual environment to manage anxiety stimulus parameters in a gradual manner according to the specific needs of the participant. VRET has been shown to assist in the reduction of anxiety; however, unanswered questions still exist regarding how the realism of the virtual environment and the individual′s level of anxiety

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are correlated in a job interview simulation. The current study proposed the following research questions (RQs):

RQ1: How does the individual's anxiety vary in relation to differing graphical fidelity of virtual humans in a social-anxiety-stimulating virtual simulation?

RQ2: How does the individual's anxiety vary between different immersive levels of VR environment for a social-anxiety-stimulating virtual simulation?

2. Literature review

2.1. Virtual humans and social anxiety

A variety of virtual social situations (e.g., public speaking) have been developed to produce an anxiety-provoking atmosphere through virtual reality environments (Powers and Emmelkamp, 2008). Across all these relevant studies, virtual humans have been shown to be a key element in producing some degree of anxiety in a virtual social simulation. Nass et al. (1996) argued that people have a natural tendency to treat a virtual human as a social actor rather than a mere image; thus, it is likely that the computer-generated virtual human evokes a similar response.

North et al. (1998) conducted the first study in VRET for social phobia. They contrived a virtual auditorium comprising three sections of chairs and accommodating an audience of up to hundreds. The VR environment allowed the experimenter to trigger in real time the number in the audience as a stimulus for provoking anxiety. Several audio clips were also employed to respond to users or to create a variety of situations for users to experience, for example, laughing, making comments, encouraging the speaker to speak louder or more clearly, and clapping hands at the end of, or during, the session. They confirmed that their VRET was effective in reducing both anxiety symptoms and the ability to face phobic situations in the real world. The limitation of this virtual environment appeared to be that most of the feedback from the virtual audience was auditory, with limited appearance and action of the individuals in the virtual audience.

As for other VR platforms for social anxiety, Pertaub et al. (2002) constructed a virtual seminar room that was inhabited by eight virtual audience members seated in a semicircle facing the participants. These virtual humans displayed random autonomous behaviors in real-time, such as twitches, blinks, and nods, designed to encourage the illusion of life. The virtual humans were able to display six primary facial expressions, together with yawns and sleeping faces. Virtual humans could also stand up, clap, and walk out of the seminar room, cutting across the speaker's line of sight. The key technique of this system was to simulate each virtual human's gaze to enable eye contact with the participants in real time; the virtual humans could move their heads to follow the participants in real time. They compared participants' responses among three different attitudes in virtual audiences who displayed friendly and hostile reactions during a seminar situation. The participants were more at ease with a friendly group of listeners and demonstrated considerable discomfort with an unpleasant audience. In addition, Roy et al. (2003) used the technique of 3D-sprites to represent characters in the virtual environments. The characters were designed with simple plain surfaces that were used to simulate single objects with video textures. Situations for four different subtypes of social anxiety (performance anxiety, informal speaking anxiety, observation anxiety, and assertiveness anxiety) were developed for the target of generalized social phobia care. All situations successfully provoked anxiety, and the authors concluded that individuals reacted emotionally to virtual humans and demonstrated the possibility and effectiveness of using VR to provoke anxiety.

Grillon et al. (2006) developed a virtual office for job interview situations. The office environment consisted of a workplace where a meeting with several interviewers was organized. Up to seven virtual humans were placed around a table to face the participant. They were all animated with dedicated animations in real time based on their gender and style: Women fixed their hair or checked their nails, a well-dressed man sat quietly, and a younger man assumed a relaxed posture by crossing his legs and arms. A sound atmosphere, recorded in similar real conditions, supported the feeling of immersion (e.g., a person clearing his/her throat, chairs creaking, distant street noise). This study demonstrated general improvement in the various questionnaires related to anxiety, and visual contact avoidance decreased after VR treatment sessions.

From the prior studies, we could identify that more realistic virtual human behaviors and appropriate reactions have a significant and positive impact on participants' responses to provoke affective outcomes in VRET.

In relation to virtual human realism and human anxiety, there is still uncertainty about how best to understand the impact of the virtual human's graphical realism as well as the way to determine a person's anxiety level in the virtual social simulation. Most researchers agree that the graphical realism of the content is related to the sense of presence, which in turn influences an individual's emotions and behavioral reactions (Krijin et al. 2004; Wiederhold and Wiederhold, 2005; Slater et al., 2009; Hendrix and Barfield, 1995). This suggests that the graphical realism of virtual human may be related to the sense of presence, and greater presence provokes anxiety experience while immersed in the virtual environment. The study presented in this paper set out to investigate the correlation among the graphical realism of the virtual human, an individual's anxiety levels, and the sense of presence in VRET for job interview. Based on the previous work, the present study proposed Hypothesis 1 (H1):

H1. Higher graphical realism of the virtual human induces a higher sense of presence, and thus provokes more anxiety.

2.2. Immersive displays and social anxiety

When considering possible moderators for the effectiveness of VRET, several studies have demonstrated the importance of the level of immersion in a virtual environment (Krijin et al. 2004). Robillard et al. (2003) showed the outcomes from the measure of involvement in VR were positively correlated with the anxiety experienced during virtual exposure, suggesting that the greater the attention devoted to the VE, the higher the level of anxiety experienced. Moreover, Krijin et al. (2004) directly compared the effectiveness of two platforms of VRET (i.e., CAVE vs. HMD) with acrophobic patients. They could not find any effect of presence on treatment effectiveness, although higher levels of immersive VRET system revealed increased levels of presence. These two previous studies confirmed that the higher level of immersion gave users an increased sense of presence; however, both studies were limited to height phobia and compared CAVE and HMD, which are both fully immersive environments. Taken together with the assumption of the link between presence and anxiety, we proposed the following hypothesis with respect to the relationship among the immersion of VE, the sense of presence, and the level of anxiety:

H2. More immersive levels of the VR display system induce a higher sense of presence, and thus provoke more anxiety.

3. Methods of experimental studies

Two experiments were carried out to address our research questions and hypotheses in the user behavior context. The first experimental study presented in this report set out to investigate