Virtual Experiences for Social Perspective-Taking

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ABSTRACT

This paper proposes virtual social perspective-taking (VSP). In VSP, users are immersed in an experience of another person to aid in understanding the person's perspective. Users are immersed by 1) providing input to user senses from logs of the target person's senses, 2) instructing users to act and interact like the target, and 3) reminding users that they are playing the role of the target. These guidelines are applied to a scenario where taking the perspective of others is crucial - the medical interview. A pilot study ($n = 16$) using this scenario indicates VSP elicits reflection on the perspectives of others and changes behavior in future, similar social interactions. By encouraging reflection and change, VSP advances the state-of-the-art in training social interactions with virtual experiences.

Keywords: Immersion, Virtual Reality, Human-Computer Interaction, Virtual Humans, Mixed Reality, Tangible Interfaces

Index Terms: I.3.6 [Computer Graphics]: Methodology and Techniques—Interaction Techniques; I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism—Virtual Reality

1 INTRODUCTION

Virtual experiences replace the user's senses with computer-generated sensations to immerse the user in another world. This paper proposes virtual social perspective-taking (VSP), a new class of virtual experience that immerses the user *in an experience lived by another person*. VSP immersion allows a user to live through, reflect on, and learn from the experiences of others.

1.1 Virtual Social Perspective-Taking

Social perspective-taking is the process of reflecting on what it is like to be another person, often described as "seeing through another's eyes" or "walking in another's shoes." This process helps people understand each other and communicate effectively [9, 11].

Virtual experiences are uniquely capable of facilitating social perspective-taking because they can render an experience from the perspective of another person. This enables *immersion* and *interaction* in the experience of another person: seeing what another saw, hearing what another heard, touching what another touched, saying what another said, moving as another moved, and - through narrative and drama - feeling the emotions another felt.

1.2 Driving Application: Medical Interview Training

Our exploration of VSP is driven by an application where social perspective-taking is critical to success, the medical interview. The medical interview is a social interaction between doctor and patient where doctors must understand the patient's perspective in order to address the patient's needs, concerns, and fears. In the medical education literature, this is known as expressing empathy [11, 8].

We developed a VSP experience for training medical students to be more empathetic with patients. First, medical students interview and examine Amanda, a virtual human patient who expresses fear

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Figure 1: A medical student converses with a patient (Left), then relives the conversation *as the patient* (Right).

that a persistent pain in her breast means she has cancer. This cancer scenario provides *empathetic moments* where students should express an understanding of Amanda's fears. Afterward, students relive these moments from Amanda's perspective (Figure 1) to aid in reflecting on and improving their empathy with patients.

We propose three principles to guide our implementation of VSP for this scenario:

1. **Provide input to the user's senses from logs of a target person's senses.** Wearing a head-mounted display (HMD), the student sees and hears herself asking questions and conducting a physical breast exam from Amanda's perspective.
2. **Instruct the user to interact as the target did.** The student is prompted to reenact Amanda's speech and movements.
3. **Remind the user that she is the target.** When looking at her body, the student sees Amanda's body.

A pilot study evaluates if this VSP experience elicits reflection on Amanda's perspective and improves student empathy in future patient interactions.

2 PREVIOUS WORK

2.1 Social VEs Can Benefit from VSP

There has been recent growth in using virtual experiences to simulate social interactions such as conflict resolution [7], cultural competency [3, 1], medical diagnosis [13], and dealing with the mentally ill [6]. Users can benefit greatly from social perspective-taking in these experiences because social perspective-taking aids in resolving conflicts [4], promoting cooperation [9], and reducing bias [16]. As social perspective-taking significantly impacts social interactions, we hypothesize that VSP can improve the behavior of users in virtual and real social interactions. This paper focuses on virtual interactions, evaluating if VSP improves users' empathic behavior in an interaction with a virtual human.

2.2 Avatars Affect Human Behavior

Previous uses of VR to give a user the perspective of another person have focused on placing a user in the avatar of a member of a group of which the user is not a member (e.g., giving a young person an elderly avatar to improve attitudes towards the elderly [18]). When placed in an avatar of a person dissimilar to himself, the user takes on the behaviors he expects from a stereotypical member of this dissimilar group (e.g., taller avatars result in more confident behavior; attractive avatars result in more intimate behavior [19]).

While previous work shows that placing a user in the body of a member of a target group causes the user to better identify with the target group, VSP innovates by immersing a user in a *specific experience* of a member of a target group. Immersing a user in a target's

specific experience has the goal of eliciting reflection on the user's past interactions with both the target and the target's group, in order to improve future interactions with the group. In this work, we immerse medical students in their fearful patient's medical interview and exam to improve their use of empathy with future patients.

3 VSP IMPLEMENTATION

In collaboration with experienced clinicians, we created a VSP experience to allow a medical student to review her interaction with a patient from the patient's perspective. The patient is Amanda, a 34-year-old woman who has had persistent breast pain for two months. The student interviews Amanda for 10 minutes to assess her risk factors for breast cancer and then performs a clinical breast exam on Amanda, visually inspecting and palpating (touching) her breasts. The scenario also includes patient challenges that should prompt the student to express empathy. For example, as the student begins to palpate Amanda's breast, Amanda says, "Wait! I'm scared you might find something bad. What if you find cancer?" Responding to such fears appropriately requires understanding Amanda's perspective. The student should handle this situation by both empathizing and educating, without demeaning the patient or her concerns.

Amanda was simulated by a mixed reality human (MRH) [10], a life-sized virtual human (VH) registered to a tangible interface representing the VH's body. Here, the tangible interface is a mannequin and physical breast model instrumented with 64 sensors that detect the student's touch. By touching the instrumented breast model, the student can perform a clinical breast exam on Amanda. The student wears a HMD to see Amanda's virtual body (co-located with the mannequin) and a webcam is mounted above the mannequin to incorporate the student's hands and the physical breast model into the virtual scene. The student can also ask Amanda scenario-relevant questions using natural speech (e.g. "When did the pain start?"). A simulation module takes touch and speech inputs and matches them to a database of Amanda's responses. Amanda's responses include pre-recorded speech, gestures, gaze-behavior, and facial expressions. We used a MRH (as opposed to a real human or VH) because MRH senses and behavior are easily logged for VSP, and MRH patients elicit more appropriate and empathic behavior than VH patients [10].

3.1 Immersion in Another Person's Experience

After interacting with Amanda, the student relives Amanda's experience of the interaction through VSP. The interaction is divided into two stages, the interview, in which the student gathers information from the patient verbally, and the clinical breast exam, in which the student examines Amanda's breasts. The student relives both of these stages in the VSP experience.

3.2 Reliving the Interview

As the patient interaction begins with Amanda sitting on a medical exam bed, the VSP experience begins with the student sitting on a similar bed. The student wears a tracked HMD (Emagin Z800 HMD, 800x600, 40-degree fov) to see Amanda's perspective from the bed. This perspective includes the virtual room where the patient interaction took place, Amanda's avatar roughly co-located with the student's body, and video of the student interacting with Amanda. The video, recorded from Amanda's perspective, is played back on a virtual plane in the scene such that the student sees approximately what Amanda saw. Audio is also played back, allowing the student to judge how his words and nonverbal aspects of speech (e.g., tone of voice) were perceived by Amanda.

Interaction in this VSP experience is analogous to acting in a play with two roles, Amanda and the doctor. Amanda is played by the student, and the doctor is played by the video recording of the student from the earlier interview with Amanda. Logs of the patient interaction serve as the play's script. To help the student play the

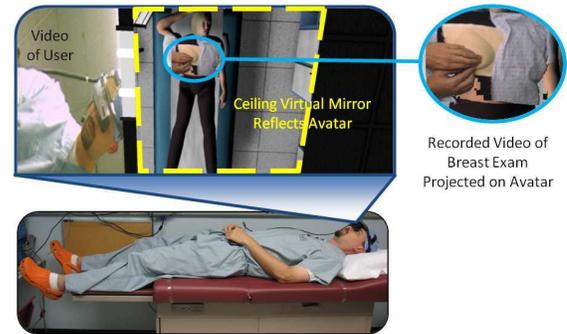Figure 2: VH speech logged for later display in the VSP experience.

Figure 3: Reliving Amanda's breast exam from her perspective

role of Amanda, the system fetches Amanda's actions from the logs and instructs the student to do them at the appropriate times. For example, when it is time to speak Amanda's lines, the playback of the video is paused and a text box appears at the bottom of the student's field of view. The text box displays Amanda's lines for the current point in the patient interaction (Figure 2). The student speaks the lines and then playback is resumed by an investigator.

3.3 Reliving the Breast Exam

In the second stage of the patient interaction, the student conducts a clinical breast exam on Amanda. The exam begins with the student instructing Amanda to raise her hands in the air and put her hands on her hips. Then the student instructs Amanda to lie down, and the student searches for potentially cancerous masses by palpating Amanda's breast (the instrumented breast model). Afterward, Amanda sits up and the student discusses next steps (e.g., additional medical tests) with Amanda. A clinical breast exam can be an uncomfortable, vulnerable experience. The VSP experience aims to improve student understanding of this discomfort and vulnerability by having the student relive the exam from Amanda's perspective.

In the VSP experience, the student reenacts Amanda's movements (e.g., putting hands in the air) when instructed by the doctor. The student's avatar is automatically updated to reflect Amanda's movements and virtual mirrors in the scene allow the student to observe and mimic the changes. In addition, when it is time for the student to lie down for breast palpation, the student's viewpoint automatically animates to the lying down position.

After lying down, the student relives the breast exam from Amanda's perspective through pseudo-haptic [12] cues (Figure 3). With pseudo-haptic cues, the student's body is not actually touched. Instead, the student sees the visual impact of that touch on the avatar. This is enabled by projecting video of the student's hands touching Amanda's breasts onto the avatar. Due to the HMD's limited field of view, the student cannot see the projection directly. Thus, a virtual mirror is placed on the ceiling. The avatar is reflected in the mirror, allowing the student to see video of her hands examining her avatar's breast.

3.4 Reminders of Virtual Identity

We hypothesize reminding the student he is playing Amanda's role increases presence, both in the VE and the role of Amanda, and im-

proves perspective-taking. This is similar to the way costumes improve actor performances [17]; actors need avatars when rehearsing in a VE [15]; and avatar appearance affects behavior [19].

Co-locating Amanda's avatar with the student's body reminds the student he is playing Amanda's role [18]. Looking down in the HMD, the student sees Amanda's avatar instead of his body. Also, two virtual mirrors in the scene allow the student to see his avatar, the mirror on the ceiling and a green-screen mirror. During the patient interaction, the student is recorded in front of a green screen, which is transformed into a dynamic virtual mirror during the VSP experience. Green screen mirrors have been used to add customized garments to a user's reflection[5]. Here the green screen allows the student to see his avatar while sitting up. When the student turns his tracked head, he sees his avatar's head turn in the mirror, and the mirror image moves to reflect parallax. Showing the student he has control over Amanda's viewpoint and avatar also reinforces the notion that the student is playing the role of Amanda.

As head tracking is the only form of tracking used, avatar co-location is roughly maintained by the student. At the start of the VSP experience, the student is initially positioned where Amanda was in the patient interaction. The student maintains the co-location for the rest of the interaction by mimicking Amanda's movements.

4 EVALUATION

In a pilot study, we evaluate if VSP affords social perspective-taking. First, we examine whether VSP elicits social processes. Social processes must be elicited if the user is to understand how the patient felt in this social interaction. Second, we examine whether VSP improves use of empathy. If empathy improves after VSP, it indicates VSP can lead to self-directed changes in behavior.

4.1 Procedure

Participants conducted breast histories and exams of Amanda (MRH1) and a MRH named Edna (MRH2), a 53-year-old woman who had recently found thicker tissue in her breast. Experienced clinicians developed both interactions such that they were similar in medical content, difficulty, and opportunities to be empathic. In between MRH1 and MRH2, participants conducted a VSP experience of MRH1. Thus, MRH1 served as a pre-test to evaluate participant perspective-taking and empathy skills, and MRH2 served as a post-test to evaluate how VSP impacts these skills. Improved empathy from MRH1 to MRH2 is seen as being due to the social perspective-taking afforded by the VSP experience.

Before the VSP experience, an investigator explained to the participant that she was going to switch places with Amanda and experience the interview from Amanda's perspective. The investigator instructed the participant to mimic Amanda as described in Section 3.1. To accustom the participant to the VSP experience, the participant relived the first minute of MRH1, followed by the empathetic moments. The length of the VSP experience was ten minutes.

4.2 Measures

Surveys assessed participants' perspective-taking, use of empathy, and copresence (an indicator of social processes). The same surveys were given after each stage of the study. One participant was called to attend to human patients before completing the post-MRH2 survey and another left items blank, so $n = 15$ for comparisons of post-MRH1 and post-VSP surveys and $n = 14$ for comparisons of post-VSP and post-MRH2 surveys. Another survey given after VSP assessed participants' perceived benefit of VSP.

Empathy and perspective-taking behavior were measured with the questionnaires in Table 1, which were adapted from validated instruments used in medical education: the Jefferson Scale of Physician Empathy [8] and the 4-Habits Coding Scheme [11]. Reliability of the questionnaires was acceptable for empathy (Cronbach's $\alpha = 0.73$) and high for perspective-taking ($\alpha = 0.91$).

Table 1: Empathy (top) and perspective-taking (bottom) questionnaires. All items measured on a 5-point Likert scale.

When the patient expressed fear, I felt sorry for the patient.
I did not pay attention to the patient's emotions.
I did not feel that it was important for me to gain an understanding of how the patient felt about her mother's experience with cancer.
I felt that I made an emotional connection with the patient.
I encouraged the patient to express her emotions.
I accepted and/or validated the patient's feelings.
I displayed little interest or concern to the patient.
I made little or no attempt to explore the patient's feelings.
I legitimized the patient's ideas and feelings.
I demonstrated appropriate non-verbal behavior.
I tried to put myself in the patient's position to help understand her fear.
I could not understand why the patient was fearful.
It was difficult for me to view things from the patient's perspective.
I understood the patient's perspective.

The copresence instrument used after the patient interactions is that of Bailenson et al [2]. This instrument was also adapted to measure copresence in the VSP experience. Three items were adapted: (1) During my time in the role of the patient, I made eye contact with the doctor; (2) During my time in the role of the patient I felt like I was talking to another person; (3) I felt that the doctor was aware of my presence. Reliability of the VSP copresence instrument was high ($\alpha = 0.83$). There was a large correlation between this instrument and the Post-MRH copresence instrument, indicating the construct this instrument measures is indeed copresence. (Post-VSP vs. Post-MRH1: Pearson's $r(13) = 0.65, p < 0.05$, Post-VSP vs. Post-MRH2: $r(13) = 0.81, p < 0.001$).

4.3 Population

Participants were 16 volunteers (10 males, 6 females) from the student and faculty populations at the Medical College of Georgia: one 2nd-year, three 3rd-year, and six 4th-year medical students, four residents and two clinicians. All participants had experience conducting breast histories and exams of human patients. None had experience with life-sized virtual people. There was no interaction of video game experience on other measures collected (Section 4.2).

4.4 Results and Discussion

4.4.1 Self Reflection and Self-Directed Change

During the VSP, participants reflected on their use of empathy and perspective-taking in MRH1. This is evidenced by a decrease in participants' self-ratings of perspective-taking ($F(1,15) = 5.6, p < 0.05$) and empathy ($F(1,15) = 4.53$, p = 0.055) from Post-MRH1 to Post-VSP (Figure 4). Furthermore, participants noted they looked different from the MRH's perspective than they expected and identified expressing empathy (3 participants), portraying confidence (3 participants), and addressing patient concerns and fears (4 participants) as skills needing improvement. Reflecting on their use of empathy and perspective taking in the patient interview, participants realized that they had not adequately taken the patient's perspective or empathized with Amanda.

The reflection afforded by VSP encouraged participants to change their behavior in future social interactions. Participants reported they improved their use of perspective-taking ($F(1,14) = 3.7$, p = 0.076) and empathy ($F(1,14) = 7.0$, p < 0.05) in MRH2 (Figure 4). They also said the VSP experience would change their future interactions with human patients. Participants agreed that "Reviewing the interview and exam changed how I will address patient fears" (10 agree / 1 disagree), "The review session increased my understanding of patient's emotions in sensitive situations" (12 agree / 0 disagree), and "After reviewing my exam of the patient, I expect to be more empathetic in future intimate exam scenarios" (10 agree / 2 disagree). Demonstrating self-reported change in behavior through review of VH experiences extends prior work [14].
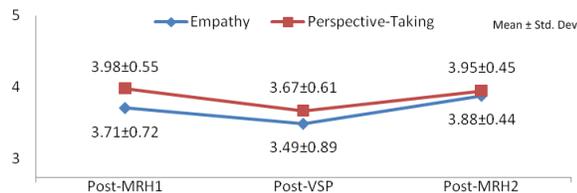
Figure 4: Empathy and perspective-taking improved after VSP.

4.4.2 VSP Affords Social Processes and Interaction

Participants reported high copresence with the doctor (themselves from the patient interaction), indicating that VSP affords social processes and interaction. Eight of 14 participants felt the doctor was aware of their presence, and eleven of 14 reported making eye contact with the doctor. Participants could not make eye contact with the doctor (the doctor's face was covered by an HMD), so these responses indicate participants felt copresent with the doctor. A significant majority of participants also felt they were talking to another person during the VSP experience. This is likely because the VSP experience has the appearance of a conversation, with the participant speaking Amanda's words and the doctor speaking back.

We hypothesize VSP facilitates perspective-taking precisely because it elicits social processes and interaction. Without social processes (e.g., conversation) participants would have difficulty understanding what it was like for Amanda to interact with them. The social processes and interaction elicited also indicate participants felt immersed in the VSP experience despite the artificial nature of the patient and VSP interactions.

4.4.3 Seeing the World Through Unfamiliar Eyes

This paper's broader impact on VR is in enabling seeing the world through unfamiliar eyes. In the study, male doctors experienced a female patient's clinical breast interview and exam. The likelihood of a male doctor experiencing a clinical breast interview and exam, much less fully appreciating the patient's physical and emotional perspective of the experience, is low. Thus, VSP provides an opportunity for users to see and learn from unfamiliar experiences.

5 CONCLUSIONS AND FUTURE WORK

This paper proposes virtual social perspective-taking (VSP), virtual experiences that immerse users in a specific experience from a person's life, with the goal of facilitating a better understanding of that person's perspective. Three guidelines for VSP were proposed and applied to reviewing a simulated patient's interaction with medical professionals. The medical professionals reviewed their interaction with the patient from her perspective, allowing them to see what it was like to talk to them. This provided an important experience of reflecting on how they are perceived by patients, and on what it was like to be the patient. Furthermore, the medical professionals identified skills in need of improvement and indicated they changed behavior as a result of the experience. These responses are difficult to realize with current approaches, such as group and instructor video review. Thus, this work highlights the expansion of VR to support the education of social perspective-taking.

While our results indicate VSP elicited perspective-taking, we hypothesize more impactful perspective-taking could be elicited by allowing the user to *think and decide* how to reenact the MRH's behavior. In future work, we will ask the user to speak what they *think* the MRH would say. We expect this will encourage the student to think about the MRH's perspective before speaking and result in improved use of empathy in future interactions.

The next major step is enabling VSP of human-human (H-H) interactions. Implementing the three VSP guidelines for H-H interactions would be a challenging but worthwhile effort because it would allow users to live and learn from the diverse experiences of others.

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