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Optimizing Clinical Training for the Treatment of PTSD Using Virtual Patients

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Abstract. Adequate treatment of PTSD is a growing concern for the military. However, there is a shortage of qualified personnel available to apply this treatment. Virtual patient systems offer a novel technology to enhance the training needs of such health providers. This pilot project builds on previous work done with virtual patients and describes a novel scenario wherein a virtual patient is immersed within an exposure therapy simulation while a clinician interacts and guides the virtual patient through the recovery process using exposure therapy for PTSD. While this work is ongoing, preliminary results will be presented.

Keywords. Virtual Reality, PTSD, Exposure Therapy, Training, Virtual Humans

Introduction

In recent years, the US Department of Defense has made a rapid and intense effort to fund the development, documentation, and dissemination of efficacious treatment methodologies for posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI). During the past decade, approximately 1.64 million U.S. troops have been deployed for Operations Enduring Freedom and Iraqi Freedom (OEF/OIF) in Afghanistan and Iraq. A recent RAND report discusses the psychological impacts resulting from these deployments, in which many soldiers experience prolonged exposure to combat-related stress over multiple rotations [1]. Unfortunately, the effective deployment of evidenced-based clinical treatment has been limited by a shortage of properly trained clinicians. This shortage is particularly notable for exposure therapy as expert consensus guidelines recommend it as the first line treatment for PTSD. Exposure to emotional situations and prolonged rehearsal result in the regular activation of cerebral metabolism in brain areas associated with inhibition of maladaptive associative processes [3]. Identical neural circuits have been found to be involved in affective regulation across affective disorders [4]. Systematic and controlled therapeutic exposure to phobic stimuli may enhance emotional regulation through adjustments of inhibitory processes on the amygdala by the medial prefrontal

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cortex during exposure and structural changes in the hippocampus after successful therapy [5].

A novel tool for conducting exposure therapy is virtual reality exposure therapy (VRET), in which users are immersed within a computer-generated simulation or virtual environment (VE) that updates in a natural way to the users head and/or body motion. When a user is immersed in a VE, they can be systematically exposed to specific feared stimuli within a contextually relevant setting. VRET comports well with the emotion-processing model, which holds that the fear network must be activated through confrontation with threatening stimuli and that new, incompatible information must be added into the emotional network [6].

The University of Southern California's Institute for Creative Technologies (ICT) has created an immersive virtual reality system for exposure therapy with combat-related PTSD. The treatment environment is based on a creative approach to recycling virtual assets that were initially built for the commercially successful X-Box game and tactical training simulation scenario, Full Spectrum Warrior. As well, other existing and newly created assets available to ICT have been integrated into this rapidly evolving application. The Virtual Iraq application (and the new Virtual Afghanistan scenario) consists of a series of virtual scenarios designed to represent relevant contexts for VR exposure therapy, including middle-eastern themed city and desert road environments (See Figures 1). In addition to the visual stimuli presented in the VR HMD, directional 3D audio, vibrotactile and olfactory stimuli of relevance can be delivered.

The presentation of additive, combat-relevant stimuli in the VR scenarios can be controlled by a therapist via a separate "wizard of oz" Clinical Interface, while in full audio contact with the patient. The clinical interface is a key feature in that it provides a clinician with the capacity to customize the therapy experience to the individual needs of the patient. The clinician can place the patient in VR scenario locations that resemble the setting in which the traumatic events initially occurred and can gradually introduce and control real time "trigger" stimuli (visual, auditory, olfactory, and tactile) as is required to foster the anxiety modulation needed for therapeutic habituation. More system details can be found in Rizzo et al. [7]

Training in exposure therapy typically requires multi-day workshops with corresponding time and resource demands to send government mental health providers to trainings that are often geographically distant from their place of duty. This may result in some facilities possessing fewer trained providers than the patient demand. Once trained, providers need resource intensive supervision with several cases in order

Figure 1. The *Virtual Iraq* Simulation

to ensure adequate learning and utilization of key skills. These challenges are the same for innovative exposure methodologies utilizing virtual reality. New more efficient yet effective training methodologies are required to address this problem and produce clinicians with the necessary therapeutic expertise.

A potential option for addressing this clinical training challenge is in the use of Virtual Human agents to serve as digital standardized virtual patients (VP). Such VP technology is now poised to create new options for clinical training in interviewing, assessment, and therapy. Early efforts in this area [8] produced virtual patients for medical examination training with a virtual examination room where a virtual patient could be interviewed verbally. The USC ICT has been conducting similar virtual human research as part of its primary mission over the past decade years to create highly interactive artificially intelligent embodied conversational agents to be used for VR military leadership and negotiation training, tactical question/answering, leadership training and in the creation of immersive environments where interactive characters are essential to meet training objectives [9].

1. Methods

Our early work with natural language-capable virtual patients involved the development of "Justin", a 16-year old male with a conduct disorder, as a virtual therapy patient for training novice clinicians in the art of clinical interviewing with a resistant teenage client [10]. The system used a sophisticated natural language interface that allowed novice clinicians to practice asking interview questions in an effort to create a positive therapeutic alliance with this very challenging virtual client. From this pilot work, we created "Justina" as a VP representation of a female sexual assault victim with PTSD [11, 12]. The emphasis of this work was two-fold: 1) Explore the potential of this system for use as a clinical interview trainer for promoting sensitive and effective clinical interviewing skills in clinicians in training; and 2) Test whether novice clinicians ask the appropriate questions needed to determine if the patient reports symptoms that meet the criteria for the DSM-4 diagnosis of Posttraumatic Stress Disorder.

The Justina domain was modified for this project to include a military version of a female assaulted within a military base. Domain building for the VP consisted of role-playing sessions to gather the verbal and non-verbal behavior for the patient along with the set of questions typically asked by a clinician. Additionally, iterative discussions with psychiatry faculty from the Keck School of medicine at USC were performed to enhance the corpus of questions and responses. The goal was to build enough of the domain to cover the six categories in the PTSD DSM criteria and cover the kinds of questions people would ask a patient.

The corpus was used for the statistically natural language question/response system. The natural language system works by selecting responses based on input questions. A domain expert manually maps the set of questions and responses. The aim was to build the domain corpus with what we could anticipate and then elicit questions from the user that s/he may ask of the VP for the specific traumatic experience and use those questions in an iterative process to further build the corpus. Since PTSD falls in the diagnostic category of anxiety disorders, rather than assessing for all of the specific criteria, we initially focused at a high level upon the six major clusters of symptoms

following a traumatic event. While this did not give the character depth but breadth, for initial testing this seemed prudent.

2. Results

While this work is ongoing, the current paper discusses the novel developments in this research program that aim to better assist the US military in clinical training for the assessment and treatment of PTSD. One aspect focuses on the creation of a military version of Justina with the aim to develop a training tool that clinicians can practice therapeutic skills for addressing the growing problem of sexual assault within military ranks. The system can also be used by command staff to foster better skills for recognizing the signs of sexual assault in subordinates under their command and for improving the provision of support and care.

The second aspect involves the use of both male and female VP's in the role of a patient who is undergoing Virtual Reality exposure therapy. The VP is in a simulation of a VR therapy room wearing a HMD (Figure 1), while the therapist practices the skills that are required for appropriately fostering emotional engagement with the trauma narrative as is needed for optimal therapeutic exposure.

This simulation of a patient experiencing VR exposure therapy uses the *Virtual Iraq/Afghanistan* PTSD system [7] as the VR *context*, and the training methodology is based on the Therapist's Manual created for that VR application [14]. We believe the "simulation of an activity that occurs within a simulation" is a novel concept that has not been reported previously in the VR literature.

Figure 2. Virtual Justina Interacting in the *Virtual Iraq* Simulation

3. Conclusions

Herein we presented an approach that allows novice mental health clinicians to conduct an interview with a virtual character that emulates an adolescent female with trauma exposure. The work presented here builds on previous initial pilot testing of virtual patients and is a more rigorous attempt to understand how to build and use virtual humans as virtual patients and the many issues involved in building domains, speech, and language models and working with domain experts. The lessons learned here can be applied across any domain that needs to build large integrated systems for virtual

humans. We believe this is a large and needed application area, but it's a small enough domain that we can perform some serious evaluations on using virtual humans in real settings.

It is our belief that with more questions covered in the domain the accuracy of the system will increase along with the depth of the conversions, which will further enhance the virtual patient system. In order to be effective virtual humans must be able to interact in a 3D virtual world, must have the ability to react to dialogues with human-like emotions, and be able to converse in a realistic manner with behaviors and facial expressions. The combination of these capabilities allows them to serve as unique training and learning tools whose special knowledge and reactions can be continually fed back to trainees.

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