Multi-Modal Memory Restructuring for Patients Suffering from Combat-Related PTSD: a Pilot Study

Matthew van den Steen [a], Willem-Paul Brinkman [a, 1], Eric Vermetten [b,c], Mark Neerincx [a, d]
[a] *Delft University of Technology, The Netherlands*
[b] *Military Mental Health Research Center, Central Military Hospital, Utrecht, The Netherlands*
[c] *Rudolf Magnus Institute of Neuroscience, University Medical Center, Utrecht, The Netherlands*
[d] *TNO, Soesterberg, The Netherlands*

Abstract. The paper discusses the design and evaluation of a multimedia software application, which can be used in the treatment of combat-related posttraumatic stress disorder (PTSD). The application allows patients and therapist to visualize the patients' past experience using maps, personal photos, stories and self-created 3D virtual worlds. The tool aims to allow patients to restructure and relearn about their past experience involving the problematic stressors. Findings of a first experiment with non-patients (N=18) suggests that the tool can facilitate more detailed storytelling. Participants stated that using the application was appealing and enjoyable. Insights were also acquired with a case study of a veteran suffering from combat-related PTSD. This case study showed how a patient uses and interacts with the system in a therapeutic setting.

Keywords. PTSD, trauma-focused psychotherapy, memory, multimedia, restructuring, reappraisal

Introduction

Combat-related posttraumatic stress disorder (PTSD) is one of the health problems soldiers may face upon their return from deployment. As an increasing number of soldiers return from war situations, such as Iraq and Afghanistan, the demand for PTSD treatment is also likely to increase. A review of PTSD treatments by Schottenbauer et. al [1] reports high drop-out rates for Cognitive Behavioral Therapy (CBT) and Eye Movement Desensitization and Reprocessing (EMDR). In an attempt to increase appeal relative to traditional face-to-face talk therapy, interest has gone out to developing other methods for improving activation of the traumatic memory during exposure therapy, thereby providing a treatment approach that may be more attractive to some service members. The proposed system presented in this paper explores the possibility of using computer-assisted technology to support trauma-focused psychotherapy, to be used both in a group therapy setting as well as a single patient-therapist setting. Supporting the treatment with computer-assisted technology is, however, not new; recently Virtual Reality Exposure Therapy (VRET) has been extended to the treatment of PTSD. Patients are exposed in virtual reality worlds resembling war situations, such as those in Iraq [2]. Using the here proposed Multi-Modal Memory Restructuring (3MR) System; patients can now build these virtual worlds themselves and link them to a specific day on a timeline, together with media, such as personal pictures and geographical maps. This way the system aims to give the patient more flexibility to restructure, reappraise and narrative about their deployment and to manage various deployment related memory elements themselves with the purpose to facilitate time sequencing of memory content.

1. 3MR system

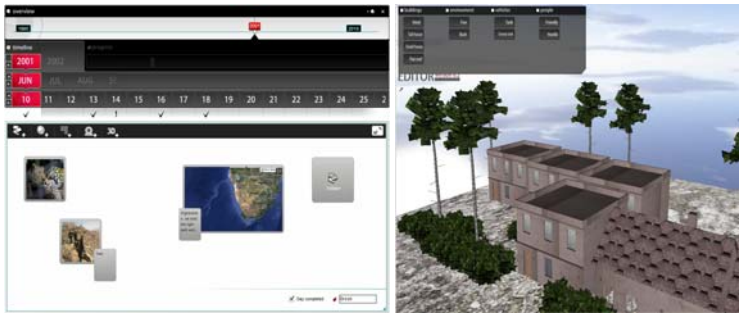
Traditional treatment of veterans with deployment related PTSD is often set within a group context as soldiers are familiar to operate in a group [3]. In these sessions, patients talk about their experiences, in an exposure based format, facilitated by the drawing of maps and other visual aids. Usually a flap–over as well as maps and photographs are used to facilitate memory content. Often memory is compromised and due to

[1] Corresponding Author. Willem-Paul Brinkman, Delft University of Technology, Mekelweg 4, Delft, Netherlands 2628 CD. Email: w.p.brinkman@tudelft.nl

memory distortions or amnesia for details these elements can be quite helpful. The 3MR approach takes this a few steps further. The 3MR focus does not lay on direct exposure, but on the way patients facilitate and manage their memory to restructure and relearn about their past experience involving the problematic stressors. Patients are invited along a set timeline to sequentially add media and self-created virtual 3D worlds, patients are able to express and rethink about their experiences during their time of deployment. The 3MR system provides contextual information in various modalities to these experiences. It is designed to run on a laptop with a projector displaying the computer screen on the wall for the group members to see. This in itself creates a safe zone, in which direct eye contact among members can be legitimately avoided; some patients do not like to be stared at during their exposure, and others do not want to look at someone in a potentially distressing state. Additionally, a camera is attached to the laptop allowing snapshots from photos or objects patients brought with them. The system support consists of several elements:

1. Information of patient is created, as a digital space or folder.
2. The session starts with a projection of a timeline set on the present day. From here the patient can move to a specific day of their deployment. To emphasize that this event has taken place in the past, the years and days from the present day to the selected day are counted back while showing photos of historical events of that time period.
3. Once the patient arrives at the specific day, they are asked to organize the event of that day by using their own photographic material, videos, or music, and by annotating satellite based geographical maps (Figure 1a). In addition, the patient can also use an easy-to-use 3D editor to recreate a specific scene (Figure 1b). Using these facilities the patient can restructure the events and place them, together with narrative elements, on a chronological timeline.
4. This can be worked through, commented on back and forth.
5. The session ends again by visually moving back from the event in the past to the present day. The way a patient initially perceives a past deployment may change if the patient continuously also adds positive pictures and documents to his or her timeline.

Although a past deployment is often related to traumatic events, the good memories, also related to the same deployment, are often forgotten. Photographs are usually taken during non stressful moments. This material can therefore be very useful, even though they are not directly linked to a stressor. In addition to these features, a psycho-educational element is incorporated to display the past and coming treatment sessions on the timeline. This gives the patient an overview of the entire treatment procedure.



a **b**

Figure 1. Left the timeline with content management (a), right the 3D world editor (b)

2. Analysis and design

The design of the system followed a situated cognitive engineering approach as described by Neerincx and Lindenberg [4]. It is an iterative approach where the requirements baseline is continuously refined as new insights are acquired through prototype evaluations and reviews with therapists. An inventory of envisioned technology, relevant human factors, and operational (therapeutic) demands was established during the domain analysis. This was done in close cooperation with a military psychiatrist experienced in treating PTSD patients. With this information scenarios and claims were specified, which resulted in three short films[2] focusing on (1) personalization of the system (timeline, own text annotations, and 3D virtual world),

[2] http://mmi.tudelft.nl/vret/index.php/PTSD

(2) the use of the 3D editor (pausing and resuming editing work, and interaction with the therapist and other group members), and (3) the return to a previous session (amending and extending previous work). These films were used in a review with ten therapists. At the start of the in-depth interviews, the films were shown to a therapist, followed by a discussion of the underlying claims on the usability and support of the therapeutic process. The three most noticeable changes made after the review were:

1. More modality was added to facilitate memory.
2. Options were introduced to personalize the system.
3. The patient was now able to tag or summarize a particular day with keywords.

Several prototypes were developed and after a heuristic evaluation and a continuous formative evaluation approach, keeping both experts and therapists in the loop, the proposed 3MR system was created and ready to be used in both an experiment and case study. It is important to note that the proposed system is a new concept and insights are necessary on what features of the system are of importance and how people would use the application. In this early stage the aim was not to acquire data to study the effectiveness of a treatment using the 3MR tool.

3. Experiment and case study

Before the case study with a real patient took place, an initial experiment was conducted to see if the system would support people in telling a story from the past. The participants were asked to tell two different autobiographic stories (e.g. holiday trips) of six minutes each, one with the help of the 3MR system and one without. The order in which the stories were told was counterbalanced. Prior to the storytelling participants already explored the 3MR system. A total of 18 people participated in this experiment, none suffering from a combat-related PTSD. Participants were allowed to bring related photographs with them to make the storytelling a bit easier. After both stories were told, each participant was asked to fill out a seven-point likert scale questionnaire. Using a one sample *t*-test, the following significant results (H_0*: score = 4,* $p < .001$) were acquired: (1) participants thought they put more details in the story told with the help of 3MR ($M = 6.00$, $SD = 0.69$), (2) comparing the two stories, they found more memories came back by using the application ($M = 5.94$, $SD = 0.80$), (3) participants enjoyed telling a story with 3MR more than telling a story without the application ($M = 5.28$, $SD = 1.27$) and (4) they thought the timeline was an essential component in a way a story was told ($M = 5.50$, $SD = 1.29$). Less positive seems the rating on whether the system encouraged them to use the features offered by the application ($t\ (17) = 0.92$, $p = .37$) ($M = 4.39$, $SD = 1.79$). Although there was no need to use them, as most of the components were designed specifically for soldiers with a PTSD, another reason could be that the available six minutes were too short to allow them to make use of the available features. Although the results from the questionnaires favor the use of 3MR, an additional analysis was done to see if the tool affected people's storytelling. For this analysis the sound recordings of only 12 participants could be used as 6 participants, mainly typed instead of talked when using the 3MR tool. The analysis focused on: (1) time referencing, (2) location, (3) event description and (4) time period covered. A Wilcoxon Signed-ranks test indicated that more participants mentioned a precise date with 3MR ($Mdn = 2.50$) than without ($Mdn = 0.00$), $Z = -2.96$, $p = .003$. The opposite was true when participants referred to a less precise time frame, *3MR-Mdn* = 1.5, *non-3MR-Mdn* = 4.0, $Z = -2.77$, $p = .006$. Concerning events, participants were more precise with the system ($Mdn = 4.00$) than without ($Mdn = 3.00$), $Z = -2.56$, $p = .011$. Examples of these events are actions, such as buying a cola and watching football on TV. Again the opposite was the case when participants referred to more general events, *3MR-Mdn* = 1.5, *non-3Mdn* = 3.0, $Z = -2.46$, $p = .014$. Going to a business trip and studying for an exam are examples of general events. Also, stories told with 3MR covered a smaller time period in months ($Mdn = 0.13$) than without ($Mdn = 0.50$), $Z = -2.43$, $p = .015$. However, the test indicated no significant difference ($p > .05$) when participants referred to locations.

A small case study of two clinical sessions was organized with a veteran with PTSD who has served in various deployments, such as Dutchbat I (Srebrenica). As the proposed system was a new concept, the aim was to acquire insights into how a patient would use and interact with the system. Before the case study started, the psychiatrist (EV) informed the patient of the study, explained what was going to happen and asked the patient to bring some photographs with him so he could add the data into the system during the first session. The patient was not new to treatment of PTSD; he was already undergoing another form of outpatient PTSD treatment at the time the case study was taken. Typically PTSD patients have difficulty to sequence events and experience distorted processing of time in the context of traumatic memories. A

clinical environment was chosen for the observations, with the patient sitting behind a laptop and the therapist sitting next to him. After introducing the patient to the system, the patient created a profile by stating his name and adding the different deployments he was in. Instead of picking a date, the patient put all the collected (digital) photos on the first date of the deployment. Here, he also added various text elements to explain, in detail, what was shown on the pictures. Instead of letting the patient type the text, the therapist decided to do it. This way the patient could read what he just said and add details if needed. One of the most used features during the first session was the 'Google Maps' option. The patient occasionally added a snapshot of a map to the timeline. Using the maps, the patient was encouraged to go into details. He started talking about the things he saw and how things have changed compared to the time he was there. He also tried to find specific places and buildings he remembered from back then. The patient usually added elements to the timeline independently. However, he did not always provide much information. In these cases the therapist asked the patient to tell more about the things he experienced by encouraging to use the narrative element within the system. Overall, the patient was very pleased with the approach and suggested that the system might be interesting to be used at home. That way the patient can create an 'archive' of the past events at any time and share these stories with friends and family. The second meeting started with a reflection of what was discussed during the session conducted in the previous week. The patient mentioned that presenting memories and treatment visually was very appealing and, according to him, useful. He felt that by using the application he was aware of the events that happened a long time ago. Also, the patient liked that he was the one working on his own timeline. He felt that he was more in control of his own treatment and also thought that other veterans with the disorder would find this new approach appealing. For the second session the patient brought a document with him. The document was related to the deployment he was editing in the previous session and he thought it was useful for his timeline. The remainder of the session was focused on the events written in the document. Mainly interaction between the therapist and patient took place, putting the 3MR system aside for a while. Unfortunately the 3D editor option was not chosen during this small case study, but both psychiatrist and patient were hopeful that it would indeed help facilitate processing of complex stressful experiences.

Looking back at both the experiment and case study, participants found the system appealing and enjoyable to work with. It acts as an archive of memories and allows patients to manage this archive by adding various multimedia elements related to their memory. The proposed timeline was found to be a useful feature and the participants thought that more memories came back when using 3MR, in an accurate non-time distorted way. Results from the additional analysis showed significant differences in how a story is told, hinting at a more detailed way of storytelling. The veteran who participated in the case study was pleased with the system and felt encouraged to work with it as he saw the purpose of talking about past events by managing a media archive.

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