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VIRTUAL PATIENTS AS AN INNOVATIVE EDUCATIONAL TOOL IN TRANSCULTURAL PSYCHIATRY

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Virtual Patients as an Innovative Educational Tool in Transcultural Psychiatry

THESIS FOR DOCTORAL DEGREE (Ph.D.)

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To my father Giorgos Pantziaras (1947-2001), for all his love, support and faith in me that still warms my heart and lights my path through life

ABSTRACT

Background: The dramatic increase in the number of patients with diverse ethnic backgrounds who have been exposed to severe mental trauma demonstrates that there is an urgent need for improvement in the quality of transcultural psychiatric health care through the development and evaluation of relevant and effective training tools.

Aim: This thesis describes the development and scientific study of a new medical educational tool based on Virtual Patient (VP) methodology and the evaluation of different aspects that highlight its educational potentials as a train environment for the clinical management of traumatised refugee patients.

Methods: We developed a dedicated VP system that portrayed a refugee with severe symptoms of post-traumatic stress disorder and depression. This was tested by a group of resident psychiatrists and evaluated in terms of user acceptance, expectations and attitudes as well as how it affected confidence levels in different aspects of providing clinical care for this patient group and core knowledge about related psychiatric conditions and communication skills.

Results: The participants responded in a positive way towards this new educational system. It was perceived as being highly realistic and there were high acceptance levels. A statistically significant improvement was exhibited in overall confidence in providing medical care for traumatized refugee patients as well as in four more specific domains of clinical care, with the area of identifying and evaluating trauma-related diagnoses and disability showing the most prominent improvement. A statistically significant improvement in core knowledge about trauma-related psychiatric diagnoses and basic communication skills was exhibited directly after the interaction with the VP.

Conclusions: Based on the results presented in this thesis it is concluded that the proposed VP-system demonstrated high acceptance among participants and good potential as a training tool for the clinical management of refugee patients. The results suggest that it can lead to resident psychiatrists' improvement of confidence in providing transcultural clinical care for this vulnerable patient group. It can also successfully facilitate the acquisition of core knowledge in the field of psychiatry. Longitudinal studies with several VPs exhibiting different psychiatric disorders are needed in the future in order to scientifically study whether these impacts are sustainable.

Keywords: Medical Education, Medical Simulation, Virtual Patients, Psychiatry, PTSD, Depression, Refugees, Single subject study

LIST OF SCIENTIFIC PAPERS

This thesis is based on four papers that will be referred to by their Roman numerals I-IV in the text.

I. **Pantziaras, I.**, Courteille, O., Mollica, R., Fors, U., & Ekblad, S. (2012). A pilot study of user acceptance and educational potentials of virtual patients in transcultural psychiatry. *Int J Med Educ*, 3:132-140.

II. **Pantziaras, I.**, Fors, U. & Ekblad, S. (2014). Virtual Mrs K: The learners' expectations and attitudes towards a virtual patient system in transcultural psychiatry. *J Contemp Med Edu*, *2*(2):109-115.

III. **Pantziaras, I**., Fors, U. & Ekblad, S. (2015). Innovative Training with Virtual Patients in transcultural psychiatry: The impact on resident psychiatrists' confidence. *PLOS One* (In Press).

IV. **Pantziaras, I**., Fors, U. & Ekblad, S. (2015). Training with Virtual Patients in Transcultural Psychiatry: Do the learners actually learn? *J Med Internet Res*, *17*(2):e46.

CONTENTS

LIST OF ABBREVIATIONS

DSM-IV-TR	Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (Text Revision)
DSV	Department of Computer and System Sciences
EPN	Regional Ethics Review Board
HPRT	The Harvard Program for Refugee Trauma
ISP	Interactive Simulation of Patients
IT	Information Technology
KI	Karolinska Institutet
KI-VP-LEQ	Karolinska Institutet – Virtual Patient - Learning Experience Questionnaire
LIME	Learning, Informatics, Management and Ethics
PCP	Primary Care Physician
PTSD	Post Traumatic Stress Disorder
PUL	Personal Data Act
R&D Group	Research & Development Group
RT-Sim	Refugee Trauma Simulation System
SP	Standardized Patient
SU	Stockholm University
VA	Virtual Advisor
VI	Virtual Interpreter
VP	Virtual Patient

1 INTRODUCTION

This thesis aims to describe the development and evaluation of a Virtual Patient (VP) system which is dedicated to traumatized refugee patients. The system was developed between 2009 and 2011 by our research team at the Department of Learning, Informatics, Management and Ethics (LIME) at the Karolinska Institutet (KI) in collaboration with the Harvard Program in Refugee Trauma (HPRT) and the Department of Computer and System Sciences (DSV) at Stockholm University (SU). This thesis also explores its different pedagogical aspects when tested and evaluated by a group of resident psychiatrists in Sweden.

This project was conducted in two phases: a pilot study and a main study. The pilot study (paper I) described the development of the preliminary version of the VP system (prototype α) that was tested by 9 resident doctors in order to examine user acceptance and educational potentials as well as face and construct validity of the system. The main study was conducted after the development of the second version of the VP system (prototype β) and explored three basic aspects of the system: (a) user acceptance, attitudes and expectations (paper II), (b) how training with the system impacts on confidence regarding different aspects of providing medical care for traumatised refugee patients (paper III) and finally, (c) how training impacts on knowledge-building and retention of knowledge (paper IV).

The structure of this thesis begins through introducing a timeline of my work with this project followed by background information which focuses on the dramatical increase of immigration and the crucial need for better healthcare offered to socioeconomically vulnerable groups of immigrants, asylum-seekers and refugees. Also included will be a general background of VPs and their implementation in psychiatry. This is followed by stating the aims of this project along with the research questions of each paper. In the next chapter, methods used are described which is followed by a presentation of the results. In the following chapter, a discussion which is focused on different aspects of this thesis is presented, followed by conclusions and implications for medical education and further research.

1.1 TIMELINE

My first contact with the world of VPs was conducted in November 2009, when I was asked by Dr. Solvig Ekblad (later my main supervisor) to participate in the development of a new educational tool - based on VP methodology – which would be dedicated to traumatised refugee patients. Dr. Ekblad had started research collaboration with professor Uno Fors (later one of my co-supervisors), at that time the Chairman of the Department of LIME and an internationally well-known researcher in the field of Medical Simulation. My interest for transcultural psychiatry combined with my passion for new technologies made that decision rather easy for me. The day after this proposal, I travelled to Boston in order to attend a two-week internship at the Harvard Program for Refugee Trauma (HPRT), financed by a scholarship from the Swedish Psychiatric Association. Once in Boston, I started writing the script (including the dialogue between the user and the VP) which was going to be used for the first VP case, and which was based on a traditional linear paper case published by Richard F. Mollica, Professor of Psychiatry at the Harvard Medical School. I had the unique opportunity to be guided during these first steps by Professor Mollica during my two-week

stay in Boston. Later, Professor Mollica became one of my co-supervisors when I officially registered as a Ph.D. student at LIME, KI.

In March 2010, a preliminary version of the VP system (prototype α) was completed. I started collecting data for paper I (Pilot Study) during April 2010 and finished in June 2010. In July 2010 I started analysing the data and preparing the manuscript for paper I. I was fortunate to get a seat in the National Research School in Psychiatry while I was also preparing my application to the Admission Committee of the Department of LIME in order to be registered as a Ph.D. candidate. In November 2010 I presented my proposal during my admission seminar at LIME and became officially registered on 21 December 2010. My application to the Ethical Review Board at the Karolinska Institutet was sent in March 2011.

During all this time, between July 2010 and May 2011, I was preparing the second version of the VP system (prototype β). The preparation included further development of the script (questions with possible answers by the patient), the video recording of the patient, video editing and finally the programming of the VP system. It was finalised in May 2011 and I started collecting data for the main part of my project (papers II, III and IV) between January 2011 and April 2013. In the meantime, paper I was submitted for consideration in March 2012 and accepted and published in July 2012 in the International Journal of Medical Education.

Between May 2013 and November 2013, I was working with data analysis and preparation for paper II, which was submitted for consideration in March 2014 and accepted into the Journal of Contemporary Medical Education in July 2014. Between November 2013 and March 2014 I analysed the data for paper III and submitted it to PLOS One in May 2014 where it was accepted for publication in February 2015. I started working with the data analysis and preparation of paper IV in January 2014 and submitted it in April 2014 to the Journal of Medical Internet Research. It was accepted for publication in November 2014.

1.2 THE PSYCHIATRIC PATIENT IN A RAPIDLY CHANGING WORLD

It is well known that during the last four decades, global population mobility has dramatically increased and changed which has led to a significant increase in the number of patients with diverse ethnic backgrounds (UNHCR, 2013; Ekblad & Kastrup, 2013). In 2012, there were 1.1 million new refugees around the globe, the highest rise in numbers since 1999, reaching a total number of 15.4 million refugees worldwide (UNHCR, 2013). Even the Nordic countries (Denmark, Finland, Norway and Sweden), which previously had fairly homogeneous populations, have become more culturally diverse during recent decades (Ekblad & Kastrup, 2013).

The reasons for migration - including the need of improved socioeconomic status, to seek asylum and personal safety, striving to live in a more agreeable environment or the desire to join family abroad (International Organization for Migration, 2013) - as well as the procedure and duration of migration can cause extraordinary stress and have a negative impact on the health of individuals. Refugees, and especially some subgroups including unaccompanied children, disabled people, pregnant women, persons suffering from mental health disorders or survivors of torture and/or other form of violence, are a very vulnerable socioeconomic group (Larkin, 2009). Several epidemiological studies have shown that refugees generally exhibit

higher rates and relative mortality risks of cardiovascular diseases, diabetes, obesity, metabolic syndrome and other chronic conditions compared to native-born populations (Rasmusson, Schnurr, Zukowska, Scioli & Forman, 2010; Coughlin, 2012). Moreover refugees have a higher risk of external causes of death than non-refugees (Hollander et al., 2012) and higher rates of disability and unemployment (Hollander, Bruce, Ekberg, Burström & Ekblad, 2013).

A large proportion of refugees and asylum seekers have moreover experienced severe traumatic life events that can give rise to multiple and complicated psychiatric conditions such as Post Traumatic Stress Disorder (PTSD), which has been found to be the most common mental health problem in this group, followed by major depression (Fazel, Wheeler & Danesh, 2005; Carta, Bernal, Hardoy & Haro-Abad, 2005; Mollica et al., 1998). Cumulative trauma has been found to be associated with the diagnosis of PTSD and depression by a dose–effect relationship, i.e., increasing levels of trauma lead to higher rates and severity of PTSD and depression (Mollica et al., 2014; Sjedjefsk, Speisman & Dierker, 2008).

Transcultural psychiatry (also referred to as "cultural psychiatry" or "cross-cultural psychiatry") is defined in this thesis as the field of psychiatry concerned with the cultural aspects of human behaviour, mental health, psychopathology and treatment (APA, 1969). Fabrega (2001) noted that 'psychiatry may outline a science of the psyche and its disturbances but it also reflects a cultural interpretation about personal experience, responsibility, social behaviour, and the requirements for social order. The cultural character of the psychiatric enterprise itself, just as much as the characteristics of its disorders, constitute the subject matter of cultural psychiatry'.

A patient´s cultural background influences various aspects of illness, including linguistic and emotional expression (Helman, 2014; Lewis-Fernandez, 1996) as well as the course and outcome of many psychiatric disorders (Kleinman, 1988; Kirmayer, 2001; Littlewood & Lipsedge, 1997). Doctors and patients coming from different cultural backgrounds may also have different definitions or explanations of illness and health (Schouten & Meeuwesen, 2006) and therefore using a cultural sensitive approach in medical communication is recommended. The offered treatment and expected outcomes to treatment may also differ due to the different interpretation of symptoms. These cultural differences, including the often limited native language proficiency, can make the process of diagnosing and treating common mental disorders in refugees a challenge. This often leads to missed trauma-related diagnoses (Stein, McQuaid, Pedrelli, Lenox & McCahill, 2000).

According to the 1986 Declaration on the Right to Development, development is defined as a 'constant improvement of the well-being of the entire population and of all individuals' (UN General Assembly, 1986). In Sweden it is explicitly noted by the National Board of Health and Welfare that access to evidence-based healthcare services must be equally available to every citizen independent of cultural differences (Socialstyrelsen, 2010). This emphasises the crucial need to increase the competence of psychiatrists and primary health care physicians in identifying and treating trauma-related conditions, including PTSD. A way to accomplish this goal would be by enhancing their ability to take up a trauma story in a sensitive way and integrate this information into a holistic treatment plan for non-native patients through

employing a bio-psychosocial approach (Engel, 1977) which in theory is the goal model in mental health.

1.3 A HOLISTIC VIEW OF MEDICAL COMPETENCY

In order to overcome cultural differences and properly assess the refugee patient's trauma history and identify the aforementioned severe mental conditions in order to provide effective and targeted medical care, the doctor has to master relevant knowledge, skills and attitudes that together comprise what we define as the medical competence. For example, important domains of competence include social and intercultural competence, professionalism, and the ability to integrate core knowledge into clinical praxis (Epstein & Hundert, 2002).

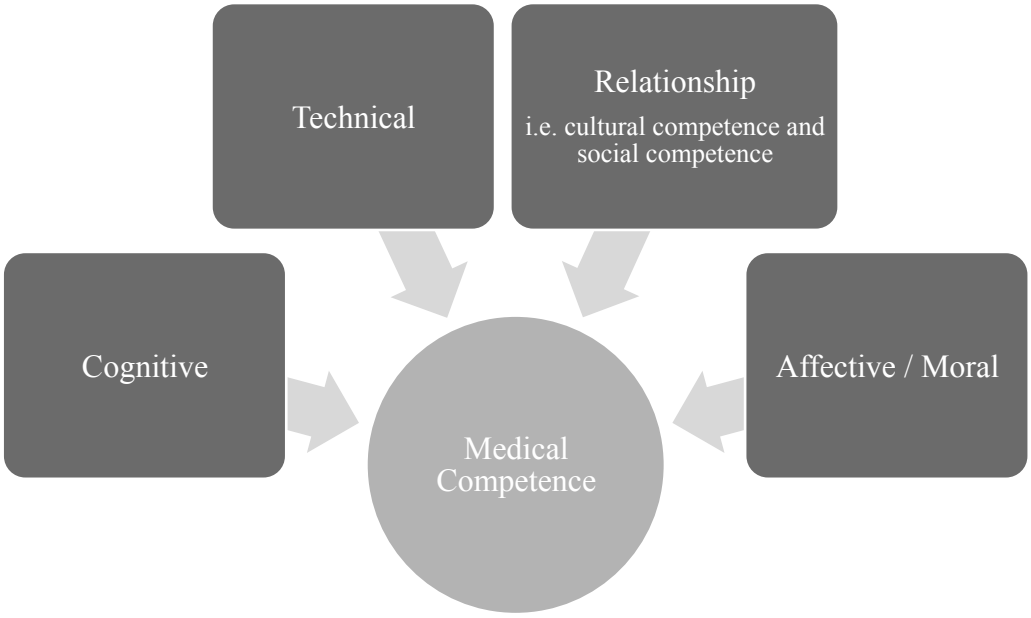

Figure 1. Different dimensions that comprise medical competence (revised from Epstein & Hundert, 2002).

Figure 1 demonstrates a review of four different domains of competence as proposed by Epstein and Hundert (2002). The cognitive domain includes core knowledge, abstract problem solving, generating questions and using resources. Similarly, the technical domain includes physical examination and surgical skills. The affective/moral domain is related to the ability of dealing effectively with stress and showing empathy, while the relationship domain has to do with communication skills as well as social and cultural competence.

These areas of competence have a crucial role when providing medical care for vulnerable groups including traumatised refugee patients. Social competence has been defined as 'a process based on knowledge, skills and attitudes that support effective interaction between the physician and patient despite the social distance that separates them' (Loignon et al., 2010). This has been shown to directly affect the outcomes of illness and costs of chronic diseases by improving patients' understanding and reducing patients' anxiety (Epstein & Hundert, 2002). Cultural competence, on the other hand, is the ability of the practitioner to overcome cultural differences in order to build an effective relationship with the patient by

means of e.g. exploring the patient's beliefs and values, finding common ground, being aware of their own biases and discrimination affecting minority groups, and effectively using interpreter services when needed (Saha, Beach & Cooper, 2008).

Acquiring and developing proper non-technical skills involved in patient-centred clinical interviewing (including verbal and non-verbal communication skills and intercultural aspects) is a long and complex process (Lane, 2007) that requires self-monitoring and self-assessment skills (Benett, 1993). Traditionally, social and cultural competences in medical school curricula have been an informal part of the clinical training, without specific focus on those skills per se. However recent advances in technology have opened the doors for new, focused and innovative training methods, which includes VPs.

1.4 VIRTUAL PATIENTS AS AN EDUCATIONAL MODEL

In the following section, a brief history of VPs will be described, along with the definition of VPs. This will be followed by an overview of the advantages of using VPs in medical education as well as a review of the implementation of VPs in the broader area of psychiatry.

1.4.1 Definition and a brief history

ELIZA: How do you do. Please tell me your problem.
YOU: I am depressed
ELIZA: I am sorry to hear that you are depressed.
YOU: How can you help me?
ELIZA: Suppose I did help you -- what would that mean?
YOU: I would hopefully be happy again and not hate my mother.
ELIZA: Your mother?
YOU: Yes
ELIZA: You seem to be quite positive.
YOU: Not at all. Why do you say that?
ELIZA: Oh, I say that?

ELIZA, who is presented above as having a conversation with a client, was a "virtual therapist" and one of the very first attempts (developed 1964-66) at constructing a conversational agent (Weizenbaum, 1966). Eliza was developed at MIT by Joseph Weizenbaum with the intention to examine what was possible in terms of having a conversation with a computer. The program simulated a Rogerian therapist and used primarily syntactic manipulations (i.e. changing statements into questions) which often produced entertaining dialogues and provided approachable digital fun in the otherwise very business-oriented multimedia and computer environment of the 1960s. More importantly, Eliza also gave rise to various descendants that portrayed computer-based dialogue agents that tried to interact with users for various purposes, using some forms of artificial.

The term "Virtual Patient" has been used to describe many different forms of interactive simulations used in health care education. A broadly accepted definition of VPs is 'interactive computer simulations of real-life clinical scenarios for the purpose of medical training,

education, or assessment' (Ellaway, Poulton, Fors, McGee & Albright, 2008). Another, more recent and more general, approach defines the term VP as 'any software that allows case-based training, in the context of medical education' (von Zadow, Buron, Harms, Behringer, Sostmann & Dachselt, 2013). VPs comprise of a highly diverse group of different educational platforms that commonly combine scientific expertise, the use of some kind of interaction between the learner and the VP and aim to complement traditional medical curricula (Barab et al., 2009).

Descriptions of VPs were first published in the early 1970s (Harless, Drennon, Marxer, Root & Miller, 1971) and since then have been studied and developed extensively. The experience with VPs at KI originated from experiments in the early 1970s, in cooperation with Dr Harless et al (1971). A new innovative development of VP systems, featured by multimedia technology (Bergin & Fors, 2003), started at KI around the mid 1980s within the R&D group in e-learning and simulation. This group developed and later implemented several educational computer-based simulation systems like the renowned Interactive Simulations of Patients (ISP) and the Web-SP system (Figure 2).

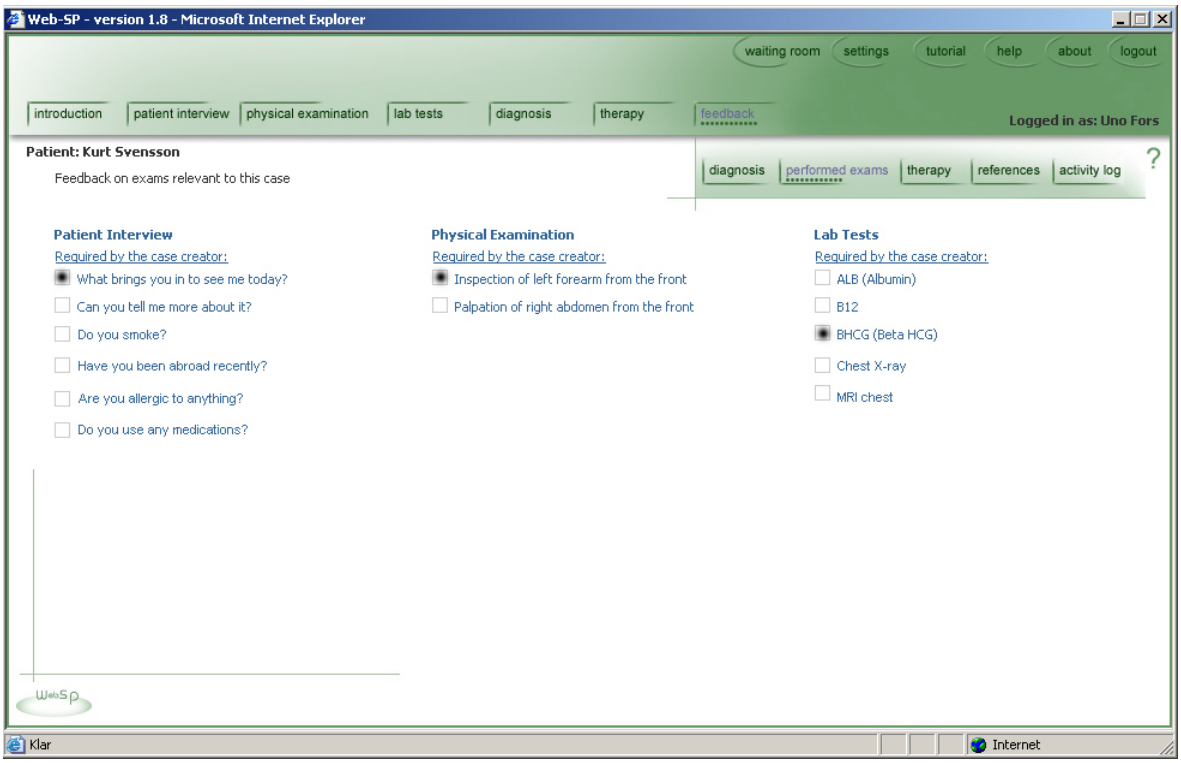

Figure 2. Screenshot of the Web-SP system developed by the R&D group at KI. Published with permission by Professor U. Fors.

Laboratories around the world nowadays work with developing and evaluating VPs based on various technologies including the implementation of lifelike avatars that are customisable and can interact through speech and gestures (Gratch et al., 2002) including speech recognition, recognising non-verbal behaviour (Morency, de Kok & Gratch, 2008) and synthesising nonverbal reponses and expressions (Thiebaux, Marsella, Marshall & Kallman, 2008).

1.4.2 Why virtual patients?

In a traditional educational system, medical students are depended on clinical experience under supervision for acquiring proper clinical, interpersonal and intercultural competence in order to become successful physicians. This fact alone can cause serious concerns regarding both the students and the patients. In this system, the students rely on chance rather than their actual academic and training needs in order to experience specific groups of patients (mostly those suffering conditions of lower prevalence) (Dave, 2012). Moreover, the clinical contact that a student has with a patient is often fragmented and short-term, and it does not provide the opportunity to follow up on a patient after the very first visit or from the onset of symptoms and throughout the course of the disease. Another important consideration is that the protection of the patient must be the first priority, limiting the ability of the student to take total responsibility for a patient. Therefore the valuable learning that comes from experience, especially from making mistakes in order to understand expected responses and behaviour, is limited (Cavazza, Charles, Lindsay, Siddle & Georg, 2015).

To overcome these limitations, some current medical training systems make use of standardised patients (SPs), i.e. trained actors who portray patients with specific health problems. However, even this method comes with its own limitations: the very high cost of recruiting and training the actors, a low variation of clinical cases, and the need for an experienced observer who can provide feedback and guidance about the management of the patient (Collins & Harden, 1998). Additionally, by definition SPs are not really standardised since human actors can act differently due to fatigue, personal preferences or prejudice. Further, invasive procedures and lab/imaging tests cannot be performed on SPs due to ethical reasons.

VPs put the learner in the position of the doctor in charge, and they provide a realistic, reliable, safe and consistent learning environment for enhancing and developing various aspects of their knowledge base (Botezatu, Hult & Fors, 2010). Different clinical skills - including clinical reasoning, clinical decision-making, developing communication skills and history taking - are difficult to teach in a lecture. This makes the use of interactive simulations an appropriate educational complement (Fleetwood et al., 2000; Stevens et al., 2006; McGee, Neill, Goldman & Casey, 1997; Srinivasan, Hwang, West & Yellowlees, 2006; Papadopoulos, Pentzou, Louloudiadis & Tsiatsos, 2013; Georg & Zary, 2014). One of the most important benefits with VPs is that rare clinical cases can be staged, repeated and mastered, and they take into consideration the actual academic needs and learning goals rather than the random availability of patients. It has also been proven that VPs can be superior to traditional teaching for training clinical reasoning and assessment (Forsberg, 2014). Compared to traditional linear paper-based patient cases, VPs have been shown to create a more engaging experience that encourages students to explore their learning (Poulton, Conradi, Kavia, Round & Hilton, 2009), while another published randomised controlled trial showed that web-based interactive cases were more efficient (as indicated by significant improvement in exam performance) compared to paper cases (Poulton, Ellaway, Round, Jivram, Kavia & Hilton, 2014).

In real life, physical or psychological harm to a future patient may become limited through repeated training in a safe virtual environment (Issenberg, McGaghie, Petrusa Gordon &

Scalese, 2005). The VPs can be designed not only to portray a variety of diseases but also have different national, regional and cultural aspects to them (Fors, Muntean, Botezatu & Zary, 2009). The can also integrate scenarios which have a substantive ethical component (Hooper, 2014). Some of the benefits to using VPs as a learning modality are listed as the following: they enable a more challenging cognitive activity in history taking; they emphasise self-pace interaction during the simulated patient encounter; they increase concentration and reduce cognitive load; they evoke the emotional engagement of students and they affect presence and arousal during the VP encounter (Stevens et al., 2006; Saleh, 2010).

1.4.3 Implementation in Psychiatry

VPs have been extensively studied and used in various areas of medicine including the training of surgical procedures (Grantcharov et al., 2004), dentistry (Buchanan, 2001), internal medicine (Botezatu, Hult, Tessma & Fors, 2010) and emergency medicine (Freeman et al., 2001). However, they are a rather new paradigm of education in the field of psychiatry. Two previously published studies reported the use of VPs for training in assessment of suicide risk: one general (Bender, 2003) and the other one specifically in patients with bipolar disorder (Foster et al., 2014). Other studies focused on the effect of VPs on the ability to diagnostically identify conduct disorder (Kenny, Parsons, Gratch, Leuski & Rizzo, 2007), PTSD in an adolescent patient (Kenny, Parsons, Gratch & Rizzo, 2008), depression with panic disorder (Williams et al., 2011), and a major depressive episode presenting with fatigue and anhedonia as the chief complaint (Shah et al., 2012). Moreover computer mediated simulation has recently been reported as a way to teach how to conduct violent risk assessment on complex psychiatric patients (Gorrindo et al., 2013). Interactive computer simulation has also been shown to be a useful complement to traditional risk assessment in offenders with autistic spectrum disorders (Wijk, Edelbring, Svensson, Karlgren, Kristiansson & Fors, 2009; Arborelius, Fors, Svensson, Sygel & Kristiansson, 2013) .

To the best of my knowledge, no other VP system dedicated to traumatised refugees has been described. However, the technology of Virtual Reality has recently been used and studied as a means of providing exposure therapy for veterans with combat-related PTSD (Rizzo, Harthold, Grimani, Leeds & Liewer, 2014).

2 AIM OF THE STUDY

The aim of this thesis was to develop and scientifically study the possibilities and challenges of a dedicated Virtual Patient system developed as an innovative interactive learning tool in medical education that can be used for training the clinical management of traumatised refugee patients.

More specifically, the described project aimed to answer the following four research questions:

1. What are the learners´ levels of acceptance and the educational potential of the preliminary version of a dedicated VP system simulating a traumatised refugee patient? (Paper I, Pilot Study)

2. What are the learners´ attitudes, expectations, and emotions towards the second version of this VP system that was developed based on results from study 1? (Paper II)

3. Do virtual refugee trauma encounters lead to a higher confidence level for the learners in caring for traumatized refugee patients? (Paper III)

4. Do virtual encounters with traumatised refugee patients have an impact on knowledge building and retention of knowledge regarding PTSD, other trauma-related psychiatric disorders and basic communication skills? (Paper IV)

3 METHODS

Since no existing VP system could handle all specific details and features needed for visualising and training the clinical management of traumatised refugee patients, it was decided to develop a new dedicated refugee trauma VP system. In the following section the development of this VP system will be described. This will be followed by a description of the study design and the methods used in order to evaluate different educational aspects of the system.

3.1 BUILDING UP THE VIRTUAL PATIENT SYSTEM

3.1.1 The case of "Mrs. K."

The proposed VP system was developed in collaboration with the Harvard Program for Refugee Trauma (HPRT) in Boston. The case presented was based on a traditional linear paper case ("Mrs. K.") that has been previously and extensively used in HPRT's statewide training of Primary Care Physicians (PCPs) in the Commonwealth of Massachusetts (n=20 trainings, 150 PCPs) for several years (Mollica, 2001). In the early stages of building up the VP system, the Mrs. K. case was adjusted in order to be used as the script for the virtual interaction. A list of possible questions and their answers was drafted, covering a wide variety of broad areas of clinical interest including social and family history, trauma history, medical history, current and previous medication as well as current psychiatric status. Moreover, screening instruments, laboratory and radiologic examinations as well as results of different aspects of physical examination were produced as a complement of the medical history.

The VP, named Katarina, depicted a middle-aged female Bosnian refugee patient with severe mental trauma exposure and symptoms of PTSD and depression. Katarina moved to Sweden during 1995, after the end of the Bosnian War, with her son who is now 23 years old. She lives in a small apartment in an area in the suburbs called Tensta, and makes her living by working in a bar as 'a kind of hostess'. The relationship between her and her son is perceived as tense and complicated, revealing clues that they quarrel a lot due to her son being worried about her working conditions and probably her alcohol consumption.

Her background consists of repeated and consecutive traumatic life experiences that include the disappearance of her husband during the war, the death of her daughter from a land-mine injury after ceasefire and her sexual abuse by soldiers in Bosnia-Herzegovina. She presents with headaches and stress as the chief complaints and, when interviewed further, exhibits severe symptoms of PTSD and major depression.

3.1.2 Prototype α

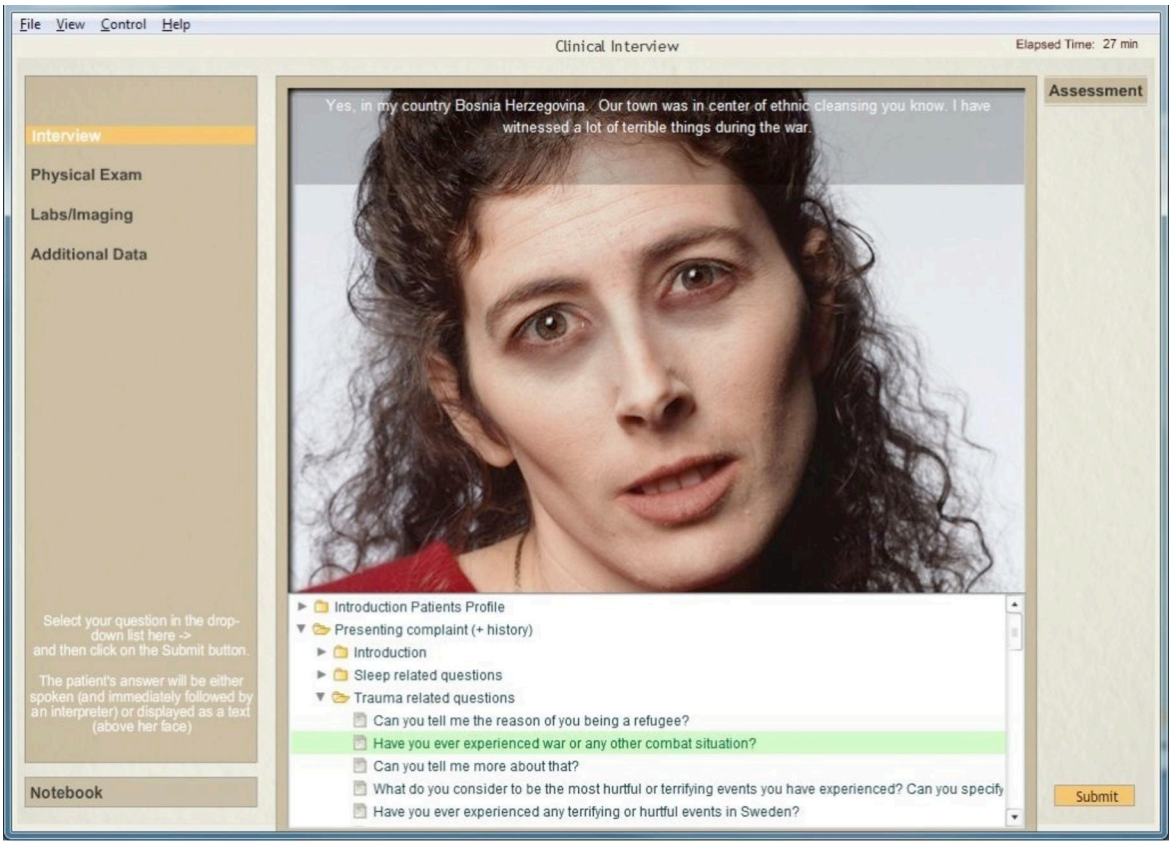

Figure 3. Screenshot of the history taking module of RT-Sim Prototype α (Pantziaras, et al., 2012)

The preliminary version of this VP system was called RT-Sim (Refugee Trauma Simulation). This prototype α was developed using Adobe Flash CS4 Professional™. In this version the VP was depicted as a still image enhanced with pre-recorded voice responses in the Bosnian language (figure 3). User interaction was menu-driven and no session timeout was implemented.

The VP system allowed user interaction in the following areas of medical care: (1) medical interview, including a comprehensive list of history questions (n=148) for investigating the chief complaint, history of the present illness, and social history (figure 4); (2) physical examination (including mental status examination); (3) screening instruments that included a screening instrument for PTSD, the Harvard Trauma Questionnaire (HTQ) and the Hopkins Symptom Checklist (HSCL-25); (4) laboratory tests and imaging studies; (5) additional data (i.e. information about the country of origin, laws about migration in Sweden and links to relevant sources of information in the worldwide web) and (6) preliminary assessment (i.e. treatment plan). The HTQ is a checklist developed by HPRT which enquires about a variety of trauma events and emotional symptoms that are associated with traumatic experiences. The HSCL-25 is a symptom inventory that measures symptoms of anxiety and depression. The psychometric properties of these two tests have been studied and found to be adequate across different cultures and languages (Kleijn, Hovens & Rodenburg, 2001).

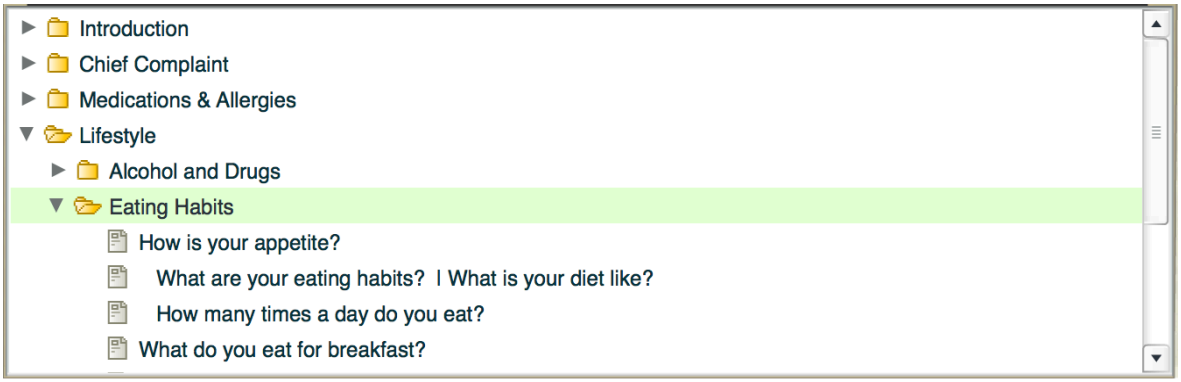

Figure 4. The drop-down menu used to ask the patient a question

In order to ask the patient a question, the user needed to find the desired question from the drop-down list of questions divided into different categories and select it. Each history question led to an associated patient response in the Bosnian language, immediately followed by a Swedish oral interpretation provided by a Virtual Interpreter (VI). Upon completion of the examination of the VP, the user was led to the preliminary assessment module that consisted of open-ended questions, which asked the participants for a structured summary of the patient's history, preliminary diagnosis as well as a suggestion for a treatment plan.

This was followed by a preliminary version of the automated and individualised feedback regarding actions taken, their appropriateness and the quality of case management. It consisted of a list of actions taken during the medical examination (e.g. questions asked, laboratory tests ordered and physical examinations performed) followed by a comment as to whether those were appropriate or not. It also presented a summary of the case management and included a side-by-side comparison of the patient's history, suggested diagnosis and treatment plan as provided by the participant and as proposed by an expert, referred to as the Virtual Advisor (VA).

3.1.3 Prototype β

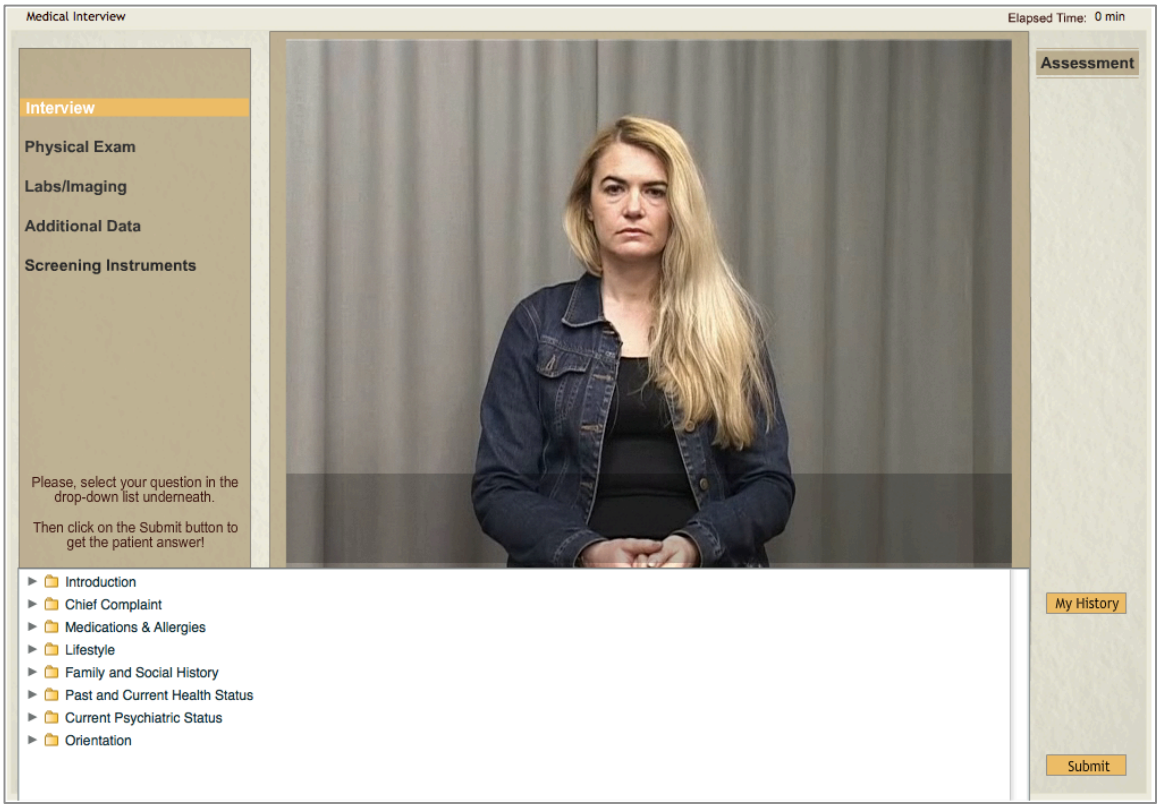

Figure 5. Screenshot of the history-taking module of RT-Sim Prototype β (Pantziaras et al., 2014)

Partly based on the results of paper I, we developed a new and more advanced version of the RT-Sim VP system, referred to as "prototype β". New features and improvements were integrated, including the video presentation of the patient's answers, the integration and fine-tuning of several possible responses by the patient depending on the earned "trust level" as well as an improved version of the provided feedback that even included feedback provided by the VP herself. The patient was depicted using pre-recorded video clips that were obtained through filming a female actor (Figure 5). Using these clips we created a large database of pre-recorded video sequences referring to appropriate patient's responses according to the case's script as well as generic responses and reactions (i.e., the patient getting in and out of the examination room, waiting for the doctor's questions, crying, coughing, etc.). These video sequences were then programmed into the system in order to create an interactive dialogue between the user (who chose the questions from a list of available medical interview questions) and the VP.

The system allowed user-interaction in the following areas: medical interview, physical examination, screening instruments with satisfied psychometric properties in different cultural settings and languages (figure 6), laboratory and imaging tests.

In this version, based on certain pre-determined rules, points of trust towards the doctor ("trust points") were earned, but never revealed to the user. These points, however, determined the "trust level" of the patient, which subsequently determined the way the patient would answer certain questions. The default trust points were zero and depending on actions taken and questions asked, points were added or subtracted leading to possible trust levels of

0 (trust points < 0), 1 (trust points: 1-10) or 2 (trust points > 10). For example, explaining the duty and importance of medical confidentiality during the initial stages of the medical interview would lead to gaining 5 trust points, whereas pressing the patient to answer certain sensitive questions due to the lack of time would lead to loosing 5 trust points. If the user had not earned enough points to reach "trust level 2" the patient would refuse to answer questions on issues such as her traumatic war experiences or certain other "uncomfortable" questions. In "trust level 0" the patient would answer reluctantly or refuse to answer most of the questions asked.

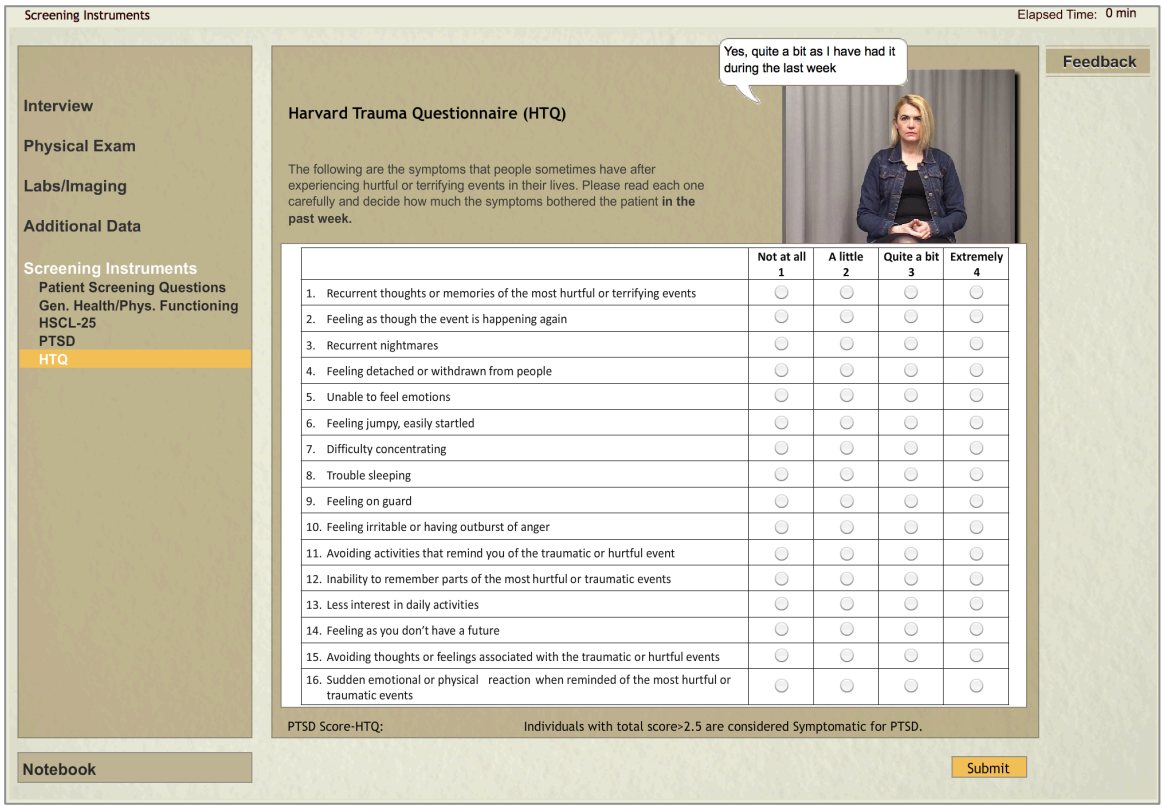

Figure 6. Using a screening instrument (Harvard Trauma Questionnaire) in RT-Sim Prototype β (Pantziaras et al., 2014)

Another improvement of the medical history-taking module in this version was the addition of multiple sub-questions that appeared as available questions or comments when certain questions were asked. These sub-questions consisted of more specific questions about aspects concerning the patient's answers, or simply comments or reflections (for example mirroring what the patient had answered). Upon completing the VP's clinical examination the user was transferred to the "preliminary assessment" module where he or she was asked to fill in and justify the patient's history and diagnosis, including differential diagnostic reasoning and a treatment plan.

The new and improved feedback module in prototype β featured two parts: (1) Individualised and automated feedback provided by the VP herself, reflecting the patient's perspective on topics such as the level of empathy she perceived, the questions asked and their relevance to the problems she was experiencing. This feedback was given as a video presentation of the VP talking directly to the learner and it was based on actions taken during the examination, questions asked (based on the type and number of questions and order of asking) and the use

of communication skills (i.e., the use of "mirroring" and summarising the patient's answers). The feedback from the VP was presented in video form, with the actual actor presenting the relevant information to the user (Figure 7).

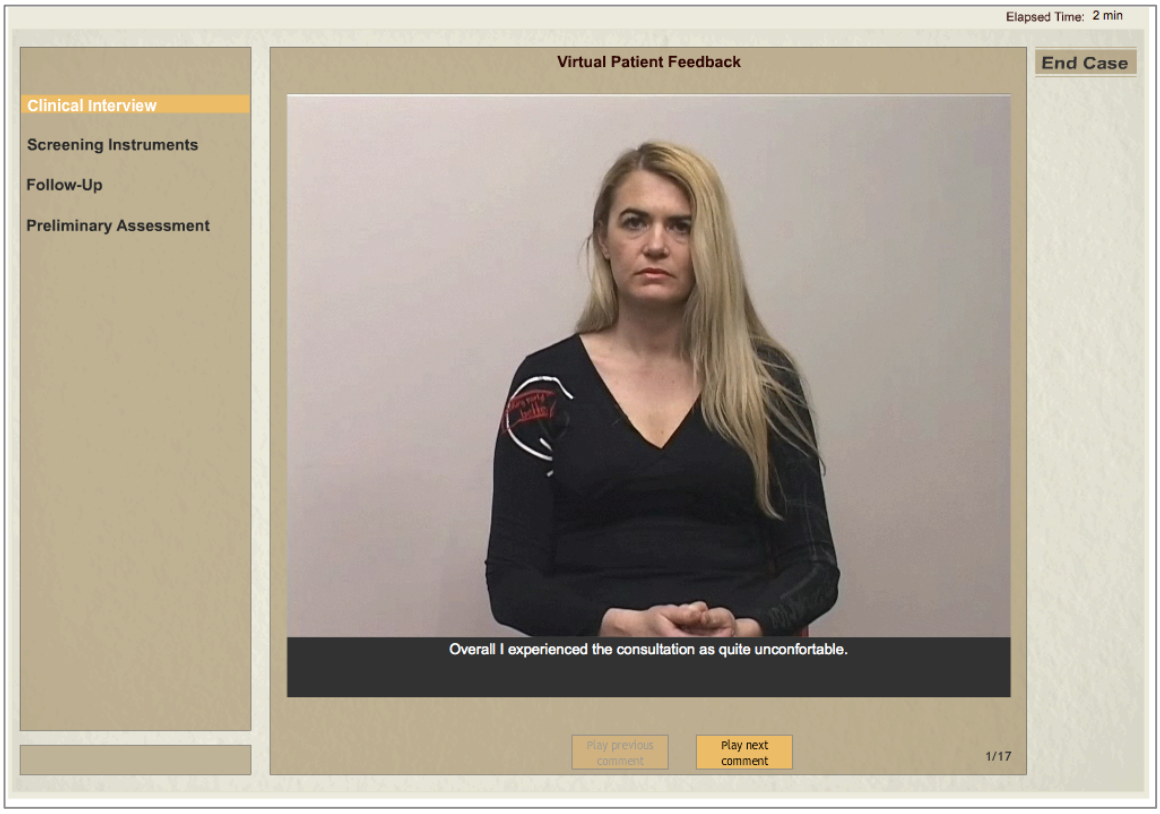

Figure 7. Screenshot depicting the VP delivering the individualised and automated feedback to the user (Pantziaras et al., 2014)

The feedback from the VP was followed by (2) the individualised and automated feedback by a Virtual Advisor (VA). This formative feedback was presented in text form and generated once again depending on the learner's management of the case. It focused on clinical aspects of the case (i.e. whether the user asked relevant question in order to penetrate the diagnostic criteria of PTSD) but also on basic communication skills (i.e. the appropriate use of mirroring during the clinical interview) and provided recommendations for improvements if warranted.

For example, in a case where the learner had not sufficiently examined the patient's trauma history during the history-taking module, the VA would comment:

> 'I do not think that you sufficiently examined the patient's trauma history by asking enough relevant questions about traumatic events. This is important in order to investigate exposure to events that could involve actual or threatened death or serious injury, or a threat to the physical integrity of self or others. If the patient reacted with intense fear, helplessness or horror during such exposure, the first criterion for PTSD according to DSM-IV-TR has been fulfilled.'

3.2 GENERAL STUDY DESIGN

3.2.1 Study Population

3.2.1.1 Phase 1: Study I (Pilot Study)

For phase 1, our participants were obtained through sending out an invitation by e-mail to all medical doctors (n=92) working as residents in psychiatry in two major university hospitals in Sweden (Karolinska University Hospital in Stockholm and Uppsala University Hospital). Eleven psychiatry residents in total (5 males and 6 females) agreed to participate. In order to achieve an equal distribution of gender, 1 male resident doctor in General Medicine with working experience in psychiatry was also approached and agreed to participate which made the total number of participants in the pilot study 12 (50% males and 50% females). The mean age was 32 years (men: 31.5 years; women: 32.5 years) while the ethnicity of 75% of our participants was Swedish and 25% had a foreign background (all were Europeans).

3.2.1.2 Phase 2: Studies II, III and IV

For phase 2, e-mail invitations were sent to all active resident psychiatrists by the directors of studies at the Karolinska University Hospital, Stockholm (Huddinge and Solna) and the University Hospital in Linköping.

IT Proficiency	**All (N=32) (%)**	**F (N=20) (%)**	**M (N= 12) (%)**
My skills on using computers is:			
Non existent	0	0	0
Low (only e-mails)	3	5	0
Medium (e-mails, word)	59	70	42
High (Excel, graphics)	31	20	50
Expert	6	5	8
During the last year, I have played computer / video games			
Not at all	34	35	33
Rarely	34	50	8
Sometimes (every month)	16	5	33
Often (every week)	13	5	25
Very often (daily)	3	5	0
During the last 5 years I trained using some kind of medical simulation			
Not at all	41	45	33
Rarely	56	55	58
Sometimes (every month)	3	0	8
Often (every week)	0	0	0
Very often (daily)	0	0	0

Table 1. Self-reported IT proficiency and experience (percentage distribution). F: Female Participants, M: Male Participants (Pantziaras, et al., 2014).

All residents (n=32) that were not engaged by other clinical or educational duties at the time of the study agreed to participate. Twenty out of 32 participants (62.5%) were women and 12 (37.5%) were men. Their mean age was 35.6 years (female: 35.5, men: 35.9) while mean time of working experience as psychiatry residents was 2.3 years (female: 2.4, men: 2.1). No statistically significant differences in age and working experience were observed between male and female participants.

Regarding experience using information technology (IT) and computing, male participants generally had a higher self-reported proficiency in using computers and more experience in playing video games. Table 1 demonstrates the participants' self-reported IT proficiency and experience.

3.2.2 Procedure during Study I (Pilot Study)

The participants of Study I obtained access to an on-line client-based web version of the prototype α with an individual login and password, which made it accessible from the participant's home or office. Upon logging in for the first time, the participants were asked to fill in an on-line pre-interaction version of a questionnaire (later on referred to as the KI-VP-Learning Experience Questionnaire). That procedure was a requirement in order to continue onto the main system and interact with the VP. There was no technical possibility to complete any pre-test measures after submission of this questionnaire and once the VP interaction had started. The participants were then invited to interact with the VP and complete the "Mrs. K." case. Directly upon completion they gained access to and were asked to fill out the on-line post-interaction version of the KI-VP-LEQ aiming to provide insights/feedback about perceived usefulness and educational value.

3.2.3 Procedure during studies II, III and IV

Figure 8. Study setting at Karolinska Institutet, 17th April 2013. Photo by Ioannis Pantziaras.

Data for phase 2 of this thesis (studies II, III and IV) were collected during three occasions (at the Karolinska University Hospital in Solna and Huddinge as well as the University Hospital of Linköping), in quiet group rooms where the participants had access to stationary or laptop computers and wired headphones (Figure 8). Upon signing the informed consent form, all participants were asked to complete a paper-based pre-interaction version of our evaluation questionnaires. They were then given access to the RT-Sim VP system and were instructed to interact with the VP for up to 45 minutes (simulating the time availability in a real life clinical setting) and try to assess, as they would do in a real life clinical encounter. After interacting with the VP and reading through the provided feedback, the participants were asked to fill in the post-interaction version of the questionnaires.

3.3 METHODS FOR EACH PAPER (EVALUATION MEASUREMENTS)

In the following section the evaluation tools used in order to collect data for the four papers will be presented.

3.3.1 Study I (Pilot Study)

For Study I, we employed a mixed methodological approach with triangulation generating both quantitative and qualitative data (Sandelowski, Voils, Leeman & Crandel, 2012). More specifically, the following data was collected:

3.3.1.1 User interaction and activity log

All of the participants' interactions with the system - including the complete history of medical questions asked, physical examinations performed and lab tests ordered - were detailed, systematically and chronologically registered in log files. For an example of an actual user log-file please see Appendix 9.1.

3.3.1.2 KI-VP-Learning Experience Questionnaire (KI-VP-LEQ)

Pre-interaction version: The pre-interaction version of the KI-VP-LEQ included two sections: (a) the first section (called the 'Overview of Clinical World-view') aimed to examine the participants' self-reported emphasis given to different aspects of clinical care during a "real life" medical examination. The self-reported overview of the clinical worldview encompasses different dimensions of clinical care, rated by level of emphasis on a scale from 1 ('no emphasis') to 5 ('full emphasis'). This questionnaire consisted of 10 questions divided in two parts depicting the level of emphasis the clinician usually places on data collected during the medical examination (chief complaint, history of present illness, physical examination, mental status examination, laboratory tests and traditional healing examination) and on root causes of the disease (biological, psychological, social and spiritual/existential).

(b) The second section of the pre-interaction version of the KI-VP-LEQ aimed to give light to the participants' preconceptions, attitudes and expectations about the VP system by collecting baseline data on a 7-point Likert scale consisting of 19 items examining current cognitive and affective states before the session with the VP. These items consisted either by statements (i.e. 'I feel self-confident', 'I am sure I will succeed very well in this exercise') with response sets '1 = Highly disagree; 7 = Highly agree' or as a range of emotions answering the question 'How would you describe your emotions right now?' with response sets i.e. '1 = stressed; 7 = relaxed'.

Post-interaction version: The post-interaction version of KI-VP-LEQ (which was completed on-line directly upon completion of the case) aimed to reflect the participants' actual cognitive and affective states during the session with the VP by using 16 items on a 7-point Likert scale (i.e. 'I felt deeply engaged in the tasks during the exercise' and 'I experienced this exercise as realistic') with response set '1 = Highly disagree; 7 = Highly agree'. It also included open-ended questions about the perceived quality and usefulness of the VP-program as well as general opinions about the learning experience (i.e. 'What are your first impressions and comments?' and 'What needs to be improved in the design of a VP case with a refugee trauma background?'). In order to address factors that contributed or would contribute to the VP being experienced as realistic we asked the participants to rate 9 different aspects or components of the system (i.e. interactivity, authenticity or recorded voice) with response set '1 = Does not contribute at all; 7 = Highly contributes'. The same inquiry applied for identifying the most important clinical dimensions to be assessed in the summative feedback.

In preliminary studies, construct items used in the KI-VP-LEQ demonstrated high reliability and criterion validity (Courteille, 2008; Winberg & Hedman, 2008).

3.3.1.3 Telephone Interviews

Individual in-depth follow-up interviews by telephone were also conducted in order to get further insights into participants' learning experience with and attitude towards the VP. An interview guideline, which was prepared by the research team, was used consisting of open-ended questions about the participants' perception of the usefulness and educational potentials of the VP case, perceived engagement, student's empowerment, virtual interpreter, virtual advisor and feedback.

3.3.2 Study II

3.3.2.1 KI-VP-Learning Experience Questionnaire (KI-VP-LEQ)

In Study II, before the interaction with the VP the participants completed a paper version of the pre-interaction KI-VP-LEQ which was identical to the version described above except that it had an additional section which examined the participants' previous experience with IT and computing, Virtual Simulations, gaming and general attitude towards using simulation as a part of medical education.

When the interaction with the VP was completed, the post-interaction version of KI-VP-LEQ was handed out to each participant. This version consisted of 25 Likert items (identical to those used in Study I) that aimed to provide insights about the participant's actual experience during the interactive session as well as open-ended questions about the perceived usefulness and educational value of the system.

3.3.2.2 Telephone Interviews

Three to four weeks after the interactive session with the VP, individual semi-structured telephone interviews were conducted in order to further investigate the participants' experience, perceptions, and attitudes towards the system. We used the same interview guide that was piloted during Study I (the pilot study). The interviews were audio-recorded and had a mean duration of 19 minutes and 21 seconds (minimum: 11 min, 46 s; maximum: 30 min, 2 s).

3.3.3 Study III

3.3.3.1 HPRT Confidence Questionnaire

In order to investigate the participants' confidence in providing medical care for traumatised refugee patients pre- and post-interaction in Study III, we used a revised instrument developed by the Harvard Program for Refugee Trauma (HPRT) that examines confidence in different aspects of providing medical care for refugee patients with mental disorders. These aspects include the ability to discuss health and illness, to communicate with the patient and to assess the effects of diet and exercise on health. Additionally it examines aspects involved with conducting related research and teaching activities.

This validated, self-administered instrument, which I will refer to as the 'HPRT Confidence Questionnaire', consists of 64 six-point Likert items and takes approximately 30 minutes to complete. All items measure the physician's confidence in performing certain medical

procedures by asking: 'How confident are you that you can...' and scoring from 1 (being not at all confident) to 6 (being extremely confident). This questionnaire has been extensively used by HPRT for evaluating the effects of training programs for local health providers in countries like Cambodia (Henderson et al., 2005).

The HPRT confidence questionnaire was revised accordingly by excluding 20 items that were considered to be irrelevant to the objectives of this study, i.e. those that examined aspects involved with conducting research and teaching.

3.3.4 Study IV

3.3.4.1 Pre- and Post-interaction Knowledge Test

The pre- and post-interaction evaluation outcome in Study IV was a knowledge test created by the author consisting of eleven multiple-choice items that were related to the following areas: diagnostic criteria of PTSD according to the DSM-IV, clinical management of patients with PTSD, and theoretical aspects of basic communication skills. Multiple response items, where more than one answer was considered correct, were stated as such.

One out of the 11 multiple-choice items for example was:

Symptoms of increasing arousal are present in patients with PTSD. Which of the following is NOT a symptom of increasing arousal?

- Sleeping difficulties
- Concentration difficulties
- Visual hallucinations (correct answer)
- Irritation

3.3.4.2 Follow-up Knowledge Test

A third follow-up test - hosted at the Karolinska Institutet's web-based learning management system (Ping-Pong) - was administered some weeks later. It consisted of identical multiple-choice items similar to the pre- and post-interaction version presented in a randomised order. Instructions were given to the participants that no external help was allowed during the follow-up online test.

3.4 DATA ANALYSIS

Quantitative and qualitative data were collected for phase 1 and phase 2 of this thesis and therefore a mixed methodology (Sandelowski, Volis, Leeman & Grandell, 2012) was used for statistical and qualitative analyses. Quantitative and qualitative methods strengthen each other e.g. qualitative citations are supported by statistical results (Creswell, 2013).

3.4.1 Quantitative Analysis

Stata/IC 12.1 for Mac (Stata Corp, TX, USA) was used for statistical analysis of the quantitative data acquired from the pre- and post-interaction versions of the questionnaires described in previous chapters. Descriptive statistics were used to analyse demographic data

(i.e. age, working experience, IT competency) as well as for computing the median values of all Likert items included in the KI-VP-LEQ (Study I and II). In Study II, a sign test was performed in order to test the hypothesis that there were no significant differences in the medians of pre- and post-interaction items.

In Study III the matched-pair t-test was used to estimate changes between pre- and post-interaction values of self-reported confidence. P-values ≤ 0.05 were considered as evidence of statistical significance. Effect sizes were calculated by using the following equation:

$$\text{Cohen's d} = |M|/SD$$

where M is the mean of differences (Δ), and SD is the standard deviation of differences. Effect size was interpreted according to the standard interpretation suggested by Cohen (2013): 0.8 = large (8/10 of a standard deviation unit); 0.5 = moderate (1/2 of a standard deviation); 0.2 = small (1/5 of a standard deviation).

All of the items (n=44) of the HPRT confidence questionnaire were classified into 4 clusters that were comprised of similar items depicting 4 different aspects of medical care for traumatised refugee patients. Cronbach's α was calculated for each cluster as well as for the whole HPRT confidence questionnaire in order to examine the internal consistency for the questionnaire and each cluster distinctly. Cronbach's $\alpha > 0.7$ was regarded as evidence for good internal consistency (Santos, 1999). The matched-pair t-test was used to estimate changes between pre- and post-test values of self-reported confidence overall, by gender and by working experience.

In Study IV, a matched-pair t-test was used in order to estimate changes in the scores between pre-interaction, post-interaction and follow-up knowledge tests. P-values ≤ 0.05 were once again regarded as evidence of statistical significance.

3.4.2 Qualitative Analysis

The audio-recorded telephone interview data were transcribed and analysed according to a revised inductive content analysis based on Granheim and Lundman's model (2004). The research team repeatedly read through the transcribed interviews in order to organise the qualitative data by applying open coding and creating a theme, categories and subcategories (see Paper II). Quotations from the participants' replies were presented under the "Results" sections of Paper I and II in order to illustrate the feelings and reactions towards the VP system.

3.5 ETHICAL CONSIDERATIONS AND ETHICAL CLEARANCES

A complete ethical application was applied for to the Stockholm Regional Ethics Review Board (EPN). The Board examined this research project and its protocol and determined that because the project did not include any sensitive personal data and it was not considered research according to the ethics law, formal ethical approval was not required. A positive advisory opinion was obtained for this study (registration number: 2011/321-31/3) and all ethical considerations were followed during the recruitment procedure and all steps of planning, performing and analysing the data. The participants received a detailed information sheet and signed a consent form prior to their participation in the study, which was voluntary and included the right to withdraw at any time without needing an explanation.

A separate application was submitted to and approved by the Legal Counsel (PUL) at the University Administration of the Karolinska Institutet, since during follow-up the research team had access to information about the participants' ages, sex, e-mail addresses and working experience. This information falls under the definition of a research register bank according to the Personal Data Act (SFS, 1998).

4 SUMMARY OF RESULTS

In the following chapter a summary of results for each of the four studies are presented. These are: the pilot study (Paper I), the study on the learners' expectations and attitudes towards the prototype β of the proposed VP system (Paper II), the impact on resident psychiatrists' confidence in providing medical care for refugee trauma psychiatric patients (Paper III) and the impact that the VP system had on their knowledge about PTSD and other trauma-related conditions as well as basic communication skills (Paper IV).

4.1 PAPER I (PILOT STUDY)

The pilot study (Paper I) evaluated user acceptance and the educational potential of the preliminary version (prototype α) of the proposed VP system. It reported perceptions and emotional reactions towards the VP during the learning experience, participants' attitudes to and expectations about the VP, and it gathered suggestions for further improvements. The VP system's validity (face validity and construct validity) was also examined.

Scores across our sample were high regarding the realistic nature of the VP system (5 on a 7-point scale, median value) as well as the ability of the VP to evoke emotional reactions, as measured by the question 'How would you describe your emotions during the exercise?' with response rate '1 = not moved; 7 = moved', (4 on a 7-point scale, median value). The participants reported that the system provided a good environment for the safe training of clinical and communicative skills and had the ability to mirror the course of a real clinical investigation (6 on a 7-point scale, median value). Figure 9 demonstrates the factors that contributed to the VP being experienced as realistic by the participants.

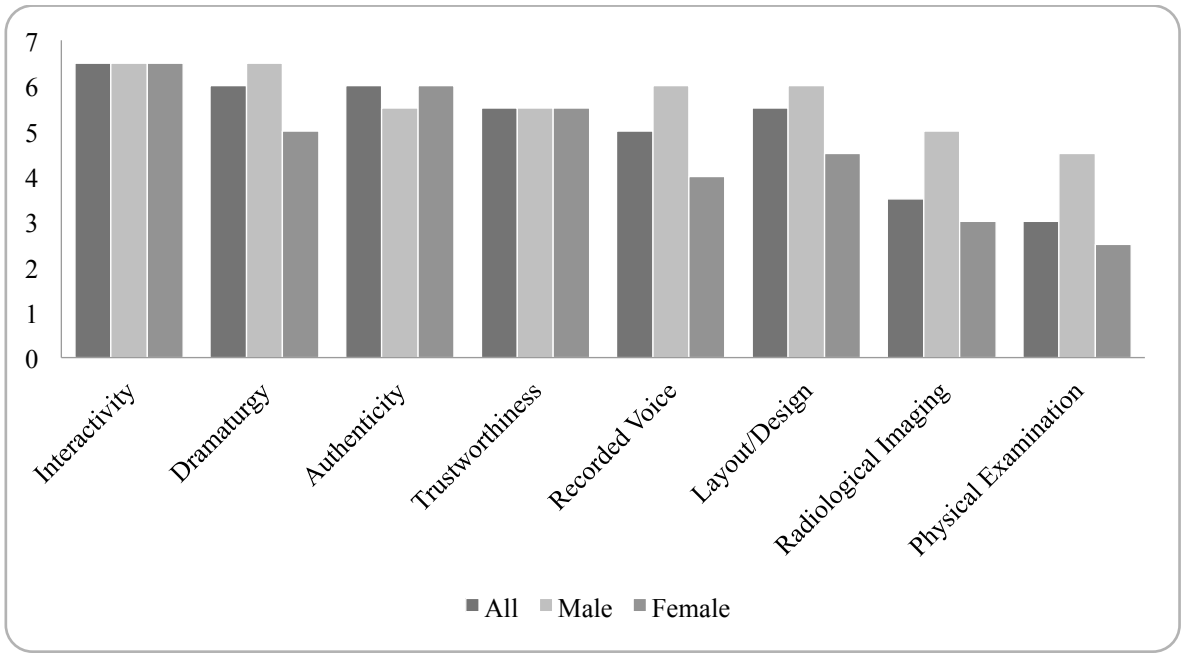

Figure 9. Factors that contributed to the VP being experienced as realistic (1 = 'Does not contribute at all'; 7 = 'Contributes highly'). N = 8 (Median values) (Pantziaras et al., 2012).

The system's face and construct validity were also demonstrated. More specifically, the participants' positive attitude favoured the system's face validity (i.e. whether the system was experienced as be doing what it is supposed to do). The observed correlation between the

participants' actual performance during the interaction with the VP and their self-reported rating of clinical overview indicated an acceptable construct validity in that it can reflect the participants' attitudes not only during the interaction in the virtual environment but also in real life.

Future improvements that were proposed by the participants included the implementation of detailed delayed feedback from a Virtual Advisor and/or the Virtual Patient him/herself (regarding the way the VP experienced the interaction and management of the case), the use of video-simulated patients and the ability to formulate own questions in free text.

4.2 PAPER II

In paper II we evaluated the participants´ expectations, attitudes and emotions towards the second version of the proposed VP system (prototype β).

Table 2 shows the participants´ responses regarding their expectations of the VP before the actual interaction as well as their attitudes during the virtual consultation. In general, the participants responded in a very positive way towards this improved version of our VP system and ranked it high in terms of experienced realism (median value 4 on a 5-point scale), engagement (median value 4.5 on a 5-point scale) and concentration (median value 5 on a 5-point scale). The experienced realism was actually rated significantly higher than the expected realism of the system, demonstrating that the system surpassed the participants´ expectation. The experienced realism was also commented upon repeatedly during the follow-up telephone interviews:

> 'I think that it actually felt pretty real. There is a difference compared to a real patient in that (with the VP) you aren't as eager to find a solution. You can keep a cool head and think a bit more. But absolutely, I think it felt real.' (Participant 20)

The participants felt that the VP system was structured in a way that parallels a real clinical investigation and provided an opportunity for them to apply their knowledge (median value of 4 on a 5-point scale). The whole interactive learning experience was perceived positively and highly rated as 'fun, exciting and pleasant' while the participants' reactions were described as 'engaged' and 'touched'.

> 'I was very touched by the Virtual Patient. It was a pleasant surprise, I think, that one can actually get so much out of it – it felt like I really wanted things to go well for her. It was a pleasant surprise – it didn't feel like just an exercise and not a real person.' (Participant 13)

Pre-test	Median (Range)	Post-test	Median (Range)	Significance
I know exactly what is expected of me during the exercise	3.5 (1–5)	I knew exactly what was expected from me during the exercise	4 (1–5)	NS
I wish I was doing something else right now	2 (1–3)	I wished I had done something else during the exercise	1 (1–4)	0.03
I feel frustrated right now before the exercise	2 (1–5)	I felt frustrated during the exercise	2 (1–4)	NS
I feel that I have full control of the forthcoming exercise	3 (1–5)	I felt that I had full control of the exercise	3 (2–5)	NS
I am going to be deeply engaged during the exercise	4 (3–5)	I was deeply engaged during the exercise	4.5 (3–5)	0.006
I am going to concentrate intensely during the exercise	4 (3–5)	I was concentrating intensely during the exercise	5 (3–5)	0.01
I feel self-confident	3 (2–5)	I felt self-confident	3 (2–5)	NS
I am going to experience this exercise as realistic	3 (1–5)	I experienced this exercise as realistic	4 (1–5)	0.03
I will forget everything that will be going on around me	3 (1–5)	I forgot everything that was going on around me	4 (1–4)	0.02

Table 2. Attitudes and perceptions. Self-reported expected (pre-test questionnaire) and experienced (post-test questionnaire) attitudes and perceptions towards the VP system (1 = 'highly disagree', 5 = 'highly agree') (Median values). NS: Non-Significant. (Pantziaras, et al., 2014).

The feedback provided by the VP and the virtual advisor was considered to be a very important element of the prototype β and a vital improvement. The participants rated its importance with a median of 5 on a 5-point scale (1 = not important, 5 = very important).

> 'It was really good. A supervisor would probably not be so explicit, fearing that I would get insulted. I think it was good that the feedback was so detailed about what I did wrong without worrying if I would get offended. This is exactly why I would use this system again. At the same time I didn't take this criticism personally and I didn't feel that I had to explain myself, which was great!' (Participant 12)

When the participants were asked to compare the proposed VP system with a traditional paper case, they rated it as much better (median of 5 on a 5-point scale: '1 = much worse, 5 = much better').

4.3 PAPER III

In paper III we examined whether a training session with the proposed VP system leads to improvement in the participants' confidence in providing medical care for traumatised refugee patients with psychiatric symptoms.

The 44 items of the HPRT confidence questionnaire were classified in 4 different clusters representing 4 different aspects of medical care for traumatised refugee patients. Table 3 presents the four clusters, number of items included, and the estimated Cronbach's α.

A statistically significant improvement was exhibited in overall confidence (mean Δ: 0.34; $p<0.0001$; d: 0.89). In all 4 specific domains of clinical care, significant improvement was also exhibited, with the area of identifying and evaluating trauma-related diagnoses and disability showing the most prominent improvement (mean Δ: 0.47; $p<0.0001$; d: 1.00). This was followed by the confidence in trading and managing victims of torture (mean Δ: 0.46; $p=0.0006$; d: 0.67).

Cluster	Examples of included items	Items (N)	Cronbach-α
Identify and evaluate trauma-related diagnoses and disability	Identify post-traumatic stress disorder (PTSD); Ask about the patient's/client's "trauma story"; Use screening instruments	12	0.90
Treat and manage trauma-related diagnoses and disability	Treat trauma-related disability; Reinforce and teach positive coping behaviours for patients; Effectively use psycho-therapeutic medications	16	0.92
Treat victims of torture	Treat the mental health problems of torture survivors; Care for the spiritual problems of torture survivors; Care for the legal problems of torture survivors	6	0.88
Elements of intercultural communication	Adapt your work to different cultures and societies; Work effectively with an interpreter; Be culturally attuned to differences in meaning and interpretation of emotional upset between cultures	5	0.87

Table 3. The four generated clusters of confidence with examples of items, number of included items (n) and Cronbach's α (Pantziaras et.al., 2015).

In general, there was an overall statistically significant improvement in all clusters. However, when analysed by gender, it was found that confidence among male participants regarding intercultural communication and treatment of torture victims had improved but was not statistically significant.

4.4 PAPER IV

In the last paper of this thesis (IV) we examined whether a single training session with the proposed virtual traumatised refugee patient system had an impact on knowledge building and retention of knowledge regarding PTSD and other trauma-related psychiatric disorders as well as the clinical management of this patient group and basic communication skills.

N	Data	Mean	SD	CI	t	P
All	Pre	7.44	0.31	6.8, 8.07		
N=32	Post	8.47	1.65	7.86, 9.06		
N=26	FU	8.38	2.02	7.57, 9.20		
	Pre vs. Post	-1.03	1.33	-1.51, -0.55	-4.38	**<.001**
	Post vs. FU	0.35	1.74	-0.36, 1.05	1.01	.32
	Pre vs. FU	-0.69	2.29	-1.61, 0.23	-1.54	.14
Male	Pre	7.08	2.02	5.80, 8.37		
N=12	Post	7.92	2.02	6.63, 9.2		
N=9	FU	8.00	2.45	6.12, 9.89		
	Pre vs. Post	-0.83	1.19	-1.59, -0.08	-2.42	**.03**
	Post vs. FU	0.11	2.02	-1.45, 1.67	0.16	.87
	Pre vs. FU	-0.67	2.00	-2.20, 0.87	-1.00	.35
Female	Pre	7.65	1.60	6.90, 8.40		
N=20	Post	8.80	1.32	8.18, 9.42		
N=17	FU	8.59	1.80	7.66, 9.52		
	Pre vs. Post	-1.15	1.42	-1.82, -0.48	-3.61	**.002**
	Post vs. FU	0.47	1.62	-0.36, 1.31	1.19	.25
	Pre vs. FU	-0.71	2.49	-1.99, 0.58	-1.17	.26

Table 4. Scores on pre-interaction (Pre), post-interaction (Post) and follow-up (FU) knowledge test, overall and by gender (Pantziaras et al., 2015).

All of the participants (N=32) completed the pre- and post-test knowledge test whereas 26 (81.25%) of them completed the online follow-up knowledge test. Table 4 shows the participants' mean scores on the three knowledge tests (pre-interaction, post-interaction and follow-up test that was performed after a mean time of 79 days).

The pre-interaction test´s mean score for all participants was 7.44 (male: 7.08, female: 7.65, no statistical significance) while the post-interaction mean score was found to be 8.47, which was significantly higher ($P < .001$).

The mean score for the follow-up knowledge test was 8.38, which was higher than the pre-test score by 0.69 points but not statistically significant. The follow-up score was 0.35 points lower than the post-interaction mean score, a difference that again was not statistically significant.

5 DISCUSSION

This chapter will present the four studies, starting with a commentary on the methods used, including the design of the proposed VP system. The results are then discussed with relation to the theoretical background and medical educational aspects, which is followed by a discussion of the limitations and strengths of this thesis.

5.1 ON METHOD

Were the methods used in this thesis applicable for exploring the educational aspects of this VP system that was designed as an education tool for training clinical management of traumatized refugee patients and basic communication skills?

5.1.1 The Virtual Patient System

Virtual patients are an extremely extensive term that fits many different entities ranging from simple multimedia case presentations to high fidelity software simulations (Talbot, Sagae, John & Rizzo, 2012). No previous VP systems included all of the features that we felt were necessary in order to have a system whose specific aim is to provide an efficient training environment for the clinical management of traumatised refugee patients. Therefore it was decided to create a new dedicated VP system that had the ability to feature specific screening instruments, which could provide individualised feedback by the VA and VP, and also included a virtual environment for training learners in history taking that was based on rules which could lead to increased trust between the VP and the user (please see below).

Modern advances in technology allow for the development of interactive interfaces which can produced real-time realistic physiological reactions to surgical or pharmacological interventions, or the ability to interact by recognising and producing natural language (Gratch, 2002) and can even understand (Morency et al., 2008) and synthesise non-verbal language such as gestures (Thiebaux et al., 2008). VPs that use this advanced artificial intelligence dialogue can be effectively used to simulate patients with various medical conditions (Triola et al., 2006), but this technology requires an extensive investment of time and resources.

In the proposed VP system we employed less complex technology for enabling the conversation between the user and the VP during the history-taking module, by using a list of different available questions that varied in their open-endedness and their relevance to the actual case. The users were able to scroll down and browse among the different categories of questions and to select those that they considered to be the most relevant and appropriate. By choosing specific questions, a number of follow-up questions were revealed which allowed for the opportunity to go into more detail regarding specific areas of the medical history. Each chosen question generated the playback of a pre-recorded video response. We also employed the use of a simple form of branching dialogue, based on the performance and actions of the user, that led to different responses based on the earned "trust level" (as described under the Methods chapter of this thesis). Despite not having the ability for dramatically different outcomes of the case, even with the varying responses from the VP based on the trust level, the system did provide a higher degree of realism. When this was

combined with some intentionally wrong or imperfect choices from the available questions, it could lead to better replay value of this system (Campbell et al., 2011). This narrative design for VPs has previously exhibited value in teaching communication skills (Bearman, Cesnik & Liddell, 2001).

Even if the text-based multiple-choice dialogue system can achieve high educational potential, our participants considered the use of voice recognition and the ability to freely formulate their own questions to be essential improvements for this system in the future. This confirms findings from previous studies which found that users who cannot freely construct their own dialogue with the VP experience being guided in a particular direction during the interactive conversational simulation (Hayes-Roth, Saker & Amano, 2009). Moreover, previous experimental studies have indicated that VPs with a natural language dialogue system provide not only a higher degree of realism but also a more profound and sustainable learning experience (Courteille, 2008). The implementation of a more advanced high-technology dialogue system based on artificial intelligence and the use of verbal and nonverbal channels should therefore be considered and studied in future versions of the proposed VP system.

5.1.1.1 The role of feedback

The automated individualised feedback provided by the VP system (prototype β) upon completion of the session was generally considered to be a valuable component. The feedback provided by the virtual advisor consisted of advice on clinical and communications skills while the one provided by the VP gave insight into the patient's perspective. The individuality of the provided feedback was meant to expose gaps in knowledge and clinical reasoning, aiming to raise the awareness about areas which needed improvement and hopefully direct the user on where to focus in their studies and clinical practice (Forsberg, Ziegert, Hult & Fors, 2014). It was thus presented in a way that could lead to changing the students' thinking, behaviour and knowledge with the ultimate goal being improved learning. There aims meet the criteria set out originally by Shute (2008) and that are necessary in order to be defined as formative, It additionally integrated short theoretical frameworks that were directly related to actions taken during the virtual session, aiming to facilitate core knowledge besides skills like decision-making and clinical reasoning.

5.1.2 On collected data

The participants for each of the studies which this thesis is based on were obtained in two phases: In the pilot study e-mail invitations were sent directly to all resident psychiatrists working at two major university hospitals in Sweden. For the second phase (paper II, III and IV) e-mail invitations that included information about the study were sent to the directors of studies for resident doctors at the Karolinska University Hospital in Stockholm and University Hospital in Linköping. The study directors invited their residents to participate in "study days" about transcultural psychiatry, where they had the opportunity to participate in this study and experience a training session with the proposed VP, which was followed by a lecture about different aspects of transcultural psychiatry held by Dr. Solvig Ekblad, my main supervisor. Although the respective study directors invited the participants, potential coercion is significantly improbable due to the nature of the role that the study directors have ("ST-

studierektor" in Swedish) in the Swedish medical educational system. Study directors primarily have a consultative role and are responsible for planning the studies of resident doctors and ensuring their quality, as well as offering advice and support to the residents and their supervisors during their residency (The Swedish Medical Association, 2006).

For all four studies, a single subject design was used, a method that is common in applied fields of education and psychology where subjects serve as their own controls (Cooper, Heron & Heward, 2007). This specific design can be effectively used to evaluate the impact of an intervention that has not been studied thoroughly, such as with VPs. The method provides some indication as to its effectiveness before planning larger-scale studies with other designs and populations.

Both qualitative and quantitative data were collected. For the analysis we applied triangulation of data methods in order to enhance credibility, dependability and confirmability (Sandelowski, Volis, Leeman & Grandell, 2012). For papers I and II, quantitative results from the KI-VP-LEQ questionnaire were used to investigate our research questions as well as crosschecking data and minimising potential distortion from the phone interviews conducted (Field & Morse, 1985). Construct items used in the KI-VP-LEQ demonstrated high reliability and criterion validity in preliminary studies (Courteille, 2008; Winberg & Hedman, 2008). For paper III, the overall HPRT Confidence Questionnaire as well as the generated clusters demonstrated very high Cronbach's alpha, which indicated a more than acceptable internal consistency and high reliability (overall α: 0.89).

5.2 ON RESULTS

In this section I will discuss whether the generated results presented in this thesis answered my four research questions. I will also discuss the most important aspects of the results from the four papers and potential limitations of this thesis.

5.2.1 User acceptance, expectations and attitudes

The results from the Pilot Study (Paper I) and Paper II demonstrated that the participants responded in a very positive way towards the prototype-α of this VP system and even more positively towards prototype-β.

In paper I, I examined the perceived usefulness and educational potential of the preliminary version (prototype α) of the proposed VP system, as discussed above, by collecting both quantitative and qualitative data. Overall and despite the technical limitations of the VP system (the patient was depicted as a still image and some questions did not generate any response by the VP), the participants exhibited a high level of acceptance and were satisfied with this tool. They felt that this educational tool had a lot of potential, especially when used early in medical training. One interesting aspect was the fact that female participants rated the system higher than men in terms of realism and reported higher engagement during the interaction with the VP. Male participants reported that they were more self-confident and active during the interaction compared with females. Past findings have stated that women (Schumacher & Moragan-Martin, 2001), especially female medical students (Kron, Gjerde, Sen & Fetters, 2010), have less experience with computers and may therefore be more easily impressed by new technology and excited when using it, but may at the same time feel less

confident and more passive. In Phase 2 of this thesis I collected baseline data about IT proficiency that confirmed those findings: 50% of our male participants self-reported «high knowledge on using computers» compared to 20% of female participants that self-reported the same level of knowledge.

The fact that the users perceived the system as doing what it was supposed to do (mirroring the course of a real clinical investigation, 6 on a 7-point scale, median value) favours the system's face validity. The data also indicated that the participants actually asked more history questions concerning the dimensions of clinical care which they had previously rated high regarding their importance. In other words, I observed that performance during the actual examination of the VP reflected the participants' self-reported attitudes and perceptions about possible root causes of the patient's symptomatology, giving support for the system's construct validity.

The fact that the participants considered that this virtual environment successfully mimicked a real life clinical situation is a very promising indicator of the system´s authenticity (Herrington & Herrington, 2006). This is very important since, according to the theoretical foundations of Situated Learning (Lave & Wenger, 1991), students can unintentionally acquire knowledge and skills by performing tasks in authentic learning environments (Lave, 1988). Similarly, it is very promising that the participants gave the system a high rating regarding the experienced realism. Especially for prototype-β (Paper II) the scores of experienced realism (as rated in the post-interaction questionnaire) were significantly higher than those of expected realism (as rated in the pre-interaction questionnaire). This can been interpreted as the system surpassing the participants´ expectations about how realistic a VP system can be.

Similarly, the participants were deeply engaged and concentrated intensely during the virtual interaction, reporting in a high degree that they forgot everything going on around them. These results verify previous reports from experimental research in the field of human-computer interaction, which found that highly engaging and challenging interactive media interfaces promote deeper motivation and concentration (Quinn, 2005). They also confirmed previous findings from computer-mediated communication research, stating that behavioural realism and the appearance of a virtual embodied agent (in our case the VP) has a direct impact on increasing involvement (Franceschi, Lee & Hinds, 2008) and emotional responsiveness of the user (Hubal, Kizakevich, Guinn, Merino & West, 2000). The role of emotional responsiveness and the affective dimension on learning outcomes has been previously studied with positive effects (Courteille, 2008). Moreover, emotionally loaded educational activities have been reported to have a positive impact on actual cognitive learning outcomes (Sansone & Morgan, 1992), a fact that is even discussed later on in this chapter.

5.2.2 Confidence in providing medical care to psychiatric refugee patients

In Paper III, I examined the impact of training with the VP system (prototype β) on the participants' confidence levels in different aspects of providing medical care for the socioeconomically vulnerable group of traumatised refugee psychiatric patients.

This study's importance is partly due to the fact that it is, to the best of my knowledge, the first published study to examine the impact of training with VPs on confidence levels when providing medical care for psychiatric patients in a broad context. Moreover the results indicated a significant improvement in overall confidence levels as well as in specific areas of providing medical care for this patient group.

More specifically, the participants reported significantly improved confidence in the following domains:

- in identifying and evaluating trauma-related diagnoses and disability,
- in treating and managing patients with trauma-related diagnoses and disability,
- in treating and managing victims of torture with mental illness, and
- in effectively using elements of intercultural communication in the clinical praxis.

The impact on confidence in these areas, as well as overall confidence levels, can at least partly be explained by the auto-generated individualised feedback provided by the VP system upon completion of the training session. Going through different domains of the case management the participants received either positive feedback explaining what was done correctly and why, or alternatively negative feedback accompanied by recommendations for further improvement. Moreover, the whole procedure of the interactive simulation allowed the user to actively train in a realistic clinical setting, acquiring knowledge and skills through the method of trial and error. At the same time, it must be stressed that the demonstrated improvement in confidence does not necessarily equal to an improvement of the actual competence. There are previously published results which indicate that doctors have a limited ability to self-assess their competence in an accurate way (Gorrindo et al., 2011; Brinkman, Tichelaar, van Agtmael, de Vries & Richir, 2015) and to identify inaccuracies in self-assessed measures (Lockyer, 2003). At the same time, there are also findings that demonstrate a strong correlation between self-rated cultural competence and patient satisfaction (Fernandez et al., 2004) as well as between self-reported 'sensitivity to emotional and psychological issues in patients' and the actual diagnosis of these issues in practice as audited by a blinded reviewer (Robbins, Kirmayer, Cathebras, Yaffe & Dworkind, 1994). These results could indicate that for at least some areas of medical care, self-reported confidence can be interpreted as a proxy for objectively assessed improvements in competence. Of course, more research is required in order to further investigate the relationship between self-reported confidence and actual objectively measured clinical competence.

5.2.3 Cognitive outcomes: building and retaining knowledge

While the impact of training with VPs on skills such as clinical reasoning and decision-making has been studied quite thoroughly, we know a lot less about their effectiveness on building and retaining core knowledge about different domains of medicine. It has been previously suggested that this methodology is not ideal for facilitating core knowledge due to potential cognitive overload and the fact that less interactive methods might be more effective (Cook & Triola, 2009). One previous study, the only one which could be found that examined this matter, evaluated the impact of training with VPs on knowledge about PTSD symptoms and found no change post-intervention compared to pre-intervention (Pataki et al., 2012).

In paper IV I evaluated the impact of training with the proposed VP system on the participant's core knowledge about PTSD symptomatology as well as clinical management and basic communication skills. The results, as presented in the previous chapter, exhibited a significant improvement of knowledge – as measured by the results of the provided knowledge test – immediately after the interactive session with the VP compared to pre-interaction. The results of the follow-up test, some weeks later, were still improved compared to pre-interaction although no longer significantly. Due to the fact that this study's participants did not receive any feedback about their answers after completion of the tests, we can rather safely conclude that the exhibited improvement depended on the actual training session and reflected actual knowledge gain rather than recall of the right answers.

Similarly to what previous research has suggested regarding other domains of medical education (McGuire, Hurley, Babbott & Butterworth, 1964), my results also indicate that a single training session with the VP system is not sufficient enough to provide a long-term impact on knowledge. We can therefore conclude that repeated sessions over time would likely generate longer-lasting results, and I propose future research about the impact of repeated sessions over a course of several months on the durability of acquired knowledge.

5.2.4 Future improvements of the VP system

Some future improvements were proposed in the comments and feedback provided by our participants, as collected in the qualitative part of the post-interaction KI-VP-LEQ questionnaire and the follow-up telephone interviews. This was despite the fact that, overall, the VP system was received in a very positive manner.

The most frequently discussed limitation of the VP system - and therefore a proposed improvement – was that participants were not able to freely formulate their own questions, comments or feedback either orally or in writing. This proposal is similar to previous findings from similar studies that showed that users who could not construct their own dialogue experienced a sense of being guided in a particular direction during the interactive conversation (Hayer-Roth et al., 2009). Implementing the ability to recognise verbal and even non-verbal input and engage in a rich in-depth conversation would most probably lead to a higher degree of realism and credibility (Stevens et al., 2006) and therefore more engagement and better learning outcomes. However, it must be stressed that the development of such a complex dialogue system involves the implementation of artificial intelligence and the use of highly technical expertise for the development of the supporting system's architecture. This is expensive and the economical factor must be weighted, since it has been already shown that a lot can also be achieved with less complicated – and easier to design – dialogue agents, including the one presented in this thesis.

Other improvements proposed by the participants that should be considered in future development of VP systems is the ability to save locally in a file and/or print the provided detailed feedback for future reference. Another proposal was the possibility to have access to the VP's medical records about previous contacts within the healthcare system and the ability to use it in modern devices, including touchscreen based handheld visual displays.

5.3 LIMITATIONS

A possible limitation of the methodology used in the four studies this thesis is based on i.e. the single subject design with pre-post measures where the participants serve as their own controls is its inability to show how a control group receiving another form of intervention would perform. However, this design is extensively used in areas that have not been studied in-depth in order to provide the necessary results before planning larger-scale studies. Moreover, it has been shown (Cook & Triola, 2009) that in this research area it is extremely hard to compare with a control group that receives other forms of traditional education (i.e. lectures) since skills like clinical reasoning demand exposure to the actual situation (as provided by real-life clinical practice or simulations). A possible control group in future studies would appropriately receive training by using standardised patients (SPs).

Another limitation of this thesis includes the rather small number of participants, which partly limits the generalizability about certain sub-groups such as gender, work experience and IT proficiency. However the study population is considered to be representative of the specific target group (resident doctors in psychiatry) since it included the majority of the active resident doctors in the three participating University hospitals at the time of the studies. Due to the non-random nature of our sample, selection-bias cannot be ruled out.

Regarding papers I and II, one limitation is that the outcome was self-reported and therefore subjective. The findings were not in any way supported by objective external observations or registration of data (i.e. physiological measurements) that would shed more light on parameters such as emotional engagement, flow of user interaction and other attitudes towards the VP. This should be taken into consideration when designing future relevant studies.

In paper III, as already discussed in a previous chapter, a significant limitation is the fact that the demonstrated self-reported improvement in the participant's confidence in providing medical care for this vulnerable patient group does not automatically mean that there was an improvement of the actual competence, as it would if measured by actual patient outcomes or external observation and assessment. An interesting aspect of this thesis would be to examine whether there was an association between self-reported improvement of confidence and actual improvement in cognitive outcomes as presented in paper IV, but unfortunately the rather small sample did not allow for that kind of statistical analysis.

Regarding paper IV, one limitation that we cannot rule out is the possibility that the participants, despite clear instructions, used external help during the follow-up test. Since it was conducted online and in a non-controlled environment this may have been possible and means they could have scored higher than they would have in a controlled environment.

6 CONCLUSION

This thesis described the development of a new educational instrument based on the technology of virtual patients. Results from the pilot study (paper I), which examined the preliminary version (prototype-α) regarding user acceptance, educational potentials and its validity were presented. The participants' expectations and attitudes towards the new and improved version (prototype-β), designed as a medical education tool for training clinical management of vulnerable refugee patients with traumatic life experiences and psychiatric symptomatology, were then investigated. The study also focused on the impact of an interactive training session with this VP system on the participants' confidence levels in different domains of providing clinical care for this patient group. Finally, I investigated whether training with this VP system had any actual impact on learning outcomes about trauma related diagnoses, the clinical management of traumatised refugee patients and basic communication skills.

My conclusion, based on the results of the four studies presented in this thesis, is that the proposed VP system demonstrated high acceptance among our participants (resident doctors in psychiatry) and has great potential as a training tool for clinical management of this patient group. The participants were highly engaged and focused during the training session and reported high scores for realism regarding the nature of the interactive experience. They reported having an emotional attachment towards the VP, and the system scored high in terms of its ability to resemble a real life clinical consultation. The provided delayed summative, automated and individualised feedback was seen as a valuable element of the system and a valuable source of knowledge.

After a training session with the VP system, the participants reported significantly increased confidence levels in providing psychiatric medical care for traumatised refugee patients overall as well as in specific domains including i.e. the ability to identify and evaluate trauma-related diagnoses and disability as well as in treating and managing survivors of torture. They also exhibited a significant improvement in core knowledge about trauma-related diagnoses including PTSD, clinical management of this patient group and basic communication skills after a training session with the VP system. This improvement was sustained – but not to a significant degree – several weeks after the training session. Therefore one could assume that repeated training sessions with VPs are required in order to achieve educational effects which are sustainable over time.

6.1 FUTURE IMPLICATIONS FOR MEDICAL EDUCATION

Based on the results presented in this thesis, I propose that VPs can be a valuable addition to current medical curricula as a safe educational environment for training clinical management of traumatised refugee patients. More specifically I propose a VP model that combines experiential learning as presented by Kolb (2014) through active training in a very realistic virtual environment, which is further enhanced by an integrated, automated and individualised formative feedback module. This feedback module should provide short theoretical frameworks that can facilitate the acquisition of core knowledge in addition to the enhancement of skills including clinical reasoning and decision-making.

VPs may never completely replace encounters with real patients, but most research studies tend to agree that blended learning, i.e. the creative combination of live patients, traditional learning methods and simulation, is the future (Papadopoulos, Pentzou, Louloudiadis & Tsiatsos, 2013; Jeffries & Hugget, 2010). VPs can provide a training environment that is available anytime and anywhere, and they offer the possibility of repeated performances in a reliable and standardised environment where learning by trial-and-error does not jeopardise patients' safety. Despite the fact that this thesis focused on the use of the proposed VP system among resident psychiatrists, I am rather confident that similar results and educational implications would apply to medical students as already demonstrated in a small-scale pilot study (Fransson, 2014). Our research team has also previously presented similar results among general practitioners in a study conducted in collaboration with HPRT in Boston (Ekblad, Mollica, Fors, Pantziaras & Lavelle, 2013).

Additionally I strongly believe that with further development and fine-tuning, VPs can be a useful complementary tool for assessing different aspects of psychiatry residents' clinical competence, as previously suggested in a published study (Fors et al., 2009), and even assist with psychotherapeutic methods and processes (Parsons, 2015). A realistic virtual environment that approximates a real clinical situation would be the ideal environment for assessing single or multiple domains of competence in a replicable and un-biased setting that does not depend on the random availability of real patients or the use of specially trained actors. The implementation of a fine-tuned and validated, advanced automated and individualised feedback module even make automatic assessment possible, eliminating the need for trained assessors.

6.2 FUTURE IMPLICATIONS FOR RESEARCH

Future studies should include randomised control studies with patient care outcomes and/or objective measures of medical competence as rated by an external trained observed in order to investigate the impact of training sessions with VPs on actual domains of medical competence. In this thesis, we examined the impact on self-reported confidence, which is considered by many to be a proxy to actual competence - at least regarding some aspects of medical care (including transcultural communication) as discussed above. On the other hand, other published studies have showed that no such correlation can be generally proved. More research about the relationship between confidence and competence is required in order to make the nature of this relationship clearer.

Other future studies should focus on examining the impact of contextual factors on learning with VPs (i.e. working with VP systems collaboratively in pairs or groups, locally or online, integrating sociocultural and gender aspects as components of the learning process and in different educational settings). As it was reported by Ellaway, Pusic, Yavner & Kalet (2014), educational interventions are highly influenced by the context where they are applied (i.e. the way the intervention is implemented, the way students interact with the intervention, the way the students perceive the intervention and the nature of the design of the intervention). This shows that the intervention itself is only one element of a complex educational ecology. In general, research should also focus on "how" VPs work to complement studies that explore "if" they work, taking into consideration the proposed theoretical frameworks including the activity perspectives and activity theory (Ellaway, 2014).

Cognitive outcomes should also be examined after repeated training sessions with the VP system over a course of at least 6 months in order to evaluate the sustainability of the gained knowledge over time. Moreover, I propose studying the degree of experienced emotional responsiveness, attachment, engagement and coping behaviours towards the VP by the use of externally measured objective outcomes, including physiological measurements (e.g. Galvanic Skin Response, EEG, Respiratory Rate) or analysing facial expressions through video recording participants in order to investigate the VP system´s actual ability to provoke those feelings that hopefully lead to better learning outcomes.

One potential disadvantage of VPs is that they might be very expensive to develop (Saleh, 2010). It is therefore important that future research focuses on more cost-effective ways to author, develop and publish VPs, limiting high costs due to technical expertise and required equipment. It has been suggested that allowing learners to customise the content of VP cases can be both cost-effective and may better suit their needs, as they won't have to depend exclusively on the authors to create new cases (Dafli, Antoniou, Ioannidis, Dombros, Topps & Bamidis, 2015; Heinrichs, Dev & Davies, 2014).

As the next step, our research team plans to conduct a large-scale study in order to examine the ability of the VP system to enhance empathy, after training with three different VP cases repeatedly over a period of six months. We also plan to study the effectiveness of subsequent lectures in groups given by our participants for their respective colleagues, as a way to spread further their acquired knowledge.

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9 APPENDIX

In this section, an example of a user log-file is demonstrated. The revised version of HPRT Confidence Questionnaire used for collecting data for paper III is presented, followed by the knowledge test that was developed by me under supervision by my main supervisor and used for paper IV.

9.1 EXAMPLE OF A USER LOG-FILE

This is an actual and unmodified log-file of a virtual session between one of the participants and the VP. In these automatically generated files all user interactions were saved, including the medical history, physical examination, labs / imaging, next steps and preliminary assessment.

CLINICAL HISTORY:

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Question: Hello
Answer: Good morning doctor

Question: I would like to ask you some questions about your health. Is
this okay with you?
Answer: I still do not understand why I am here.

Question: Would you like to describe your problem? I can also ask some
questions in order to find out how can I help you.
Answer: OK, please do so. I will try to answer.

Question: I would like to inform you that everything that we will talk
about together would stay in this room.  All information you tell me
is strictly confidential.
Answer: Thats good to know. It makes me feel a bit more secure.

Question: What is your name?
Answer: My name is Katarina

Question: Where do you live?
Answer: I rent an apartment in Tensta.

Question: Do you live alone?
Answer: I live together with my son.

Question: Where were you born?
Answer: I am from a village near Sarajevo…

Question: And when did you come to Sweden?
Answer: Sometime during 95… About fifteen years ago. My son was still
a child then.

Question: How old are you?
Answer: I am 45 years old

Question: Would you like to tell me what has happened to you and your
family before coming here?
Answer: Oh no, that is too hard to talk about now.

Question: Did you live with a big family back in your home country or
just your husband and children in your village?
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Answer: With my husband and our two children. My parents lived near as well as all my cousins and my husband's parents.

Question: Whom did you come to Sweden with?
Answer: It was only my child and I. My father was very sick and he stayed at the village, he could not move to Croatia, so he stayed with my mother.

Question: Did anything special happen that made you come to Sweden to live?
Answer: I would never come to Sweden if it weren't for the war. I mean it is nice in Sweden but I enjoyed life with my family in my village there.

Question: Are your parents alive? Where do they live?
Answer: My father died during the war (1992-1995) and my two old brothers were soldiers and died during the war. I have one older sister married in USA and one younger sister married in Croatia.

Question: How did your father die?
Answer: He had cancer. I think he had high blood pressure too.

Question: Have you any illnesses running in your family?
Answer: No, not really. My father died because of cancer in 1990. My mother is still in Bosnia and she has a high blood pressure and diabetes, I think.

Question: Is there anyone in your family who has any psychological problems or contact with psychiatry?
Answer: I am not sure. We didn't use to talk about things like that a lot in my family.

Question: Do you suffer from any disease?
Answer: No, but I have some pain in my right arm.

Question: Have you ever met a psychiatrist or psychologist?
Answer: No, never.

Question: Do you have any pain?
Answer: Yes, my right arm hurts from time to time.

Question: Have you ever had your arm examined by a doctor?
Answer: No, never.

Question: Do you have any headache?
Answer: Yes, all the time.

Question: Have you ever been wounded?
Answer: Yes one time. But it was a long time ago.

Question: When?
Answer: During the war… sometimes during 1995.

Question: How?
Answer: There was a bunch of soldiers who beat me and…

Question: And…? Would you like to describe what happened next?
Answer: I really don't want to talk about this right now.

Question: Have you ever been hospitalized?
Answer: No.

Question: Do you suffer in other ways?
Answer: Yes, I am tired.

Question: Have your health problems become worse since your arrival in Sweden?
Answer: Yes, very much so.

Question: In what ways?
Answer: In a lot of ways…

Question: Have you lost or gained weight during the last months?
Answer: I feel like I have lost weight, my clothes do not fit. But I don't have a weight to measure.

Question: How do you feel today?
Answer: I've been better...

Question: OK, I see that you are not feeling great. I will ask some questions that will help me to understand your problems a little bit better if this is all right with you.
Answer: OK

Question: When were the last time you felt really happy and healthy?
Answer: I do not even remember… when my daughter was born.

Question: When was your daughter born? How many years ago was that?
Answer: It was a long time ago when I gave birth to my little daughter…

Question: And then what happened that made things to change?
Answer: It began when the war began. My neighbors were not my neighbors. They did not like me any more and I have to say, I had a nice time with them and it changed.

Question: Do you have nightmares or dreams about the war?
Answer: Yes, but I do not really want to talk about this.

Question: How do you feel when you wake up in the mornings?
Answer: I am very tired. It feels like I don't want to get out of the bed.

Question: Can you describe your nightmares?
Answer: I don't feel really confortable to describe my nightmares right now…

Question: Do you feel stressed?
Answer: Yes, always.

Question: Do you feel nervous?
Answer: I feel very stressed and anxious.

Question: Do you feel jumpy or easily startled?
Answer: Sometimes.

Question: Have you experienced any problems with your memory? For example trouble recalling names or numbers?
Answer: Yes, I think I have many memory problems due to the war.

Question: Have you been depressed?
Answer: Yes, I have not been feeling that well during the last time.

Question: How long have you been feeling like that?

Answer: Well, its hard to say exactly. It really has been a long time since the last time I felt actually really well.

Question: Have you been feeling depressed for more than two weeks?
Answer: Yes, for sure. Every single day.

Question: Do you feel depressed most of the time during the day?
Answer: Yes, most of the day and every single day.

Question: Do you cry often?
Answer: I feel like crying very often. Mostly when I am at home alone and everyday when I wake up.

Question: Do you have little interest or pleasure in doing things?
Answer: I have lost my interest in doing things.

Question: Do you feel detached or withdrawn from people?
Answer: Yes, a bit. I don't feel I have the same relationship with my son like I used to have.

Question: Do you feel unable to feel emotions?
Answer: Well, you could say that I guess. I often feel that I cannot be glad or sad, even when something really intense happens.

Question: Do you have any difficulties concentrating?
Answer: All the time.

Question: Can you give an example of your difficulties concentrating?
Answer: Before I usually liked to knit, but I cannot concentrate here…

Question: Do you feel often irritable?
Answer: Really often. I used to be a calm person, but now I get angry often.

Question: Do you have often outbursts of anger?
Answer: No, not really. Well, sometimes when I quarrel with my son.

Question: Have you lost interest in daily activities?
Answer: Yes. Nothing feels like fun anymore. I just worry about things all the time.

Question: Do you have any difficulties performing work or daily tasks?
Answer: Oh yes. Everything is absolutely like an impossible task. I can't even perform the simplest housework. It feels like I have no energy left.

Question: It sounds like you struggle to do even simple things…
Answer: Most of the times

Question: Do you ever feel as if you don't have a future?
Answer: It feels like this almost whole of the time. My life has been destroyed and I see no light.

Question: Do you ever feel that you would be better off dead?
Answer: It comes often to my mind but I don't think that I would be able to end my life. I'm not that brave you know.

Question: Have you ever thought to end your life?
Answer: Well, no. My son needs me even if he doesn't show that. But it's not really fun to live with all those problems.

Question: I understand. Even though you are not feeling well you wouldn't consider ending your life since you have your son.
Answer: Yes, this is exactly what I mean doctor.

Question: Have you ever experienced war or any other combat situation?
Answer: Yes, in my country Bosnia Herzegovina. Our town was in center of ethnic cleansing you know. I have witnessed a lot of terrible things during the war.

Question: Can you tell me more about that?
Answer: What do you want to know?

Question: Do you feel that in your mind the war is still with you? Or can you move beyond it in Sweden?
Answer: I ask myself, why did it happen to me, am I a bad person? I use to ask myself. What do you think? Is it my fault? I am coward. Sometimes I think about suicide, but my religion does not allow and my son may need me, I do not know.

Question: Have you ever witnessed the murder of strangers?
Answer: War is a terrible thing…

Question: Have you ever witnessed the murder of someone you know?
Answer: Well, I wouldn't like to talk about it right now.

Question: Have you ever felt that your life was in danger?
Answer: Yes, I did… during the war in my country.

Question: Have you ever been kidnapped?
Answer: I guess you could say that. I was violently displaced from my village and family.

Question: Have you ever been tortured?
Answer: A lot happened during the war.

Question: Have you ever experienced any terrifying or hurtful events in Sweden?
Answer: Well,Ä¶ it was a bit frightening not speaking the language and being alone with my son when I came here, but not something really terrifying. But I do feel really alone here, just like no one understands what I'm going through,Ä¶ I have no one to support me.

Question: Do you ever have the feeling as though the events during the war are happening all over again?
Answer: Not really. But then sometimes I get afraid without knowing why. Well I guess you could say that I do have that feeling now and then.

Question: Do you avoid any activities that remind you of the war?
Answer: Well, I wouldn't read an article in the newspaper about the war. It brings back so many memories… So does now.

Question: Do you avoid any thoughts or feelings associated with the war or the time in the enemy camp?
Answer: Sometimes, it doesn't feel good to think about the past. I get so anxious.

Question: Do you experience any sudden emotional or physical reaction when reminded of the most hurtful or traumatic events?
Answer: Most of the times. I get very anxious and it often feels like I want to cry. My heart beats and I feel like shaking.

Question: Have you ever re-experienced the events during the war in any way?
Answer: What do you mean doctor? Can you give me any example?

Question: Do you ever experience recurrent thoughts or memories of the events during the war?
Answer: Yes, I think about the past often.

Question: Do you ever feel that people do not understand what happened to you?
Answer: Yes, I feel so alone. I don't think that anybody understands what I have been through. Not if they haven't been by themselves in a situation like mine anyway.

Question: Do you feel hopeless?
Answer: Yes. Why wouldn't I? Nothing is working in my life. I see no light in the tunnel.

Question: Do you feel ashamed of the events that have happened to you during the war?
Answer: Yes, I feel dirty.

Question: Have you ever been sexually abused?
Answer: No. I wouldn't like to talk about that kind of things now.

Question: Do you ever feel that you need to revenge?
Answer: I don't know what I could ever do to revenge. If I had the chance, maybe.

Question: Tell me about your religion/beliefs?
Answer: I am a Muslim, but I was never active with my religion in Bosnia.

Question: Would you consider yourself a religious person?
Answer: I have never been really religious. But my grandmother was, so I knew some things about religion but I never practiced.

Question: Do you have any friends here?
Answer: People are nice but I do not know them. I can speak with them 10 minutes and then I have to go, I am alone. It is not the same as in Bosnia, there I knew everybody.

Question: What do you work with?
Answer: I am a kind of a hostess in a club

Question: What did you work with before you came to Sweden?
Answer: I was a housewife

Question: What is your education?
Answer: I went to high school. But I always dreamt to become a teacher…

Question: How is your economical situation?
Answer: I have very little money and I need to pay a lot for the apartment, one of my sisters sends me money regularly.

Question: Do you have anyone that you trust?
Answer: Well, it feels like that I don't really have anyone I can talk with about everything.

Question: Do you feel that you have no one to rely on?
Answer: I feel really alone. I'm not sure if I can really rely to anyone.

Question: Do you feel that others are hostile toward you?
Answer: Sometimes.

Question: Do you ever feel that someone you trusted betrayed you?
Answer: No, not really. Well, maybe sometimes when I quarrel with my son I feel betrayed.

Question: Do you ever feel powerless to help others? Your family? Your son?
Answer: I can't do anything to help them. Whatever I do just feels wrong…

Question: Do you suffer in other ways?
Answer: I suffer actually in many ways. Just ask me what you want to know…

Question: What would help you to feel better?
Answer: Well I don't think that things could get better, I guess a better relation with my son would be the best thing for me to happen. And maybe a more decent job.

Question: What is the date today?
Answer: Well, let me think... I think it's the ... (she provides today's date correctly)

Question: Which year?
Answer: Year 2011.

Question: Where are we right now?
Answer: At the Karolinska Hospital

PHYSICAL EXAM:

INSPECTION:
Full body from front: No abnormalities
Head and neck, front: No abnormalities
Head and neck, back: No abnormalities
Back: No abnormalities
Right arm and hand: Right arm bruised and lightly swollen near the joint
Left arm and hand: No abnormalities
Right leg and foot: No abnormalities
Left leg and foot: No abnormalities

VITALS:
Blood pressure (Systolic/Diastolic): 160/100
Heart rate: 100 and regular
Temperature/fever: Normal
Body height / Weight: 165 cm / 68 kg

AUSCULTATION:
Respiration/Lungs: Normal
Heart: Normal
Stomach/Intestines: Normal

PALPATION:
Abdomen: Slightly obese with no abnormalities
Lymph nodes: Normal
Percussion: Normal

NEUROLOGICAL:
Reflexes: Normal
Sensation: Normal
Strength: Normal

LABS/IMAGING:

CHEMICAL CHEMISTRY:
Hb: 132 [Range 120-155 g/L]
Glucose: 5.2 [Range 4.0-6.0 mmol/L]
Thyroid metabolism: Normal
Electrolytes (Na, K): Na: 141 [Range 137-147 mmol/l]; K: 4,0 [Range 3,3-4,6 mmol/l]
CRP: 11 [Range <3 mg/L]
Creatinine: 62 [Range: <100 mmol/l]
Liver enzymes: Normal

PHYSIOLOGY:
ECG: Normal

IMAGING:
Right arm X-ray: Normal

Patient Screening: 0

NEXT STEPS

Referral: You sent a referral to a physiotherapist.

Reason for referral:
Need therapeutic contact, EMDR?

Diagnosis - Question:
PTSD and depression

History - Status:
Woman suffering from depression and PTSD, experienced war during formal Yugoslavia, been beaten and raped by soldiers, witnessed the death of her daughter and her husband disappeared during war. Suicidal thought, no actual plans. Needs psychiatric contact, possible antidepressant medicine and therapeutic contact.

Preliminary Assessment:

Reason for contact: Depressive symptoms

Past medical history: No

Family History: From Bosnia, lost her brothers and a daughter in war, husband disappeared. Father died in cancer. Both mother and father high blood pressure.

Social Situation: Lives with her son in expensive apartment. She works as a hostess in a club.

Current Medication: No

Current Problems: Concentration problems, sleeping problems, suffering from worrying all the time, flashbacks to the war.

Assessment: PTSD and Depression

Measures/Planning: Gives her a follow up time for myself, starts with antidepressant medicine, referred to psychiatrist and psychotherapist for follow-ups.

Preliminary Diagnosis #1: PTSD
Motivation Diagnosis #1: There is a trauma; she fulfills the symptoms of PTSD, with nightmares, flashbacks and so on.

Preliminary Diagnosis #2: Depression
Motivation Diagnosis #2: She also seems depressed and fulfills that diagnose also.

9.2 HPRT CONFIDENCE QUESTIONNAIRE [PAPER III]

The questionnaire was revised from Henderson et al. (2005). These questions are aimed at assessing your CONFIDENCE (i.e., your sense that you are capable of achieving the following):

Please rate your level of **confidence** where:

1 = Not at all **confident** ... 6 = Completely **confident**

How confident are you that you can:

1. Ask about the patients'/clients' "trauma story"

2. Identify the concrete physical and mental health effects of trauma

3. Identify post-traumatic stress disorder (PTSD)

4. Identify grief reactions

5. Identify depression

6. Identify trauma related disability

7. Treat PTSD

8. Treat grief reactions

9. Treat depression

10. Treat trauma related disability

11. Use screening instruments

12. Use Hopkins-Symptoms Checklist-25 and/or Harvard Trauma Questionnaire

13. Refer cases of serious mental illness

14. Reinforce and teach positive coping behaviours for patients/clients

15. Recommend altruism, work and spiritual activities to patients/clients

16. Reduce patient's/client's high risk behaviours

17. Effectively use psychotherapeutic medications

18. Provide close and scheduled follow-up visits

19. Be culturally attuned to differences in meaning and interpretation of emotional upset between cultures

20. Help patients/clients with disability related to financial/housing/food problems in violence victims

21. Intervene with a patient/client threatening to commit suicide

22. Treat a patient/client who is from a different ethnic group from yours

23. Identify and treat adult (>18) traumatized patients/clients

24. Reduce the physical and emotional stress in your daily practice associated with caring for torture/trauma survivors

25. Work effectively with an interpreter

26. Understand the folk diagnosis given by the community to the patient

27. Refer a patient to a psychiatrist, social worker, nurse, or job counsellor

28. Teach skills and train other health professionals

29. Go to rural areas and/or the field to treat patients/clients

30. Discuss ethnic, racial and diversity issues in the doctor-patient relationship

31. Use scientific journals as a reference for your work

32. Work effectively with evidence-based (i.e. scientifically proved) practices

33. Adapt your work to different cultures and societies

34. Develop an evaluation plan

35. Conduct evaluation

36. Maintain patients'/clients' privacy

37. Identify the medical problems of torture survivors

38. Identify the mental health problems of torture survivors

39. Treat the medical problems of torture survivors

40. Treat the mental health problems of torture survivors

41. Care for the psychosocial problems of torture survivors

42. Care for the legal problems of torture survivors

43. Care for the spiritual problems of torture survivors

44. Refer torture survivors to appropriate providers/services

9.3 KNOWLEDGE TEST [PAPER IV]

1. **During a psychiatric examination of a traumatised patient it is of interest to investigate the patient's physical health because (choose all that apply):**

A. Physical diseases can give symptoms that mimic psychiatric disorders. (X)
B. Exposure to trauma is a risk factor for different physical conditions like diabetes and heart diseases. (X)
C. You have to show to the patient that you are a "real" doctor.
D. You should take the patients physical health in consideration if you decide to prescribe pharmacological therapy. (X)

2. What is the required duration of the symptoms in order to set the PTSD diagnosis according to DSM-IV?

A. More than a month. (X)
B. More than a week.
C. More than three months.
D. More than six months.

3. Exposure to traumatic events can according to DSM-IV lead to PTSD if (choose all that apply):

A. The event involved actual or threatened death or serious injury (X)
B. The person involved reacted with intense fear, helplessness, or horror (X)
C. The event happened at least three months before the psychiatric examination.
D. The patient was not under the influence of drugs during the exposure to the event.

4. An important communication skill is called "mirroring". What's this?

A. To repeat all the details the patient has said.
B. To use words like "I understand" often during the conversation in order to show to the patient that you are listening.
C. To verbally reflect back to the patient words that let him or her know that his or her message was fully understood. (X)
D. To repeat the patient's answers word by word.

5. Which of the following instruments is suitable for screening for PTSD symptoms and trauma exposure?

A. The Harvard Trauma Questionnaire (HTQ) (X)
B. Accidental Injury Questionnaire
C. MADRS
D. ASRS

6. Symptoms of increasing arousal are present in patients with PTSD. Which of the following is NOT a symptom of increasing arousal?

A. Difficulties to sleep
B. Concentration difficulties
C. Visual hallucinations (X)
D. Irritation

7. What is a proper way to allow the patient to correct any misunderstandings during a psychiatric interview?

A. By summarising often given information in your own words. (X)
B. By asking often the patient to repeat his or her answer.
C. By having a patient's relative or friend in the examination room.
D. By asking often the patient to formulate his or her answers in other words.

8. Which of the following are important aspects of the patient's social history that should be penetrated during a psychiatric examination (choose all that apply)?

A. Family situation (X)
B. Financial situation (X)
C. History of immigration (X)
D. Other social network (X)

9. Which of the following is NOT required for the diagnosis of PTSD?

A. Symptoms of chronic arousal
B. Reexperiencing of the traumatic event
C. Constant and uncontrollable worrying (X)
D. Emotional detachment

10. In persons who have survived a traumatic event, an anxiety syndrome that lasts for less than one month is termed:

A. Post traumatic stress disorder (PTSD)
B. Acute stress disorder (X)
C. Adjustment disorder
D. Conversion disorder

11. Which, from those listed, is the most common comorbidity in patients with PTSD?

A. Aggression
B. Depression (X)
C. Stomach ache
D. Headache