Participants responses to a stroke training simulator

M Maxhall[1,2], A Backman[2], K Holmlund[2], L Hedman[3], B Sondell[1] and G Bucht[1]

[1]Department of Community Medicine and Rehabilitation, Geriatric Medicine, Umeå University, Umeå, SWEDEN

[2] VRlab, Umeå University, Umeå, SWEDEN

[3]Skill Acquisition Lab, Umeå University, Umeå, SWEDEN

[1,2]*masmal@hpc2n.umu.se,* [2]*andersb@cs.umu.se,* [2]*Kenneth.Holmlund@hpc2n.umu.se,* [3]*leif.hedman@psy.umu.se*, [1]*bjorn.sondell@germed.umu.se,* [1]*gosta.bucht@germed.umu.se*

[1]*www.umu.se/medfak/institutioner/samh_reh_eng.html,* [2]*www.vrlab.umu.se,* [3]*www.psy.umu.se/forskning/Forskare/l_hedman*

ABSTRACT

The primary goal of this research was to study a virtual environments (VE) possibility to influence empathy on caregiver personal. In the present explorative study, 9 subjects from Norrlands University Hospital (NUS) completed a test consistent of three everyday tasks, reading a newspaper, filling a glass of water and putting toothpaste on a toothbrush. The procedure was done twice first from a non-stroke perspective and secondly from a perspective of a patient with stroke handicaps. The VE looked like a normal apartment and could be experienced with or without different perceptual disorders of stroke. Data from interviews and observations was analyzed via methods inspired by Grounded Theory. Results from observations and interviews indicate that the simulator in spite of problems of usability were effective in influencing caregivers empathy.

1. INTRODUCTION

Stroke is one of the most common diseases. Costs related to stroke, is the most costly of all in healthcare budgets in the industrialized world. In Sweden about 35000 persons is affected every year, The yearly cost for society is estimated to 9.9 billion SKR (€ 1.1 billion) (Ghatnekar et al, 2004). The individual problems caused by stroke can vary greatly depending on the location and severity of the brain damage, and the degree of support from the surroundings. Symptoms may include; motor problems such as poor balance and limb control, problems with the field of vision, other problems related to emotional control and behaviour. These stroke related problems therefore one way or another directly influence the persons activities of daily living. A previously simple task such as going to the bathroom may now need assistance from others, or new strategies may have to be employed, initially often through the support from others. The affected individual may therefore suffer problems on several different levels. Due to the impact and character of the damage, stroke could secondarily create conflicts within the meeting with family, friends, home caring and living style. (The National Board of Health and Welfare, 2004).

In general there is a need to develop methods which may improve the situation for stroke affected individuals, their friends and families. In stroke rehabilitation efforts are made to meet the individual in his or her current total situation and work from there. Each individual may have her own background story and her own expectations and goals in life both before and after being affected by the stroke. There may be great individual differences regarding social support and social abilities and cognitive function.

Concomitant disease is another important issue regarding stroke and stroke rehabilitation, for some individuals there may be sufficient cardiovascular disease which may hinder parts of the stroke rehabilitation training. Visual impairment may make the use of motorized wheelchair impossible when the wheelchair is user driven, here the use of assistant guided motorised wheelchairs may provide sufficient transportation for the assistant but may not yield the satisfaction wanted for the patient who wants to drive as he has always done. Understanding these issues may be a cue to better relating to the patients real problem which may be feeling sorrow for the loss of the ability to drive independently on his own. Here the use of tight rehabilitation teams with a multiprofessional approach is often a method used. Many different categories of professionals provide their support in a network around the patient. For this setup to work properly around the patient and patient family, there is a need for a tight well-functioning network of dedicated professionals, with a deep understanding for the patient related issues, in order to provide the best possible professional support.

Continuous professional education and development is crucial, but oftentimes there are only limited budgets today for such professional education. Sometimes relatives and caregivers can together take part of the rehabilitative training process. Especially relatives may find this part of the support very helpful. Many times there is certain levels of performance seen during training at the hospital or at home when trained personnel are present that may not necessarily be evident in the persons own home among relatives and vice versa. Both relatives, the patient and the caregivers can therefore learn from each other on how to address certain issues and how take new steps to move forward in the rehabilitative process. Here sometimes ways are also found on how to move forward in life in general. The importance of being able to understand each other and gaining a mutual feeling for each other on several levels, among these empathy, is important to reach as far as possible in improving life for all involved.

Improving empathy might thus be an important goal in order for relatives and care personnel to be better careers. Empathy has been described in several ways (Holm, 1995, 2001), most commonly related to an interaction between individuals. Empathy is characterized as an ability to place oneself mentally and emotionally in the world of another person, be sensitive to another's state of mind, current feelings and to communicate this understanding back to the other. The ability to be empathic depends on several factors, such as personality, health, attitudes and workload. According to Rogers (1975) unless you care about a person's wellbeing you can not accurately understand, value and sense the other person perceptions of the world. The term empathy was coined in 1909 and researchers has historically emphasized different aspects and character of empathy; cognition, affects, emotions, morality, individual similarity, understanding, altruistic behaviour and the relationship between empathizer and the object of empathy (Håkansson, 2003). However most researchers agree on that empathy is an active process consistent of all above-mentioned aspects (Holm, 1985, 2001). Empathy has been investigated and a positive outcome of training empathy among students and health care workers has been seen (LaMonica, 1976). If a simulator has the same effect, i.e. to improve persons empathic ability toward handicapped people is however not known.

Virtual Reality (VR) therapy, as a new therapeutic approach, that can be used to overcome some of the difficulties inherent in the traditional treatment of phobias. VR, like current imagine and in vivo modalities can generate stimuli that could be utilized in desensitization therapy. VR is being used to provide exposure and desensitization for a number of phobic conditions (Wiederhold et al, 2002. Roy et al, 2003. Garcia-Palacios et al, 2002. Wald et al, 2000, Vincelli et al, 2003)

In fear of flying it has been shown that a Virtual environment (VE) was more effective than an imagined environment. It is also suggested that physiological feedback may add to the efficacy of VR treatment. The physiological response of phobic participants, who were able to fly without medicine after VR treatment, showed a gradual trend toward the non-phobic's physiological responses as therapy sessions progressed (Wiederhold et al, 2002). Psychological interventions based on exposure therapy have proved to be effective, but given the particular nature of this disorder they bear important limitations.

Exposure therapy for fear of flying might be excessively costly in terms of time, money, and efforts. VR overcomes these difficulties as different significant environments might be created, where the patient can interact with what he or she fears while in a totally safe and protected environment-the therapist's consulting room (Banos et al, 2002).

Studies have also shown an effectiveness of low-budget VR exposure versus exposure in vivo in a between-group design in patients suffering from acrophobia. A study, for example, shows that VR exposure can be effective with relatively cheap hardware and software on stand-alone computers currently on the market (Emmelkamp et al. 2002).

Virtual reality training has many advantages over other clinical rehabilitation methods, and has the potential to develop a human performance training and testing environment (Lee et al, 2003).

Few studies have been made focusing on VR and empathy. Empathy has been studied as a cognitive factor and its relation with presence. It was concluded that empathy and creative experience, absorption and fantasy, play a distinctive role considering experiencing presence (Sas et al, 2002). Another study, not specifically investigating VR but the relationship between empathy and online interpersonal trust concludes that empathy and the accuracy of the empathic response between community members is an influential factor, but complicated and fragile (Feng et al, 2004).

It seems likely that VR could be an effective tool to influence and understand the problematic world of stroke patients and enhancing empathy.

2. AIMS AND METHODS

The main purpose with this study was to investigate if a virtual environment (VE), simulating stroke can influence caregiver's empathy for stroke patients and a stroke patient's daily experiences in their home environment.

In the present explorative study, 12 volunteers (2 physicians, 5 registered nurses, 3 licensed practical nurses, 1 nurse's aid and 1 occupational therapist) participated from the University Hospital of Northern Sweden (NUS). Nine of these (1 man and 8 women) completed the tests. Three nurses could not be tested due to technical problems. The tests took place during working hours, without reimbursement. The variation of age was between 22 and 52 years. Their experience of working with stroke was between 6 months and 16 years. Previous VE experience was non-existent.

The VE tests consisted of three everyday tasks, reading a newspaper, filling a glass of water and putting toothpaste on a toothbrush. The test procedure was repeated twice, initially from a non-stroke perspective and secondly from a simulated stroke-perspective with anomalies such as motion blur, unilateral neglect, and vestibular damage.

The VE looked like a typical Swedish apartment and could be experienced with or without different virtual perceptual disorders resembling a stroke, while navigating through it with a wheelchair as an interface.

3. TECHNICAL EQUIPMENT

The technical system was divided in two parts, hardware and software. The hardware system consisted of six parts, sensor system, wheelchair system, sound system, display system and two computers (one SGI Onyx 2 and one PC). The participant was during the trial equipped with an Ascension Motion Star tracker system, with nine motion sensors (hands, head and body). The system delivered sounds from objects in the VE, presented via a V8 head mounted display (HMD).

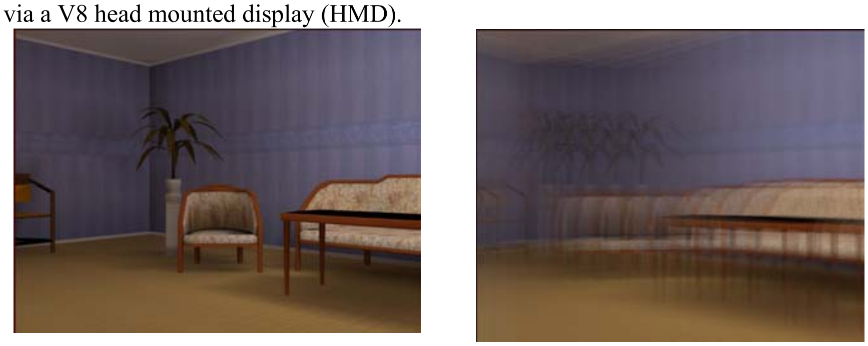

Figure 1. *Virtual apartment from a normal perspective (left image) and from a stroke perspective (right image).*

3.1 System Design

The participant is seated in an ordinary wheelchair which is mounted on a stand. This allows the wheels be elevated from the ground so that each wheel can freely rotate when the participant turns the wheels. Each wheel is equipped with step counters which measures the rotation. From this measurement the velocity of the wheels at any given time can be calculated, and hence the participant can use the wheelchair to navigate the VE.

A 3D model of an ordinary Swedish apartment consisting of a kitchen, a bathroom and a living room was used as the environmental model in the trials (Figure 1). This apartment also contains objects with interaction possibilities. The objects and their interaction possibilities were: glasses that could be filled with water from a tap; a newspaper that can be picked up; toothpaste that can be put on a toothbrush. To make the VE as natural as possible, the objects were also associated with sound events, such as streaming water etc. The participant was immersed in the VE environment using the HMD equipped with headphones.

On each hand the participant wear Pinch Gloves used for grasping objects in close proximity to each hand. There are four motion sensors used in the system: one on each hand of the participant, one mounted on the HMD and one attached to the wheelchair. The sensor on the wheelchair is used to calculate the participant's relative position to the wheelchair. The participant is free to navigate the apartment model using the physical wheelchair as the navigation device. The view and the interaction/navigation can be altered in the simulator to emulate the anomalies a stroke patient can suffer from. There are currently three stroke anomalies implemented in the simulator.

3.1.2 Anomalies. The anomalies are first described with the sensation experienced by real stroke patients, and later how they are implemented in the simulator.

3.1.3 Unilateral neglect. The sensation is of not being able to use the left side of the body (motor). It also implies an impairment of the left visual field (visual). Difficulties in finding objects to the left can occur, and also there may be difficulties in finding the proper way around in the apartment, when doors on the left might disappear. The implementation is focused on the navigation and the interaction aspect of the neglect. When this anomaly is activated, the left hand is switched of visually and for interaction. This means that only the right hand is available for interaction, mimicking the appearance of a stroke patient with neglect. Also, the camera in the VE which is controlled by the participants head is constrained to rotations to the right. This is also true for the wheelchair rotation which can only be navigated straight forward or to the right. When the participant is given the task of navigating a corridor and to move into a room located to the left, a 270° rotation to the right is the only way to solve the task, resulting in the same behaviour which can be observed in stroke patients suffering from neglect.

3.1.4 Motion blur. Motion blur is the sensation, described by patients, when objects and the surroundings perceived looking from one side to another. This anomaly is implemented using the accumulation buffer on the graphics computer. The amount of motion blur is parameterized and can be controlled during the setup of the test setup.

3.1.5 Vestibular damages. Vestibular damages may occur in stroke patients due to cerebral infarctions, symptoms such as dizziness, nausea, the sensation of the surroundings rotating around them and balance impairments are sometimes reported. This is implemented by moving the camera additionally to the participant's head movement. The anomaly is parameterized by specifying the amount and velocity of longitude and latitude movement.

4. PROCEDURE

The whole test took about 90 minutes per person. The main parts were:

Before the session; Information was given about the test, its general aim, equipment and purpose. Just before the session, the test leader and the participant made sure that there were no misconceptions about the term empathy and agreed on the definition being "empathy for another person's experience". The user learned to navigate the wheelchair. After this the sensors were connected and the HMD were adjusted comfortably and information about the three tasks was given.

During the session; the participants got time to familiarize with the VE and the supporting technologies. No time limits were set for the different tasks but a total test time limit of 20 minutes was set in order to reduce cyber sickness. Observations of real and virtual behaviour were made. Directly after the session, recorded interviews took place.

5. DATA COLLECTION AND ANALYSIS

To get more sources for interpretation the subjects were observed during their interaction with the virtual world and trying to understand the meaning of the subjects' virtual and real actions and interactions. We wanted to generate hypotheses using a version of Grounded Theory (Strauss et al. 1990). To examine the human – machine interactions we wanted to be able generate theories and hypotheses using a version of Grounded Theory. Grounded Theory has in this study been used as source of inspiration and whose characteristics are explorative, unconditional, aims to generate theories and hypotheses. The design was explorative with a semi usability character. The main approach was to view the participants as a human base of knowledge that could be an active part in exploring the emotional impact of interaction with the stroke simulator and its usability. The test design made from a non-performance perspective i.e. the participant couldn't perform well or bad, just perform.

The interviews consisted of two parts the first aimed to gather spontaneous information from an emotional response perspective and the second part was based on question based usability dialog.

6. RESULTS AND CONCLUSIONS

Results from observations and interviews indicate that the simulator in spite small problems of usability were effective in influencing caregivers empathy. All tested individuals expressed some sort of stroke, and empathy like experiences. Indicating that the anomalies developed in close collaboration with stroke affected individuals may in some way resemble a stroke experience. Considering empathy and the vast different terms and definitions historically made, we have found correlations between observed behaviours, information from interviews with different parts of the emphatic process. Observed behaviours and responses were; acting like a stroke patient in the environment such as not using their left hand for navigation and interaction even though it was working. Frustration and anger was seen during the observations resulting from experiences of not being able to cope with the everyday tasks available in the VE. Typical stroke behaviours, such as problems navigating in the hospital environment were seen among the caregivers in the virtual apartment while these professionals were performing the various tasks. Problems with orientation and dizziness, commonly found among stroke patients were also evident among the caregivers while in VE. All these factors, probably contributed to added knowledge and understanding among the participants in their role as clinical caregivers and new perspectives of their understanding for their patients. Still the exact mechanisms involved in gaining these new perspectives remains to be elucidated, and calls for further research in this field.

Psychological phenomena related to empathy were also evident, such as the overtaking of patient role, activation of cognitive schemes concerning stroke patients and the triggering of old traumatic experiences. This seems to indicate that most participants experience different variations of the whole process of empathy. More research is needed to make adequate measurements on what specific aspects that are influenced.

As medicine today are rapidly progressing there is a need for professional continuous education. This professional education is needed both for the development of functional rehabilitation teams around stroke patients and their families, and to be able to take today's knowledge a step further. Here we have presented a system now tested by professional caregivers who are normally working on a daily basis with stroke related issues. These results are encouraging since it appears that that this stroke simulator is usable for training caregiver's empathy for stroke patients, possibly creating an increased understanding for stroke patients daily problems. The results found have initiated studies concerning caregiver-VR-training, and the tentative clinical use of this system. Validation and evaluation of the anomalies, technical development and emotional impact are other aspects of ongoing research in our departments.

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