

An Exploration of Clinicians' Sense of Presence in Critical Care Telemedicine

Leila Alem, Susan Hansen, Jane Li
ICT Centre; CSIRO, Australia

{Leila.Alem@csiro.au, Susan.Hansen@csiro.au, Jane.Li@csiro.au}

Abstract

The Virtual Critical Care Unit, (ViCCU[®]), is a telemedicine system that allows a specialist at a major referral hospital to direct a team in another, usually smaller and remote hospital. In this study we used a modified version of the Slater-Usoh-Steed (SUS) presence questionnaire to measure clinicians' sense of presence when using ViCCU[®]. We also explored the relationship between presence experienced when using ViCCU[®] and personal, usability and media factors. Results indicate that in this context, personal factors influenced clinicians' experience of presence and that a positive relationship between presence and both usability and media factors may exist. Reflections on the appropriateness of the SUS presence measure in this real-world setting are also included.

1. Introduction

Telemedicine is the delivery of healthcare over a distance and for years telemedicine technologies have enabled off-site clinicians to provide healthcare to patients in remote locations. In 2002 a telemedicine application for a critical care setting, the Virtual Critical Care Unit (ViCCU[®]), was developed in a collaboration between CSIRO through the Centre for Networking Technologies for the Information Economy (CeNTIE) and Sydney West Area Health Service. It was installed in Katoomba and Nepean Hospitals, Australia, in December 2003 for a 2 year clinical trial.

ViCCU[®] is composed of two main stations: a remote station, Figure 1(a), located at Katoomba Hospital and a specialist station, Figure 1 (b), located at Nepean Hospital.



(a) The remote station (b) The specialist station
Figure 7 The Virtual Critical Care Unit

Using the stations allows a specialist at a major referral hospital and clinicians at a remote hospital to work together as one team to treat and diagnose patients at the remote hospital by transmitting multiple channels of real-time video/audio information of the patient, the clinical team, x-ray/paper documents and patient vital signs from the remote site to the specialist [1].

The literature describes numerous attempts to measure presence in the medical area when using virtual reality or augmented reality, however these have typically been performed in laboratory environments [e.g. 2]. This paper goes further and attempts to measure presence in a real-world clinical setting and explore its relationship with other factors measured in the study.

2. The Study

One of the aims of ViCCU[®] was to give clinicians located in a remote hospital the feeling that a specialist was physically 'there' at the end of the bed. For this reason we decided to focus our study on physical presence.

As access to the emergency clinicians was limited it was important that the presence measure chosen could be administered easily and quickly. Following a review of existing subjective measures of physical presence, the Slater-Usoh-Steed (SUS) questionnaire [3] was chosen and adapted for this context. The SUS questionnaire was adapted to assess presence using ViCCU[®] by:

- Replacing direct reference to an experience within a virtual environment with experience with using ViCCU[®].
- Generating two versions of SUS questionnaires, one for the doctors and nurses in Katoomba (containing 4 out of the 6 items) and one for the staff specialists in Nepean (containing 5 out of the 6 items).

The adapted versions of the SUS questionnaire were then added to the Katoomba and Nepean Technical Evaluation Questionnaire's. In addition to measuring presence using the SUS questionnaire, we decided to explore the construct of presence specific to three factors: personal – employment category, gender, prior experience with videoconferencing; usability – ease of use, ability to focus on patient, satisfaction with overall design; and media factors – overall satisfaction with video and audio.

Fifty clinicians in total (36 hospital staff from Katoomba and 14 staff specialists from Nepean) took part in this study.

3. Results

A reliability analysis was performed, and the Cronbach's alpha calculated. As sufficiently high alphas were obtained, 0.808 for the Katoomba presence questions and 0.918 for the Nepean presence questions, the items were summed. Spearman correlation tests were performed on non-recoded data to test whether there was a relationship between presence scores, usability and media factors. T tests were used to detect group differences. Results are described below.

Personal Factors Katoomba nurses had significantly higher presence scores ($m=18.38$, $s=5.608$, $p=0.018$) than Katoomba doctors ($m=13.64$, $s=5.329$).

Katoomba females reported significantly higher presence scores ($m=18.50$; $p=0.018$) than males ($m=13.93$).

In Nepean, this was reversed with male specialists mean presence scores ($m=22.00$) higher than females ($m=14.67$), however this was not significant at the 0.05 alpha level.

In both hospitals, although there were differences in the mean presence scores of those who had prior videoconferencing experience and those that did not, this was not statistically significant.

Usability Factors With the exception of a moderate positive correlation between Nepean presence scores and ease of use ($r=0.553$), no other usability factors (i.e. ability to focus on patient and satisfaction with overall design) significantly correlated to the overall presence scores.

Media Factors There were no significant correlations between Katoomba presence scores and overall impression of video or audio quality. Interestingly, a subtle negative relationship was observed between the mean presence scores of those who were dissatisfied ($m=21.00$), neutral ($m=17.27$) and satisfied ($m=16.09$) with the overall video quality.

In Nepean, there was a significant positive moderate correlation between presence scores and overall satisfaction with video quality ($r=0.549$). Although not statistically significant, Nepean specialists who were satisfied with the ViCCU[®] audio displayed higher mean presence scores ($m=21.70$) than those who were neutral ($m=17.25$).

Comparison to Specialist Physically Present Of particular interest to us in this study was how using ViCCU[®] compared to having a specialist physically present in the room and whether indeed a comparison could be made.

The majority of Katoomba staff reported that using ViCCU[®] was the same (53%) or better (19%) than the specialist being physically present, and only 28% reported using ViCCU[®] was worse.

From the specialists station however, the majority of staff specialists reported that using ViCCU[®] was worse (62%) than being physically present and approximately a third (31%) thought it was the same and only 8% reported that it was better.

4. Discussion

Clinicians reported high levels of presence when using ViCCU[®]. The study revealed that presence experienced by the clinicians was influenced by some personal factors including employment category and gender. There was some evidence to support a positive relationship between presence and satisfaction with usability and media factors. There was also evidence to suggest that the high levels of satisfaction with ViCCU[®] expressed by the clinicians could be influenced by the high levels of presence experienced when using ViCCU[®], making it comparable to actually 'being there'. The majority of Katoomba staff felt that using ViCCU[®] was the same or better than the specialist physically being there, but the majority of Nepean staff felt that using ViCCU[®] was worse.

Whilst the SUS questionnaire may not be as comprehensive as other presence measures, it has shown itself to be a context flexible and an adaptable measure of presence. The major advantage of the SUS questionnaire, particularly in this time-critical telemedicine context, was the length of the questionnaire which lent itself to be easily integrated into a larger questionnaire and could be completed quickly. However, the short length also meant that it may not have necessarily been able to capture the wide range of elements that contribute to presence and provide a more accurate measure. To investigate this, it would be interesting to conduct a study using an adapted SUS questionnaire and a more comprehensive instrument such as the ICT-SOPI [4] in a clinical setting and compare the results.

This study supports the notion that it is possible to measure presence in telemedicine applications; that the SUS presence measure can be used in a real-world clinical context; and that it is sensitive enough to allow the investigation of the influence of different factors such as personal, usability and media factors on presence. While acknowledging the limitations, this study also represents a positive step in measuring presence in telemedicine applications in a clinical context.

References

- [1] R.Y. Qiao, K. Bengston, A. Krumm-Heller, M. Hogan. A Critical Care Telemedicine System on Broadband IP network. In *Proceedings of Asia-Pacific Conference on Communications* 852-856. October 2005.
- [2] M.C. Juan, D. Perez, D. Tomas, B. Rey, M. Alcaniz, C. Botella, R. Banos. An Augmented Reality system for the treatment of acrophobia. In *Eighth Annual International Workshop on Presence* 315-318. September 2005.
- [3] M. Slater. 1999. Measuring presence: a response to the Witmer and Singer presence questionnaire. *Presence: Teleoperators and Virtual Environments*, 8, 560-566.
- [4] J. Lessiter, J. Freeman, E. Keogh, J. Davidoff. 2001. A cross-media presence questionnaire: the ITC-Sense of Presence Inventory. *Presence: Teleoperators and Virtual Environments*, 10, 282-297.