Evaluating Clinicians’ Experience in a Telemedicine Application: A Presence Perspective

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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 a rural hospital. ViCCU® allows remote consultation to take place based on the transmission of 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. This paper explores clinicians’ experience of presence in a telemedicine application. 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 felt when using ViCCU® and personal, usability and media factors. Initial results indicate that in this context, personal factors influenced clinicians experience of presence and that there was a positive relationship between presence and both usability and media factors. Reflection on some of the challenges in conducting this study in an emergency department and the appropriateness of the SUS presence measure in this real setting are also included.

Keywords
Telepresence, Telemedicine, Medical Application

1. INTRODUCTION
Telemedicine is the delivery of healthcare over a distance and for years, telemedicine technologies have enabled off-site clinicians to provide health care to patients in remote locations. Recent advances in video conferencing and high bandwidth data transmission have made it possible for telemedicine applications to incorporate complex procedures and information flows with more sophisticated user interfaces. This has therefore presented the opportunity to provide more complex services over distance and to enter areas previously considered too complex such as critical care. However, remote diagnosis in critical care is more challenging than other areas which currently use telemedicine applications due to the variable and unpredictable work pattern, the load of team communications and complex clinical settings (Coiera & Tombs, 1998).

A joint project - ViCCU® was formed in 2002 between Sydney West Area Health Service and the Centre for Networking Technologies for the Information Economy (CeNTIE) at CSIRO to develop a broadband telehealth system for complex and critical clinical settings (Li, Wilson, Hansen, Qiao, Krumm-Heller, Stapleton, Cregan & Murphy, 2006). ViCCU® was installed in the Katoomba Hospital and Nepean Hospital in December 2003 for a 2 year clinical trial.

A usability and technical evaluation was conducted by CSIRO after ViCCU® had been used for 21 months. A sense of presence was thought to be important for clinicians to operate as one team when using ViCCU® and clinicians frequently commented on how using ViCCU® felt like the specialist ‘was there’. Therefore a more formal and structured investigation of presence was undertaken within the usability and technical evaluation carried out by CSIRO.

Although telepresence is frequently mentioned in the telemedicine literature and its importance in telemedicine supported, it is generally mentioned in its most literal form – tele – present, to be present from a distance. Some attempts have been made 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. Juan, Perez, Tomas, Rey, Alcaniz, Botella & Banos, 2005). This paper goes further and attempts to measure presence and explore its relationship between the presence measures and other factors measured in the study. The study also represents the first study known to the authors to investigate presence using a telemedicine application in a real world clinical environment.

This paper describes ViCCU® as an example of a medical presence application and explores clinicians’ experience of presence while using ViCCU® and the different factors that influence this sense of presence.

The Virtual Critical Care Unit system is described in Section 2, Section 3 contains a review of existing presence measures and the justification for selecting the SUS measure as a foundation for this study, Section 4 describes the design of the study, Section 5 contains the results, and Section 6 presents our conclusion and suggestions for future directions.

2. THE VIRTUAL CRITICAL CARE UNIT (VICCU®)
ViCCU® is composed of two main stations: a specialist station located at Nepean Hospital and a remote station located at Katoomba hospital. The system transmits
digital video (DV) over an ‘ultra-broadband’ Gigabit optical fibre link between the two hospitals.

2.1 THE REMOTE STATION - KATOOMBA
The system has four cameras that capture and transmit multiple views to the Nepean specialist. These include a camera for general treatment overview, a document camera for transmitting X-rays, ECG reports and other patient records, a camera on the ceiling for viewing the patient, an auxiliary video channel for plugging in a mobile camera for close-up examination or other sources such as an ultrasonic scanner and an overhead view camera.

Figure 2.1 The Remote Station at Katoomba Hospital
In order to minimise the clutter created by the equipment necessary for ViCCU®, the majority of the equipment for the remote unit was designed as a mobile trolley, Figure 2.1. The mobile trolley set-up allows ViCCU® to be easily wheeled in when needed to the end of the patients’ bed – where a specialist would usually stand when physically present.

2.2 THE SPECIALIST STATION - NEPEAN
At Nepean, a room was dedicated to house the specialist unit of ViCCU® as shown in Figure 2.2. It consists of three monitors that are able to continuously display the patient’s vital signs as well as different patient views, X-rays and patient notes to a specialist in the room.

Figure 2.2 The Specialists’ Station at Nepean Hospital
The patient’s vital signs are continuously displayed on the top right monitor. On that same screen the specialist may select the patient or document view desired by selecting the corresponding thumbnail.

3. DEFINING AND MEASURING PRESENCE
The most suitable definition and most appropriate tool to measure presence is a contentious issue in the presence literature. Before we could define presence and select the most appropriate tool to measure it, we needed to first select the aspect of presence that was most appropriate to focus on in this context.

Heeter (1992) recognizes three aspects/dimensions of presence:

- Physical presence : the sense of being in one place or environment
- Social presence: the feeling of being connected to other people in the place or environment.
- Environmental presence : the extend to which the environment itself appears to know that you are there and reacts to you

As one of the aims of ViCCU® was to create a system that gave clinicians located in a rural hospital the feeling that the specialist located in a major hospital was physically ‘there’ at the end of the bed, we decided to focus our initial study on the physical aspect of presence.

Following the decision to focus on physical presence, we chose to adopt an extension of Witmer & Singer’s (1998) definition of presence for this study. That is: ‘the subjective experience of being, or someone else who is remotely located being, in a place or environment, even when they are physically situated in another.’

Our next challenge was to find a suitable method to measure physical presence. The literature on presence proposes a number of methods for measuring this phenomenon. A detailed review of the available measures is beyond the scope of this study, however a comprehensive review of existing measures is available in Baren & Ijsselsteijn (2004).

Due to the constraints presented by the emergency department environment – which is a highly complex and dynamic environment with continuous interruptions – and ethical constraints, the measure of presence chosen had to be as non-obtrusive as possible. In this environment any external intervention was unfeasible making subjective measures of presence the most practical and feasible to consider.

Of the subjective measures of presence available, presence questionnaires are the most commonly used method in presence research. Questionnaires are easy to administer, can be completed relatively quickly and do not require interfering with users during their presence experience, which would not have been possible in this situation.

In this study it was important that the presence measure used could be administered relatively easily and quickly as the access given to the emergency clinicians was limited. The most appropriate questionnaire found for this context was the ITC-Sense Of Presence Inventory (ITC-SOPI) (Lessiter, Freeman, Keogh & Davidoff, 2000). The ITC-SOPI covers 15 content areas relevant to presence including: sense of space, involvement, attention, distraction, control and manipulation, realness, naturalness, time, behavioral realism, para-social presence, co-presence, personal relevance, arousal and negative effects. It is composed of 63 general questions.
applicable to various application domains. Whilst the ICT-SOPI was the most appropriate measure of presence in this context, incorporating 63 additional questions to the technical evaluation was not feasible.

Another method considered that is commonly found in the literature as a measure of presence was Witmer and Singer’s Presence Questionnaire (PQ) (Witmer & Singer, 1998). Witmer and Singer assert that there are several factors that influence presence. These factors are: control factors (ability to control the relation of sensors to the environment), sensory factors (quality of sensory input), distraction factors (awareness of the real environment) and realism factors (environment realism and meaningfulness and disorientation when returning to the real world). In PQ, Witmer and Singer measure presence by investigating those factors assumed to influence presence by asking users to qualify their perception of these factors. A criticism to this approach to measuring presence by Slater, is that the PQ measures the users’ perceptions of the system properties, rather than presence (Slater, 1999).

After a careful consideration and review of the existing subjective measures of presence, (an extended comparison of subjective measures is proposed by Insko (2003)), that could be incorporated into our technical evaluation questionnaire, the Slater-Usoh-Steed questionnaire (SUS) (Slater, Usoh & Steed, 1994) was selected as the most appropriate measure and adapted to suite the conditions of our study.

The SUS questionnaire assesses the experience of presence by asking users their sense of being in the Virtual Environment (VE), the extent to which the VE becomes the dominant reality, and the extent to which the VE is remembered as a place. Even though it was originally designed for VE’s it has since been used to measure presence in VEs compared to real-world settings e.g. Usoh, Catena, Arman and Slater (2000).

The SUS measure of presence was selected for three reasons:

- SUS focuses on evaluating the subjective experience of presence (versus using objective measures to evaluate directly a sense of presence)
- The SUS questionnaire has been used for assessing the experience of presence in reality
- The SUS questionnaire was able to be easily included in the Katoomba and Nepean technical evaluation questionnaires due to its short length

The SUS questionnaire was adapted to assess presence using ViCCU® by:

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

Acknowledging the limitations of presence questionnaires, an open ended question about presence was included in the interviews to supplement the questionnaire data collected.

4. METHOD

4.1 DESIGN

The aim of this study was to explore clinicians’ experience of presence using ViCCU®. In addition to measuring presence using the SUS questionnaire, we decided to explore the relationship between presence as measured by the SUS questionnaire and some of the factors associated with presence. The three factors we chose to explore are commonly mentioned in the literature as influencing presence includes personal, usability and media factors.

The factors investigated were operationalised in the following way:

- Personal Factors
  - Employment category i.e. doctors vs. nurses
  - Gender
  - Prior experience with videoconferencing
  - The interface, i.e. Katoomba or Nepean
- Usability Factors
  - Ease of use
  - Ability to focus on patient
  - Satisfaction with overall design
- Media Factors
  - Overall satisfaction with Video
  - Overall satisfaction with Audio

Presence in this study was operationalised as the cumulative value of the presence scores from the adapted version of the SUS questionnaire. It was measured using two adapted versions of the SUS questionnaire, one for Katoomba and one for Nepean, as described in Section 4.3.

4.2 Participants

50 clinicians in total took part in this study. These participants were identified as staff that had used ViCCU® by the telehealth nurse consultant in charge of ViCCU® and were recruited through a series of informal information sessions. 36 hospital staff (21 nurses, 14 doctors and 1 person who did not report their employment category) from Katoomba Hospital completed the Katoomba questionnaire. This sample comprised all of the current Katoomba staff who had used ViCCU® during the data collection period. 14 staff specialists from Nepean Hospital completed the Nepean questionnaire. This sample comprised all of the staff
specialists (13 emergency specialists and 1 neurologist) who had used ViCCU during the data collection period.

4.3 Materials
The Katoomba and Nepean technical evaluation questionnaires were the primary instrument used to collect data in this study. A description of the sections in the technical evaluation questionnaire, and an indication of the sections that the personal, usability and media factors were derived from are displayed in Table 4.1.

Table 4.1 Katoomba and Nepean Technical Evaluation Questionnaire Structure

<table>
<thead>
<tr>
<th>Section Number</th>
<th>Section Heading</th>
<th>Factors Derived from Section</th>
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<tbody>
<tr>
<td></td>
<td>Design</td>
<td>Usability Factors</td>
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<tr>
<td>2</td>
<td>Technology</td>
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<td>2.1</td>
<td>Visual</td>
<td>Media Factors</td>
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<td>2.2</td>
<td>Audio</td>
<td>Media Factors</td>
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<td>2.3</td>
<td>System Reliability</td>
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<tr>
<td>3</td>
<td>Usability</td>
<td>Usability Factors</td>
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<td>4</td>
<td>General Questions</td>
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<tr>
<td>5</td>
<td>Experience</td>
<td>Presence</td>
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<tr>
<td>6</td>
<td>Participant Profile</td>
<td>Personal Factors</td>
</tr>
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#broad section heading  
*not used in this study

With the exception of the questions in Section 5, which comprised the presence section of the questionnaire, other scale items in the questionnaire were measured on a five point Likert scale. A modified SUS questionnaire was incorporated in Section 5 in both the Katoomba and Nepean technical evaluation questionnaires.

Participants were asked to rate on a 7 item scale the following questions:

Katoomba SUS questions (based on questions 1, 2, 3 & 6 of the original SUS questionnaire)

1. Please rate your sense of the specialist ‘being’ in Katoomba on the following scale:
   Not at All (1) -- Very Much So (7)

2. To what extent were there times while using ViCCU did you feel that the specialist was in Katoomba in reality?
   None of the Time (1) -- Almost All of the Time (7)

3. When you think back of your experience interacting with Katoomba using ViCCU, do you think the specialist was as a place that you visited?
   Video interaction (1) -- Face to Face Interaction (7)

4. While you were remotely interacting with the Nepean specialist using ViCCU, did you think to yourself that they were actually in Katoomba?
   Not at All (1) -- Very Much So (7)

Nepean SUS questions (based on questions 1, 2, 3, 5 & 6 of the original SUS questionnaire)

1. Please rate your sense of being in Katoomba hospital on the following scale.
   Not at All (1) -- Very Much So (7)

2. To what extent were there times while using ViCCU did you feel you were at Katoomba hospital in reality?
   None of the Time (1) -- Almost All of the Time (7)

3. When you think back of your use of ViCCU, do you think of Katoomba hospital more as something you saw over a video, or more as a place that you visited?
   Images I Saw (1) -- Somewhere I Visited (7)

4. Consider your memory of your remote interaction with Katoomba staff using ViCCU. How similar is your memory of Katoomba hospital to other places you have been to? Consider issues such as: Do you have a visual memory of Katoomba hospital? Is your memory in colour? The extent to which your memory of Katoomba hospital seems vivid, panoramic?
   Not at All (1) -- Very Much So (7)

5. While you were remotely interacting with Katoomba staff using ViCCU, did you think to yourself that you were actually in Katoomba hospital?
   Not at All (1) -- Very Much So (7)

4.4 Procedure
Ideally clinicians would have filled in the technical evaluation questionnaires with our presence measure incorporated directly after a ViCCU consultation. However as emergency staff’s time can not be scheduled due to the unpredictable nature of emergencies and the sporadic use of ViCCU, we had to be opportunistic with the clinicians’ time. To provide as many cues to the experience of using ViCCU as possible, Katoomba staff were requested to fill in the Katoomba Technical Evaluation Questionnaire in front of the remote station and Nepean staff requested to fill in the Nepean questionnaire in front of the specialist station where possible. The questionnaires were completed when staff had at least a 10 minute break.

4.5 Data Analyses
A reliability analysis was performed, and the Cronbach’s alpha (Cohen & Cohen, 1983) calculated to assess suitability of summing the adapted SUS questionnaires in the Katoomba and Nepean presence responses.

As sufficiently high alphas were obtained, 0.808 for the four Katoomba presence questions and 0.918 for the five Nepean presence questions, the item responses were considered suitable to sum. In addition to exploring overall presence, the individual modified SUS presence questions were also explored separately.

Skewness and Kurtosis normality test results indicated the data set was normally distributed. Spearman correlation tests were performed on non-recoded data to establish whether there was a relationship between peoples self-reported summed presence scores and the usability and media factors. T tests were performed to
look for group difference such as differences according to employment category, gender and previous videoconferencing experience.

Means were reported for recoded independent variable data with the positive and negative scores in the 5 point scale collapsed to form a 3 point scale.

5. RESULTS

The summary of individual presence questions scores for Katoomba and Nepean are shown below in Figures 5.1 and 5.2.

5.1 Personal Factors

5.1.1 Employment category Katoomba Nurses reported a higher level of presence (m=18.38, s=5.608) than doctors (m=13.64, s=5.329). There was a significant difference between doctors and nurses responses to presence at Katoomba (p=0.018).

As all of the Nepean clinicians were staff specialists, a comparison between different types of staff using the specialist station was not relevant.

5.1.2 Gender In Katoomba, females reported significantly higher presence scores than males (female m=18.50, male m=13.93; p=0.018). In Nepean, this was reversed with male specialists mean presence scores (m=22.00) higher than female specialists mean presence score (m=14.67). This difference in Nepean however, was not significant at the 0.05 alpha level.

5.1.3 Previous videoconferencing experience In Katoomba, the majority of people with previous videoconferencing experience had a lower mean presence score (m=14.14) than those without previous videoconferencing experience (m=18.05). Conversely in Nepean, the majority of the people with previous videoconferencing experience had a higher mean presence score (m=24.00) than those without previous videoconferencing experience (m=18.80).

However, in both of the Nepean and Katoomba data, there was no significant difference between people with videoconferencing experience and those without videoconferencing experience.

5.1.4 The interface For the purposes of comparing the mean presence scores of the Katoomba and Nepean clinicians, the Katoomba presence scores were multiplied by 1.25 to transform the presence score from a score out of 28 to a score out of 35.

The majority of clinicians from both Katoomba and Nepean reported feeling a sense of the specialist being located at Katoomba. There was no significant difference between the overall mean presence scores in Katoomba (m=20.61) and Nepean (m=20.43) questionnaires.

5.2 Usability Factors

With the exception of the correlation between Nepean presence scores and ease of use, no other usability factors significantly correlated to the overall presence scores at the 0.05 alpha level. When correlations were explored between the individual presence questions and usability factors a weak but significant positive correlation was observed between Katoomba presence question 1 and ease of use.

Despite the lack of statistically significant relationships between presence and usability factors, differences were observed that are worth mentioning and are described under each of the relevant usability categories listed below.

5.2.1 Ease of use The mean Katoomba presence score of those who found ViCCU easy to use (m=17.31) was higher than the mean presence score of those who reported ViCCU was neutral to use (m=14.11). Although no significant correlation was found between Katoomba staff’s summed presence score and ease of use, a weak significant positive correlation was found between Katoomba presence question 1 and ease of use (r=0.355, p<0.05).

Similar to Katoomba, the mean Nepean presence scores of those who found ViCCU easy to use (m=21.83) was higher than the mean presence score of those who reported ViCCU was neutral to use (m=12.00). There was also a significant moderate positive correlation between Nepean presence scores and ease of use (r=0.553, p<0.05).

5.2.2 Ability to focus on patient Katoomba staff who reported finding it easy to focus on the patient displayed higher mean presence scores (m=17.25) than those who were neutral on the matter (m=14.82). There was no clear
pattern in the relationship between the mean presence scores and Nepean specialists reported ability to focus on patient.

5.2.3 Satisfaction with overall design There was no observable relationship between the mean presence scores of the Katoomba staff of those who were dissatisfied (m=16.50), neutral (m=15.40) or satisfied (m=17.10) with the overall ViCCU® design. Similarly, there was no observable difference between the mean presence scores of the Nepean staff of those who were dissatisfied (m=18.00), neutral (m=24.33) or satisfied (m=19.50) with the overall ViCCU® design.

5.3 Media Factors

5.3.1 Overall satisfaction with video There was no significant correlation between Katoomba presence scores and overall impression of video quality. Interestingly though a subtle negative relationship could be 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.

There was a significant positive moderate correlation between the Nepean presence scores and overall satisfaction with video quality (r=0.549, p<0.05). In Nepean, those who reported satisfaction with the overall quality of ViCCU® displayed a higher mean presence score (m=22.40) than those who were neutral (m=15.50). No-one reported being dissatisfied with the video quality of ViCCU®.

5.3.2 Overall satisfaction with audio Similar to findings in the area of video quality, there was no significant correlation between Katoomba presence scores and overall impression of audio quality.

Although there was no significant correlation between Nepean presence scores and overall impression of audio quality, a significant positive moderate correlation was found between Nepean presence question 1 and overall impression of audio quality (r=0.543, p<0.05). Nepean specialists who were satisfied with the ViCCU® audio also displayed higher mean presence scores (m=21.70) than those who were neutral (m=17.25) about the audio.

5.4 Comparison to Specialist Physically at Katoomba

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 as shown in Figure 5.3, below.

5.3.2 Satisfaction with video

5.3.3 Overall satisfaction with design

5.3.4 Overall satisfaction with audio

5.4 Comparison to Specialist Physically at Katoomba

5.4.1 Overall satisfaction with video

5.4.2 Overall satisfaction with audio

Figure 5.3 Katoomba Staff’s Comparison of Using ViCCU® to Specialist Physically Present

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, as displayed in Figure 5.4, below.

Figure 5.4 Nepean Specialists Comparison of Using ViCCU® to Being Physically present at Katoomba

Also of interest was whether there was a relationship between how clinicians compared ViCCU® to a specialist being physically present and their presence scores. A weak but significant correlation was found between Katoomba staffs comparison and presence score (r=0.372, p=0.036). A moderate correlation was found between Nepean specialists comparison and presence scores (r=0.713, p=0.006).

6. DISCUSSION

This study measured clinicians’ sense of presence using the SUS presence measure and explored how the presence score relates to factors known to affect presence. Relationships were observed between presence and personal factors, usability factors, media factors and how they compared using ViCCU® to the specialist physically being there. These are explored in more detail below.

Personal factors

Whilst there was no significant difference between the mean presence scores of Katoomba and Nepean clinicians, the relationship between presence and personal...
factors was different across the two interfaces. That is in
the case of gender, Katoomba females had significantly
higher mean presence scores than males, whereas in
Nepean, males had higher mean presence scores than
females. The relationship between presence and previous
experience with videoconferencing also differed across
the two sites, with those with previous videoconferencing
experience having lower mean presence scores in
Katoomba and higher mean presence scores in Nepean.

A possible explanation for the difference in mean
presence scores for males and females across the two sites
could be provided by looking at the presence scores
across employment category in the Katoomba data.
Nurses had a higher mean presence than doctors in
Katoomba, and the majority of nurses in Katoomba were
female. As the results were in the opposite direction for
the Nepean data, this suggests that the nature of the job
may influence presence more than the gender. For
example, in Katoomba whilst the nurses role when using
ViCCU® was similar to what it would be if a doctor were
leading them, the doctors experienced a change in
responsibility and power with the specialist present over
ViCCU® than in their previous work situation.

However, the different direction of presence scores across
gender in the two hospitals may not necessarily due to or
solely due to the nature of the job, but the nature of the
interface, which may affect the genders differently.
Further study and exploration of this is needed in order to
clarify the reason for this finding and to see if this finding
is consistent.

Usability factors
Consistent with the findings of Nosper, Behr, Hartmann
and Vorderer (2005), the mean presence score of those
who found ViCCU® easy to use was higher than those
who were neutral across both hospitals. However,
although there were indications of relationships between
the other usability factors, i.e. ability to focus on patient
and satisfaction with overall design, there were no other
statistically significant relationships.

This could be because with the exception of ease of use,
there was no relationship between presence and
usability/control factors, the way we operationalised
usability, or the way the sample was distributed. That is,
most people reported positively on the usability factors
with very few or no people expressing dissatisfaction in
any of the three categories. The small number, or
complete lack of people in these negative categories,
although positive for ViCCU®, made it difficult to assess
the relationship between presence and these factors.

Media Factors
There was some evidence of a relationship between
presence and media factors in this study.

For Nepean specialists, a positive significant relationship,
as hypothesised, was found between presence and overall
satisfaction with video. However, no significant
relationship was found between presence and overall
satisfaction with audio.

There was no significant relationship between presence
and any media factors for Katoomba clinicians.

The lack of relationship between presence felt by
Katoomba clinicians and satisfaction with media factors
may be due to a lack of relationship, or it could also be
because very few or no clinicians reported dissatisfaction
with the media factors. This meant that there were either
very few or no people to represent dissatisfaction giving a
disproportionate weighting to individuals who did express
dissatisfaction when comparing mean presence scores
across the categories.

As the majority of Katoomba and Nepean staff reported
high levels of satisfaction with the media factors, as they
also did with usability factors, it was difficult to explore
whether and how these factors affected presence.

Comparison of using ViCCU® to specialist being in the room
As face to face is widely considered the gold standard, at
best we thought that some clinicians may report that
ViCCU® was the same as the specialist being there.
Whilst there was no significant difference in the presence
experience by Katoomba and Nepean clinicians, a
surprising finding was that the majority of Katoomba
staff actually felt that using ViCCU® was the same as the
specialist actually being there and almost 20% of the staff
felt that it was better. However, the majority of the
Nepean clinicians felt that using ViCCU® was worse than
actually being there. This could be due to several reasons.
From the interviews conducted with nurses, doctors and
specialists, it is proposed that this could be due to the
differing nature of their jobs. Although the visual
information provided by the vital signs monitor,
documentary camera and various patient views give the
specialist more information to form a diagnosis than they
would have available through more basic communications
mediums such as a telephone, in some cases it is important for the specialist to be able to touch
and feel the patient, which is not possible through
ViCCU®. The nurses and doctors on the remote end
however, only need to hear the specialists’ advice, and
any additional information is supplementary.

The SUS questionnaire
Whilst the SUS questionnaire may not be as
comprehensive as the ITC-SOPI, it has shown itself to be a
context flexible and adaptable measure of presence. The
major advantage of the SUS questionnaire, particularly in
this time-critical telemedicine context, is the length of the
questionnaire which lends itself to be easily integrated
into a larger questionnaire and is quick to fill in.
However, the length of the questionnaire could also be its
major disadvantage as it may not necessarily be able to
capture as wide a range of the elements that contribute to
presence and lead to a more accurate measure. If possible,
it would be interesting to assess an adapted SUS
questionnaire to a more comprehensive measure such as the
ITC-SOPI in a real-world telemedicine context and
compare the results.
Limitations

Whilst usability and media factors were found to influence presence largely in the directions expected, it was difficult to establish statistical significance and explore this comprehensively for two main reasons, including the sample size and the nature of the responses.

Although the full sample of Nepean staff specialists using ViCCU® at the time of data collection of was captured, this sample size of 14 lacked power and was therefore not sufficiently large to detect some of the potential significant differences. Even in the Katoomba data with the larger but still relatively small sample size of 36, in cases where there were few clinicians represented in a category, interpretations of the data needed to be made in a more qualitative manner i.e. from graphical representations of the mean presence scores across each category.

In addition to this, while it was very positive news for those who designed and developed ViCCU® that majority of clinicians were satisfied with the usability and media factors, the ability to assess how these perceptions were related to presence was limited as there were either very few or no clinicians who reported feeling negatively in these areas.

Conclusion

The study revealed that the presence experienced by the clinicians was influenced by personal factors including employment category, gender and previous experience with videoconferencing. There was some evidence to support the positive relationship between satisfaction with usability and media factors and presence.

There was also evidence from the study 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 was the same or better than the specialist physically being there, although the majority of Nepean staff felt that using ViCCU® was worse.

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

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