ICU-Talk, A Communication Aid for Intubated Intensive Care Patients

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ABSTRACT

A Multi-disciplinary project staffed by personnel from nursing, computer science and speech and language therapy developed a computer based communication aid called ICU-Talk. This device has been designed specifically for intubated patients in hospital intensive care units. The ICU-Talk device was trialled with real patients. This paper reports the challenges faced when developing a device for this patient group and environment. A description of the methods used to produce ICU-Talk and results from the trials will be presented.

Keywords

Communication, AAC, ICU, Usability, HCI.

BACKGROUND

Patients who find themselves in an intensive care unit (ICU) are acutely ill and disabled. The effects of the drug treatments along with the acute nature of their medical condition renders the patient unable to breath for themselves and they may have a degree of physical weakness. Although this is a temporary situation and many patients make a good recovery, the psychological effects can be long lasting [9]. One of the most difficult things for the patient to cope with while they are in ICU is the inability to communicate [9].

Most patients in an ICU require mechanical ventilation to assist with breathing. While patients require help with their breathing, they are unable to communicate using speech. This is because they are intubated. Intubation is either a plastic tube that is inserted into the patient's throat via their mouth or where they have a tube in their neck (referred to as a tracheostomy). Using an augmentative or alternative method of communication can be very difficult for an intubated ICU patient. Many patients attempt to mouth words, but if they are intubated orally, lip reading becomes even more difficult. Weakness can effect the movement of their hands and arms and make writing or gesturing more difficult. Patients' hands or arms may also be attached to drips or monitors that restrict their movement. Some patients in this situation have reduced ability to learn new information, impaired memory, visual disturbances and reduced attention and concentration [1]. Nursing staff who work in intensive care units are highly skilled at anticipating the communication needs of patients who are trying to communicate but find interpreting their communication attempts time consuming and difficult [2].

Although there is a range of augmentative and alternative communication (AAC) devices available commercially, most of these are not appropriate for use with this patient group. There are no AAC devices available that have been designed with the specific needs of the adult ICU patient and the ICU environment in mind. One of the major problems is the temporary nature of the patient's condition. Many patients will only be ventilated and requiring a communication aid for a very short length of time, perhaps one or two days. Costello [5] reported success with children who have planned admissions to ICU following surgery. Prior to admission, users were trained and the children pre-stored phrases into an AAC device using their own voice. This AAC device is commercially available but has not been developed specifically for ICU patients.

The ICU-Talk was a three-year multi disciplinary research project that was staffed by personnel from nursing, computer science and speech and language therapy. The aims of the project were to develop and evaluate a computer based communication aid specifically designed for intubated adult patients in ICU.

DEVELOPMENT

ICU-Talk has been designed to be quick to learn and easy to use. It comprises a choice of two interfaces, both of which support interaction via touch screen, mouse emulation or a single switch. There is a database of pre-

stored phrases, which can be personalised through the completion of a computer-based interview.

Patient Interface

Design considerations had to address several issues. These included the user's lack of concentration, their restricted physical access and the need to provide both generic and personalized vocabulary. Two ICU-Talk interfaces were developed with the guidance of a computer games company and were designed to be visually stimulating but not distracting. Both interfaces accommodate eight topics and a varying number of phrases. The layout had to be simple to accommodate single switch scanning [4]. A large font was used to try to help patients with visual impairments but small enough to allow sentences to be displayed.

The interfaces are colour-coded by topic to aid memory and visual stimulation. For example the topic 'Family, visitors' and associated screens were colour-coded pink and the topic, 'Feelings' and associated screens were colour-coded green. Phrases were displayed as black on a yellow background to maximise contrast. Both interfaces are able to support direct selection, mouse emulation and single switch scanning. This required extra consideration to be given to the number and placement of control buttons. Simple animation was used to link the dynamic screens together to give a smooth transition from one screen to the next. The two interfaces developed were called Boxes and Bubbles.

The Boxes interface (Figures 1 & 2) is similar in style to the interfaces found in currently available AAC devices. The screens contain a grid of box shaped buttons. When a selection is made, the new screen 'slides' into view. This interface allows a maximum of 10 phrases to be displayed at any time plus control buttons are at the top and bottom of the screen.

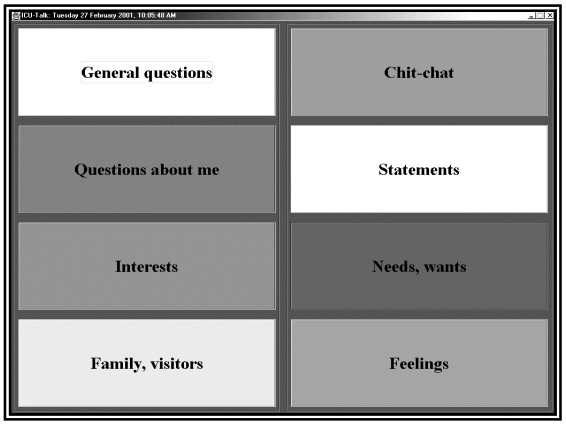

Figure 1 - Boxes interface showing topics

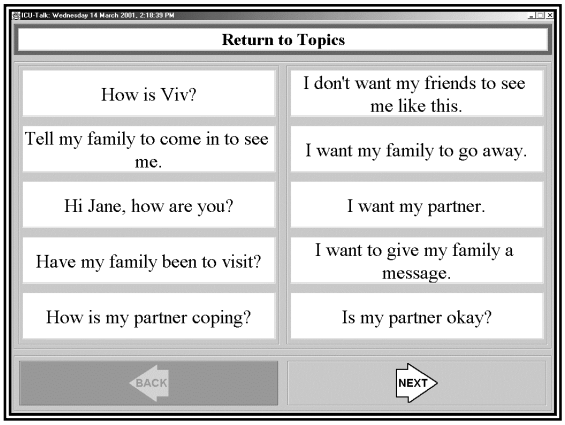

Figure 2 -Boxes interface showing phrases

The Bubbles interface (Figures 3 & 4) is a 2-D version of the Cone-Trees visualization system for hierarchical information [8]. It is as if the user is looking down the cone and when you move from one screen to the next it is as if the old screen shrinks into the centre and new screen grows out of the centre. The bubbles interface only allows up to six phrases to be displayed at a time, as two buttons are required to be used as control buttons. However, this interface is more suitable for single switch scanning.

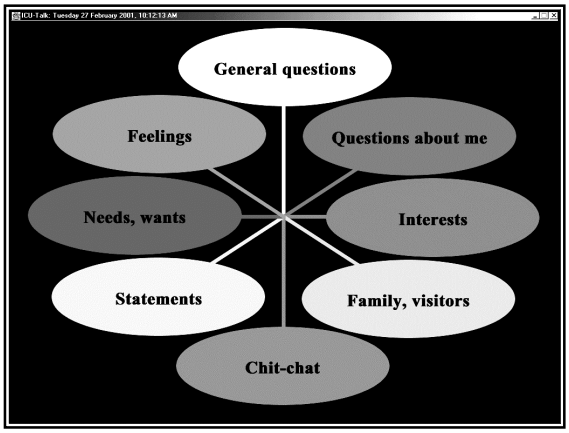

Figure 3 – Bubbles interface showing topics

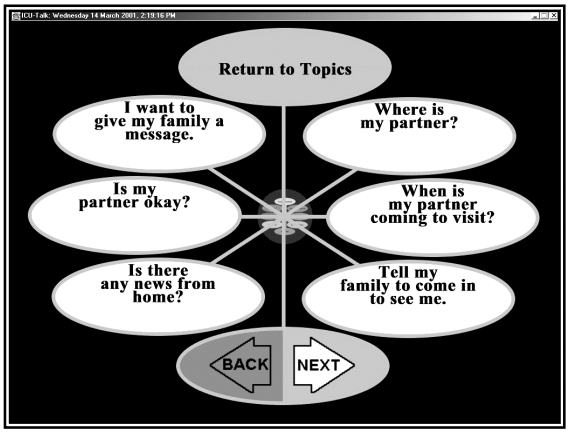

Figure 4 - Bubbles interface showing phrases

Both of these interface types were available to all patients. The patient chose, with help from a researcher, the interface they preferred.

Patient Database of Phrases

A database containing core phrases and personalised phrases was developed. The core phrases were suitable for all patients whereas the personalised were collated specifically for each patient. The database contains approximately 250 phrases.

The collection of the core phrases was done in two stages. In the first stage, 75% of the nursing staff from the ICU were surveyed to find out what they thought patients most often tried to communicate. Each nurse was given 8 topics names and asked to suggest up to three phrases for each topic that patients frequently try to communicate. In the second stage, a tool was developed which allowed the researchers to observe patients who were attempting to communicate and record their communication attempts. The phrases from the nursing staff and those from the patients were then combined. From the combined list, it could be seen that there were a group of phrases that were very person specific and a group of more generic phrases. The generic phrases were retained and used to form the core database.

Collecting a set of personalised phrases for ICU patients is very challenging, as patients only require the AAC system for a short length of time so traditional methods of data collection were not suitable. A fast method of turning information about the patient into phrases for inclusion in the database was required. A computer interview was set up which asked specific questions about the patient. Answers to the questions took the form of real names or were chosen from multiple-choice lists. Answers were then automatically incorporated into phrases by the computer to form the database of personalised phrases.

Equipment Constraints

ICU Patients are highly immuno-compromised. To prevent the possible cross infection amongst patients using ICU-Talk, the ICU-Talk device must be waterproof and able to withstand thorough cleaning.

In an emergency gaining access to the patient to deliver life-saving treatments is critical. Staff must therefore be able to easily move the ICU-Talk device out of the way to gain fast access to the patient.

The patient must be able to access the ICU-Talk device from a number of different positions e.g. sitting, lying flat, lying on their side. To meet all these requirements a rugged flat-panel screen was selected for use with standard personal computer in combination with a mounting system developed for the task by the Medical Physics Department at Ninewells Hospital, Dundee.

METHODOLOGY

In May 2001, the ICU-Talk device was introduced into the Intensive Care Unit at Ninewells Hospital, Dundee. Evaluating the effectiveness of the device in use with real patients was complicated. Each patient is unique presenting with different medical diagnoses, treatments and because of the acute nature of their illness their condition can change rapidly [7]. Experimental conditions can not be controlled and post-trial feedback from patients is unreliable because surviving patients who have been in intensive care rarely remember anything of their visit [6]. To overcome these problems the results were gathered using the following methods.

Results were collected using two automated collection mechanisms, in conjunction with three paper-based questionnaires and a face-to-face interview with members of the ICU nursing staff. One of the automated collection systems was an event recorder that tracked all use by the patient, the other was an electronic questionnaire for the patient that appeared at specific intervals to gather their opinions of the system. To gather expert opinion and anecdotal evidence from the nurses, a one-page nursing questionnaire was handed out for completion at the end of each shift. To collate the opinions of patient's relatives on ICU-Talk a two-page relative questionnaire was completed by the relative once the patient was discharged from ICU. General feedback from the nurses giving their opinions of the project and the ICU-Talk device were gathered via a questionnaire issued half-way through the evaluation period and a questionnaire at the end of the evaluation period. Nursing staff that used ICU-Talk with patients were also interviewed. The structure of the interview was based on their responses to the mid-point questionnaire.

Patients were referred to the ICU-Talk project by the nursing staff in ICU. Nurses used a referral checklist to ensure that the patient met the required criteria. A member of the project team then visited the patient to explain what was involved and demonstrate ICU-Talk. If the patient agreed to participate in the project then the ICU-Talk device was set-up. Their preferred interface and an appropriate input method were selected. Following a brief training and practice session, patients were encouraged to use the ICU-Talk device to assist in their communication attempts. The nurses looking after that patient were asked to complete a questionnaire at the end of their shift to evaluate their perception of the usefulness of ICU-Talk. The patient's next-of-kin or family member was also asked to complete a computer interview that was used to generate the additional personalised phrases.

RESULTS

At time of writing, the evaluations were ongoing. The preliminary findings to date will be documented in this paper, and the final set of results will be described at the conference presentation.

The first two months of the patient evaluations were used to confirm the stability of the software and eliminate unforeseen problems. Following this initial period the device remained largely unchanged. To date six patients

have successfully used the ICU-Talk system to communicate with nursing staff, family and friends. The results presented in this paper were gathered from the automated event recorder and from the paper-based mid-point questionnaires completed by nursing staff. The results from the other collection mechanisms will be collated at the end of the evaluation period and presented at the conference.

Event Recorder Results

The event recorder recorded all the selections made by a patient when using the ICU-Talk device. This allowed the researcher to examine the conversation patterns of the patient and view the most frequently used phrases. Unfortunately, some patients have repeatedly selected the same phrase within a very short time frame either accidentally or due to tremor or perhaps because their communication partner did not hear the phrase the first time. Therefore, summary statistics such as the most frequently used phrase may not accurately describe the phrases the patient found most useful.

Mid-point Questionnaire

Of the forty-four nurses working at the Ninewells Hospital Intensive Care Unit, thirty-two completed the mid-point questionnaire. The questionnaire asks how long they have worked in intensive care, followed by six questions based on ICU-Talk equipment and patient communication in general. The results from the questionnaire are summarised below:

- 97% felt nurses should be involved with using ICU-Talk with patients.
- 90% felt patients in intensive care need a computer based communication aid.
- 88% felt a patient's well-being is affected by their ability to communicate.
- 74% felt in their experience patients fail to communicate effectively using mouthing and/or gesture.
- 71% felt ICU-Talk obstructs their view of the patient.
- 55% felt the ICU-Talk device is difficult to manoeuvre.
- 53% of the nurses had less than 5 years experience in intensive care.

Discussion

The ICU-Talk project aimed to develop an augmentative and alternative communication (AAC) system for intubated patients in a hospital intensive care unit (ICU). The results collated so far have confirmed the ICU-Talk software is easy to use and requires very little training. Patients with a planned admission to ICU as well as those admitted due to an emergency have trialled the ICU-Talk device. Training was given at the time of intervention and not prior to their visit to ICU. The evaluations carried out so far have highlighted problems with the software and the current equipment.

The most significant problem with the software concerns the organisation and the navigation of the database of phrases. The current approach uses a hierarchy of topics and approximately 250 phrases. When the patient first uses the device they do not know, what phrases are available or where they are stored. Thus, patients may try to find a phrase that does not exist, and if it does, they still have to correctly identify the appropriate topic. The issue of organisation and retrieval of large quantities of data has been ongoing in the field of AAC. The next stage of the ICU-Talk project will address this issue.

Animation has been shown to be a powerful tool in reducing cognitive load in several fundamental pieces of research in Human Computer Interaction [3,8]. However, there is no evidence of its successful use in AAC devices featuring dynamic displays. Literature suggests that for an AAC device like ICU-Talk where the potential users' cognitive skills are compromised, animation could make a difference to the usefulness and effectiveness of the device. Further work is required in this area to evaluate the usefulness of animation as part of the interface design in ICU-Talk.

The project has overwhelming support from the nursing staff and they agree on the need for a computer based communication aid, though their concerns regarding access to the patient need to be addressed and an investigation into other possibilities is underway. Currently funding is being sought to trial a smaller computer but there are concerns about its ability to withstand the rigours of the ICU environment.

A future project is planned to address the issues discussed above and to trial an improved device in several intensive care units in the United Kingdom.

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