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Observing remote prescription of AT

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Abstract. A lack of widely accepted guidelines/protocols for remote prescription of assistive technology is noted. This paper reports observations from attempts to use web based videoconferencing with embedded tools for the provision of assistive technology to children with complex needs.

Keywords: videoconference, remote, prescription, assistive technology

1. Introduction

Historically the potential of videoconferencing to be useful in the field of Assistive technology(AT) has been recognised[1,2]. Remote AT prescription activity appears to have failed to establish widely accepted and applicable guidelines for good practice[3]. Despite myriad studies in related fields relatively few have paid attention to the interactions between participants as in this article. This paper publishes some past case study results and methods from England where videoconferencing supported remote AT prescription. The AT end users were school children, the AT experts were based in a hospital up to ninety minutes away. These results were from the European Artemis project evolving a software platform using personal computers with Internet videoconferencing and embedded tools [4-5] (see complementary conference poster). The European project technology was intended to be fit for purpose across scenarios of available AT and, facilitator skills and knowledge at the end user's location. Proof of concept and qualitative evidence were the research goals. While the technology available at the time was limiting compared to that available today many of the observations still hold value to others currently attempting to develop similar services using up to date technologies.

2. Methods

Principles of user centred working were applied. Quantitative service evaluation was inappropriate due to the early stage of the system design and experience of participants.

Prior to the investigation a simulation of remote prescription was conducted. This greatly informed the adopted research protocol. Real AT prescribers, facilitators and end users were asked to use, and therefore experience first-hand, the Artemis system. Tables 1 and 2 provide an overview of this. All participants were new to the use of

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Artemis[4] and working with a video link, and so all staff learnt how to operate it. Research ethics approval was granted to the study.

Observational data was collected by the researchers present in the sessions, who made notes during and immediately after each session, and from video recordings. Views were also sought from the participant AT experts, facilitators and end users. Analysis of the observations and video recordings relied upon combining qualitative interpretation of both the notes and the visual and audio information.

Table 1. Characterisation of the England evaluations - Expert setting

Descriptor	Characterisation
Who	Clinical Engineers with many years of expertise in AT prescription; i.e. one who routinely prescribed AT at the end user location, or, another who did not.
AT resources	Wide selection of low cost ATs, capacity to have one off technologies made.
Artemis resources	Artemis server with capacity to manage clients data, to make notes, to invoke typing and drawing tasks, to invoke use of Artemis compatible AT devices; a networked computer, IP camera and loudspeakers.
Goals	To negotiate and manage tasks with the facilitator to set up equipment and end user tasks, to agree tasks with the end user, to observe the end users performance of tasks.

Table 2. Characterisation of the England evaluations- End user setting

Descriptor	Characterisation
Who	A child end user who has complex physical and may have some cognitive disability, that may or may not be degenerative, whose age is between 6 and 15. And, a facilitator who routinely helps the children practice use of their AT; i.e. one who routinely gets involved in selecting AT and working with the experts and the end user during the prescription, or, another who has less knowledge of the selection of AT but nonetheless often supports the prescription process.
AT resources	Limited selection of joysticks, mice, rollerballs, switches, and computer based voice output communication aids and games.
Artemis resources	Researcher observer, Video camera. Facilitator operable interface to view and hear the AT prescriber and follow set tasks. A networked computer, movable microphone, moveable IP camera and loudspeakers.
Goals	To get the right AT to enable the end user to complete school learning tasks. To follow instructions from the expert and feedback observations to them.

3. Results

The use of the system was limited to assessment for AT to operate a computer, or, to review the suitability of the end user's current AT. Any AT input devices whose operation/use could be viewed were suitable. Four end user volunteers participated. Remote prescription occurred within a 20 week period. Assessment was, swapped to face to face (F2F) when deemed necessary by ethics of care, or, stopped when the end user's need was met. An overview of the 15 remote sessions is given in Table 3.

Operating the system revealed some issues. There were challenges in installing and operating live video conferencing between two security conscious organisations. This included: negotiating permission to operate through firewalls, and, problems during moderate to high contention ratios on either intranet or the external communications network. In times of moderate levels of contention, operation was patchy, using video in one direction often helped. In high contention ratios the system was unusable. End users were not bothered to see what the remote expert was seeing, although it was useful when arranging the expert's view of the end user. In situations of reduced

network capacity or when the end users' task filled the screen, not seeing the remote expert was not disturbing to participants nor was hearing their dis-embodied voice. However, the expert not speaking caused concerns that the connection may be lost.

Table 3. Overview of cases investigated in remote provision in the evaluations

Diagnosis	3 participants with Cerebral Palsy and one with MS
Significant factors	All had Strength in control, Range in movement, and Mobility. There were variations in Muscle tone, Perception, Language skills/Comprehension, Co-ordination. All had limited mobility in their upper limbs. Two had no speech. But other capabilities/limitations were very varied.
Goals	1) Typing text, pointing & clicking with any reliability and sustainability; 2) sustainable 'switch' clicking; 3) typing text, pointing & clicking; 4) type text with less errors and ease of use.
Types of AT included in assessments	Switches, joysticks; Eye gaze; Automatic Speech Recognition, mechanical support for physical accessibility.
AT sets and final status (in same order as Goals)	1) 4 explored, last combination met need; 2) 2 explored, last combination gave some success; 3) 4 explored, last combination met with some success, end-user practice indicated; 4) 2 explored, last combination met need
Sessions and total time (in same order as Goals)	1) 9 remote, 2 F2F, 16 hours across 20 weeks; 2) 2 remote, 0 F2F, 2 hours across 9 days; end user illness prevented completion; 3) 2 remote, 3 F2F, 5 hours across 7 weeks; 4) 2 remote, 0 F2F, 1.75 hours across 2 weeks.

The aspects of remote viewing and communication between local and remote participants lead to many observations; these are described in Table 4 below.

Table 4. Observations on remote viewing and communication in the sessions

Positioning of the camera at the end user setting	Sometimes to see the whole upper half of the child, sometimes the screen and the input device, sometimes close in just to see the physical contact with the AT device. Such ongoing adjustments during sessions were a cause of some frustration and contributed to staff reporting the relative slowness of remote sessions; although this impact faded with familiarity.
Experts view of what was happening	A practice adjustment was necessary where local staff stood back more to not block what the remote expert could see.
Video transmission quality/success	Because of the problems in maintaining quality video transmission participating staff discussed, bandwidth requirements. The image quality both in resolution and frames per second of the expert almost always could be low. Image quality of the end user needed to be higher resolution but often a few frames per second would have been enough.
Following instructions and sharing observations.	Local participants following instructions and communicating what they saw/achieved was crucial. This was necessary more often than in F2F. The initial novelty of managing this was significant for staff. Translating verbal instructions without demonstration was occasionally problematic. These dialogues contributed to reported slowness of remote sessions.
Sense of reduced capacity to maintain child's engagement.	The remote experts missed the capacity to directly engage the children in making the assessment interesting and motivating, i.e. maintaining the child's attention. In a change of practice the expert had to instruct the local staff for this, especially with unidirectional video when the expert was not visible.
Talking at the same time.	End user location participants talked at the same time as and/or ignored the expert. While appropriate for an immediate issue for the end user otherwise it was not. This contributed to expert reports of feelings of difficulty in engagement and frustration at not being present as in usual practice.

Staff participants reported specific comparisons with F2F working. With increasing experience remote instruction and observation worked. A lack of immediacy and direct involvement was reported in: interacting with participants; setting up at the start and of positioning AT during the sessions; and, reacting to observations. The latter leading to a strong sense of reduced efficiency. There was also a sense of risk of

missing something from the restricted camera view. In all cases the sequence of assessment compared to F2F was unaffected. The number of remote sessions used and the respective progress was highly variable, not unlike in F2F service. The experts stated that thorough case or referral notes would be necessary, explaining that F2F observations would otherwise be essential.

4. Discussion

The scenarios under study are complex. Methodological improvements such as video recordings at both remote and local locations and more systematic and formal analyses should be made in any future studies. Only 4 cases were examined, nonetheless useful insights were found relevant to the AT field. It was confirmed that the process of introducing new technology and ways of working needs to be managed carefully. Staff confidence is likely to be improved if peers have systematically researched the remote delivery protocol. Future innovations in practice should be explored in a graduated way involving practitioners and assessment facilitators in simulated sessions that approach real world use. Ethically this is better but also simulated 'experiments' of the real world initially with simulated end users is likely to allow for greater safe experimentation.

More needs to be done to ensure the remote expert can motivate and more fully engage with the end user. Embedded tools, use of two screens and/or placing a camera in a robot to move the expert's view and simultaneously stimulate the child could all help. Ideal skill levels and language needed by the staff involved needs further study. The only negative for end users was slower remote working causing slower progress in choosing AT. However this inference is uncertain because of the interspersed end user practice with prescribed AT and the impossibility to compare like with like.

Today TeamViewer[6] is a resource for working remotely; one author practitioner makes savings on return journeys of up to 5 hours through intervening on end users' computers. The other employs Skype™ and Facetime™ for initial service user data gathering, post-assessment follow up and for training. An evolution of the Artemis system and results[5] could integrate these capacities in a secure online experience. With emerging technologies such as telepresence robots, virtual and augmented reality there could be more comprehensive remote provision. All of which could operate within widely established guidelines based on thorough evidence.

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