Using Tangible Symbols with people with profound learning disabilities to access computer based media

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ABSTRACT
This project was an exploratory pilot study with 4 single cases. The aim was to explore the potential for using paper based machine readable symbols as a method for accessing media on a computer with people with profound and multiple learning disabilities. We were interested in the features of user engagement during a session, and what changes occurred over the 4 recorded sessions.

Author Keywords
Tangible symbols, Learning disabilities, choice, fiducial, Multimedia Advocacy.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design, Human Factors.

INTRODUCTION
The people we worked with in this study were in the range of people with severe learning disabilities [1], and people with profound and multiple learning disabilities [2, 3]. Many people in these groups have a lot of labels applied to them, and while these will never adequately define an individual, we need a collective way to talk about some of the issues they face. It is important to remember that these descriptions are not medical conditions or definitions but a combination of different individual factors for each person. There are no universally agreed definitions for this group, and individuals within it are as diverse and individual as any group of people.

For most people with profound learning disabilities using the computer through a mouse, keyboard and mainstream operating system is not appropriate.

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The most common starting point for computer access is using a single switch of some description through a switch box [4] to control some aspect of what is happening on the computer. This could replicate a mouse click to sequence through a simple visual PowerPoint presentation, picture slideshow, or to play games aimed at learning cause and effect.

Once someone understands the cause and effect nature of a single switch, a second switch will usually be introduced. The aim then is to develop the idea of choice between things, but it is often difficult (and expensive) to move beyond a couple of switches to introduce a wider choice. There are a number of ways to navigate choices using one or two switches in software, but they tend to be too complex for people with profound learning disabilities to navigate.

Touch screens are often used, and while their cost is coming down, it is still significant. The lack of physical tactile feedback about where on screen buttons are, and their location changing can make then difficult to use.

BUILDING ON WHAT IS ALREADY THERE
Symbols and pictures on cards are already used with many people in this group away from the computer to encourage and support understanding and communication. These range from home made icon systems, to more formally structured symbol systems that include methodologies about the interactions used with them. An example of a symbol system that includes these is Picture Exchange Communication System (PECS). [5]

Symbols and pictures can be used at a basic level to indicate something that is about to happen, to choose between to indicate a preference, or in more complex combinations to represent more complex ideas if it is appropriate for that person.

As this population face significant issues in learning new things we wanted to leverage any skills they may already have from working with this kind of system in the real

world, and extend them to control and make things happen on a computer.

We wanted to make a system to play media on the computer in response to symbol cards. The system needed to be free, or very cheap (for someone who already had a computer) so that if it worked for someone they could have it, and continue to use it after the study, as well as take it home if they were using it at school.

In order for this to be possible the hardware requirements were restricted to commonly available things, so that a parent or carer could use it for little or no additional cost if they already had a computer

The symbols that the computer recognised needed to work quickly, whatever their orientation and distance (within reason).

WHAT WE USED

We used the widely adopted reactivision computer vision framework [6] for recognising symbols on the backs of cards. Although other symbol recognition systems offered potential advantages in encoding information within the symbol they all had weakness in the speed and ease of recognition for the software in the free implementations. This made them impractical for this group. We also considered using RFID tags, but the lack of availability of over the counter domestic style readers at time was a barrier, and the potential issues of getting the correct replacements for lost tags made their continued use less likely.

We did not propose to use symbols in the usual table based system, as although it has some advantages it has significant access issues for people who use wheelchairs, and failed our criteria of cheap and readily available hardware. The default operation was simply holding up a card so a webcam could "see" them. If you are facing the computer, then holding up the card so you can see the symbol you recognise means the symbol the computer recognises on the other side is visible to a webcam built into a laptop, or positioned above or below the monitor on a desktop computer.

The program used in the study plays a video based on which symbol is shown. The program can play video full screen, or in a window so you can also have the reactivision webcam window visible. That helped some people to learn the process when it was first introduced. The program plays video files stored on the machine, each reactivision symbol has a number associated with it – the program simply plays video 1 if symbol 1 is seen.

We made some prototypes that played web based content, but the delay between showing the symbol and the media appearing and starting to play was significant and variable, making the cause and effect nature of the symbols much more difficult to discern, and so it was not used in the study.

We worked together with staff to identify appropriate content that would motivate people and look at ways that the symbols should be presented for the person they were working with.

They carried out regular weekly session over four months with the person taking part in the study, and once a month we videoed the session and analysed the video. The number of symbols used and the length of the sessions varied depending on the capacity of the individual participants to engage with the activity.

DATA COLLECTION AND ANALYSIS

The staff filled in evaluation sheets for the sessions they ran unobserved. We used two video cameras to record the observed sessions. They were positioned to capture the participant and staff member's expressions and interaction, and the interactions with computer hardware and screen display.

The two videos from each session were synchronised, put side by side, and sampled in 60 second segments with 60 second gaps.

The video samples were transcribed using recommended conventions from discourse analysis, and then coded using interactional/discourse structure (turns and moves). [7]

Repeat coding was carried out by a second person on 30% of the data, and Cohen's Kappa Coefficient applied as a statistical measure degree of reliability.

INITIAL OBSERVATIONS

We are still analysing the video shot at the sites, but have initial anecdotal observations.

The staff working with people were very enthusiastic and excited about the possibilities this offered, and enthusiastically set up and started using the software.

Music videos were used in most settings as they provided strong motivation for students. It also meant that if they presented a card when they weren't looking at the screen they got feedback from the sound.

In one of the school settings symbol cards were already being used away from the computer.

They cut a hole in a desk the size of sheet of A4 paper, stuck a sheet of frosted Perspex under the hole and put the webcam under the table. The students needed to put the cards onto the Perspex to have them recognised. This produced something similar to the way the cards were already being used in the school, but made it less easy for the use to transfer to the home setting from the school. Cards were used with photos of stills from the videos that would play. Both students were able use the system independently after 2-4 sessions. They used six cards, one of which was a control that would play a video of grass, with no sound. The grass clip was never deliberately played.

One student developed an interesting technique for manipulating the symbols, leaving all (except the grass one) lying on the Perspex, and then shuffled them around on the Perspex until the one she wanted triggered the video.

The teacher is now looking at how to use it with the other students in the class, and is planning to use it with the two current users in their review meeting at the school to show videos of what they have been doing this year.

The teacher is keen to develop the system with us to do other things, but for now feels that the enjoyment they get from using it as it is should be left for a while.

In other places people were using one card to understand the cause and effect relationship, but the staff were excited about this being a significant step for the people involved.

Staff needed some support to understand they needed to run two programs at once (the software to detect the symbols and the software to play the videos). Although they were familiar with more than one program running, they were less familiar with the idea of the interdependence of two programs.

People who have less profound learning disabilities who tried the software have more awareness that they are showing something to the computer and tended to turn the card around so the picture they recognise is shown to the computer, rather than the fiducial symbol. They are able to learn to hold it the other way round, but a system that recognised the same symbol that they do would be more simple for them to use, and has some advantages, but is at this stage much more computationally intensive for the computer.

Physically picking up the symbols was difficult for some people, and this may not be the most appropriate system for them, but the low tech nature of the tangible element of the system meant that the person working with them was able to try and implement ways of picking up and selecting the symbols with that person, rather than needing support for that.

The ability to increase or decrease the number of symbols during a session enabled the person offering support to change the degree of complexity (how many choices) without needing to reconfigure the computer, enabling a fluent and confident use by staff who don't feel they are technically inclined. It also enabled them to work in a way they were familiar with the participant to enable them to choose things, rather than the technology overwhelming them.

CONCLUSION

We are unable to draw firm conclusions as this was a pilot study, and the video analysis is not yet complete, but the anecdotal evidence at this stage is promising. The system was used in a range of settings with different people. The staff supporting the people in the study felt that it had been successful and are keen to continue using the system with people and develop other use case scenarios. It was used by people in the study at a cause and effect level, and also to choose what was played. At one site two participants started to use the symbols together to watch videos as a joint activity, an exciting development for the staff working with them as well as the participants.

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