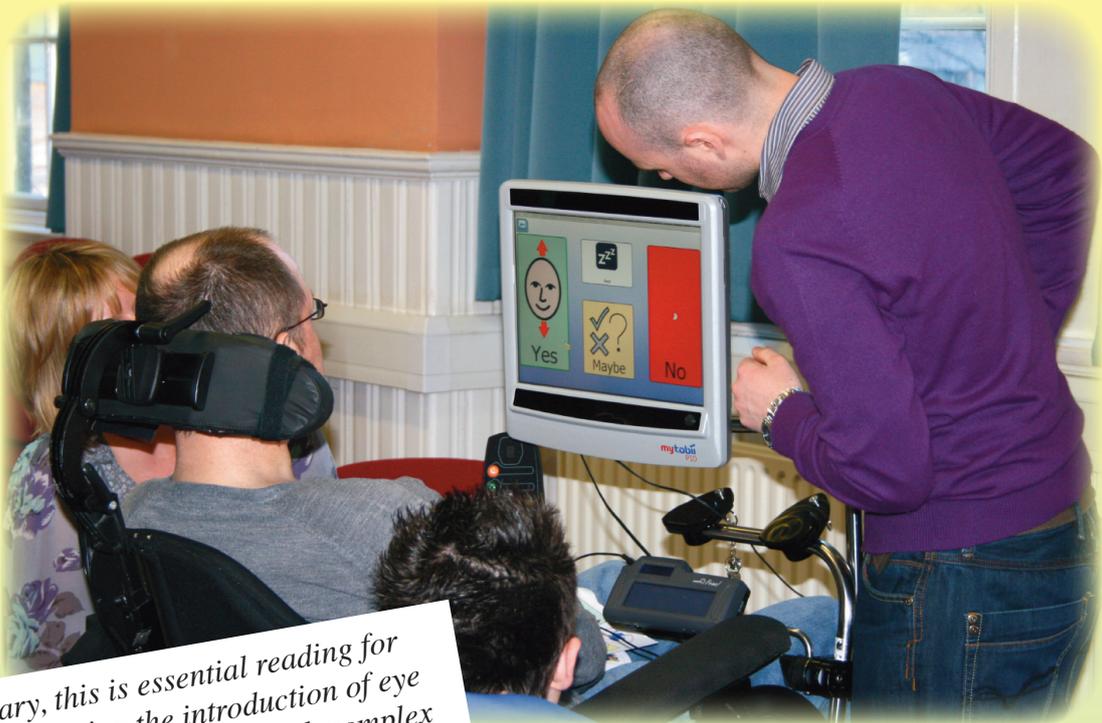


The Eyes Have IT!

The Use of Eye Gaze to Support Communication



“In summary, this is essential reading for anyone considering the introduction of eye gaze to support an individual with complex communication needs.”
Child Language Teaching and Therapy
May 2012



Collected Papers from the 20th Annual Augmentative Communication in Practice: Scotland Study Day

The Eyes Have IT!

The Use of Eye Gaze to Support Communication

Edited by Allan Wilson and Rebecca Gow

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Augmentative Communication in Practice: Scotland

This is an open group composed of people who have an active interest in augmentative communication - users of AAC, families, carers and professionals from a variety of different disciplines. This book brings together the various papers presented at the group's Twentieth Annual Study Day, *The Eyes Have IT! The Use of Eye Gaze to Support Communication*, held in Stirling in November 2010.

Study Day Organising Group

The Study Day was organised by staff from the main communication aid services in Scotland:

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Welcome to the Collected Papers from the 20th *Augmentative Communication in Practice: Scotland Study Day*. The book is made up of the papers presented at the Study Day on the use of eye gaze to support communication, held in Stirling on November 9th, along with additional material contributed by augmentative and alternative communication (AAC) specialists working in Scotland. We are delighted to include contributions from Linda and Andrew Lawson, who both use eye gaze technology for communication. It is heartening to see the impact that technology has had on their lives!

Mick Donegan and Janet Scott have worked with a number of people with communication difficulties who have benefited from the use of eye gaze technology. They are both passionate advocates of access to the right technology, but both stress that eye gaze is not a 'magic bullet' that will cure all communication difficulties. Mick stresses the need to consider the individual's needs and abilities, while Janet lists the prerequisites necessary for success.

Sandra Miller raises the ethical issues that can arise when considering the cost of introducing eye gaze to a person who may already have an alternative communication system.

Communication by eye gaze (or eye pointing) is not just about technology. Clare Latham describes a project in which a number of children with speech and language difficulties were encouraged to develop their communication skills by the use of symbols with low tech eye pointing frames with their families. Sally Millar, while supportive of the appropriate use of eye gaze technology, makes the case for far greater use in schools of eye pointing techniques. Her paper should be required reading for all teachers working with children with severe and complex communication difficulties.

We hope that this little book will open your eyes to the communication possibilities presented by eye gaze technology, while also reminding people that it is not always necessary to have technology in order to use the eyes for communication.

Finally, I would like to say thank you to Rebecca Gow for her valuable assistance in editing and desktop publishing this book.

Allan Wilson
CALL Scotland
The University of Edinburgh

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Device Specifications

- 2GB RAM, 1.6 GHz, 60GB Solid State Drive
- Weight: 6lbs., 13oz. With Single Changeable Battery
- Dimensions: 13.2"W x 11.2"H x 2.9"D
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- LCD Screen Resolution: 1024 x 768
- Lithium Ion Battery, up to 8 hours run time
- Digitised Speech Record Time: 660k/min

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Gaze Controlled Technology – How Far have we Come? Where are we Going?

- Mick Donegan

As someone who has specialised in gaze control over many years, people often ask ‘Which is the best gaze control system?’

There is no simple answer to this question – in fact, I’d argue that there is no answer to this question. Each system has its strengths and weaknesses. Each system responds differently to different eye gaze users. The question that actually needs to be asked is ‘Which is the best system to meet a particular person’s needs and abilities?’.

Before deciding which system to go for, then, there are a range of features and issues in relation to user requirements that I personally feel need to be taken into account. I have listed some of these below. Their relative importance will, of course, depend on the needs and abilities of the individual user.

What do I want to do with the gaze control system?

Communicate socially? Access the web? Control the environment? Etc. All of these things can be done on more or less any of the available eye gaze systems, given the right application. In comparison with other control devices, the only thing that gaze control is not generally ‘allowed’ to do is control the wheelchair (due to health and safety issues).

Wheelchair mounted or not?

It is important to think carefully about whether the gaze control system is to be wheelchair mounted or not. If the system is intended to be wheelchair mounted this will, of course, influence the kind of system that is purchased. Issues relating to the size, robustness, use of mounting, etc particularly need to be taken into account when choosing a gaze control system for wheelchair use.

Why is gaze control being considered for a particular end user?

One would think that there is a simple answer to this question. However, in my experience, professionals are divided into two distinct camps when it comes to this issue.

Because there is no alternative to gaze control?

On the one hand, there is a group of professionals who might consider gaze control when there is no possible alternative. In other words, if the person involved can only move their eyes and no other part of the body then a professional in the ‘no-alternative’ camp might consider gaze control for that particular individual. In other words, such professionals would only consider gaze control when all else fails.

Because gaze control is the BEST option for the end user?

There is another group of professionals who do not differentiate between gaze control and any other form of control. It is simply another access method. They will not be influenced by issues such as cost but more by questions like the following:

- *Does gaze control involve less effort for the client than other control methods?* I’ve been surprised in many cases how much less effort gaze control requires than other control methods for many people with disabilities, in particular people with involuntary movement.
- *Is the client in a more comfortable position when using gaze control than when using other control methods?* One of the benefits of using gaze control is that it allows the person using it to sit in a comfortable midline position rather than, in some cases having to control the computer with an asymmetrical posture, for example when using a joystick to one side.
- *Is gaze control less painful than other control methods?* I have been surprised by the increasing number of people with disabilities who have only commented on how painful computer access can be when given the option to use gaze control. For them, many of the issues that are so important when choosing a control method, such as speed, efficiency, etc pale into insignificance compared with the fact they do not find gaze control painful compared with previous methods of computer control. Discussing this issue further, until gaze

control, it seems that many people with disabilities feel that pain and discomfort are simply an integral and unavoidable price they have to pay for successful computer control.

- *Is gaze control quicker for the client than with other control methods?* In many cases, gaze control is often quicker than other forms of control. I was recently amazed and inspired to witness a mother and her daughter communicating ‘in real time’ at a conference at which they spoke together.

everything. Even when gaze control is **not** quicker, the person using it is often able to continue for far longer because they are more relaxed and in less pain. As a result they are not only able to do more with their system but are less tired at the end of it.

Grid-based access or direct pointer control?

There are fundamentally two main approaches to gaze control – direct pointer control and grid-based control. Often, people using grid-based control use a ‘centralised dwell-select’ feature. This feature is very helpful for those with visual difficulties, involuntary head movement, or learning difficulties – or simply because they find it less tiring or demanding to have an ‘eye-control friendly’ grid than to use pointer control.

While many grid-sets are available that will enable the user to communicate socially, send emails, control the environment, play music, etc, new grids often need to be developed if the eye gaze user needs to have direct control over specific software.

The alternative is to have direct pointer control. By ‘direct pointer control’ in this context I mean controlling the actual on-screen pointer **directly** through eye movement in the same way that a mouse would control it except that it is the eye which controls the pointer movement instead of the hand on the mouse.

Many people looking to purchase gaze control systems are not even aware of what direct pointer control actually is and simply look for a gaze control system with an appropriate grid-based utility. Those people who do know that direct pointer control is possible without the need for a grid-based utility think that it is something that might only be appropriate for high-level users.

However, there are a range of potential benefits to having the option of using direct pointer control for gaze control users of all ages and abilities. For example, the use of music can provide an excellent introduction to the use of gaze control, whether in an assessment or during the implementation process. The reason why it can offer such a helpful introduction to gaze control is because there is no pressure to spell a word correctly or select the correct phrase. Such demands, early on, can be counter-productive, as they introduce the possibility of failure which can, as a result impact motivation and performance. On the other hand, if enjoyable music can be produced by looking at any area of the



An example page from Hanne’s gaze controlled ‘me-too’ grid-set running on ‘Communicator 4’

- Marianne Semner and her daughter Hanne’s presentation was remarkable in that it was completely unrehearsed. It was simply a natural conversation between a mother and her young daughter only Hanne conversed using gaze control with a special grid-set called ‘me-too’ running on *Communicator 4* software. Hanne’s mother had gone to a huge amount of effort in designing a grid set that suited the needs and interests of her daughter. However, she felt that all of this effort was worthwhile because, as a result, she could have as natural a conversation as any other mother and daughter. Furthermore, it was very nearly as quick as any other natural conversation. Marianne feels that such use and speed of communication has greatly enhanced her relationship with her daughter and that all of the time and effort has been completely worthwhile. Because of this success, she was asked to produce both a low-tech version and a high-tech version for others to use as a basis for a communication system. More information is available from www.me-too.no. However, it must be remembered that, whilst there can be immense benefits that result from increasing the speed of communication and control, speed isn’t

screen then there is no pressure, no right or wrong answer, and the person can be allowed simply to enjoy it and become accustomed to this completely new form of alternative computer control. For example, whilst never originally intended for gaze control, Inclusive Technology's *Target and Touch: Patterns*, accessed by direct pointer control, can provide an excellent introduction to gaze control for users of all ages and abilities.

What TYPE of gaze control system do I need?

There are essentially three categories of system – 'all-in one', modular and 'add-on'...

All in one systems

The MyTobii P10 is one example of an 'all in one system'. Amongst the advantages of such a system is the fact that there are no difficulties in terms of connecting separate pieces of hardware, as with add-on and modular systems, below. However, one of the disadvantages is that, when the system gets older, the computer hardware cannot be updated. Therefore, even though, as a gaze control system a MyTobii P10 might continue to work effectively for many years, unfortunately the user cannot update the computer itself.

Dedicated modular systems



The Tobii C12 + CEye, Dynavox VMax + EyeMax or the ECO2 with ECOpoint are all modular systems

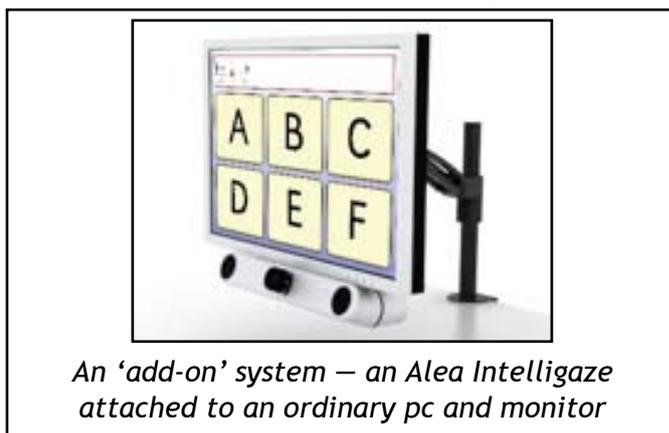
The C12, VMax and ECO2 are all speech output devices that can work very effectively using a wide range of input methods. With these, gaze control is just one of many options. They are therefore particularly worth considering if the person using the system either needs multimodal input or if they might need to use gaze control at a later stage, for example, due to a degenerative condition.

With such dedicated modular devices it must be acknowledged that a specific gaze control module must be used with a specific communication aid so, obviously, a CEye cannot be used with a VMax and an EyeMax can't be used with an ECO2, etc. Therefore, as each gaze control module might respond differently to different eye gaze users, my own recommendation would be that, if gaze control is important, then the level of success of the gaze control module for an individual user should actually take priority over the choice of which communication aid it should be used with. This view is, admittedly, at odds with decisions taken by a number of people who have based their decision on which modular gaze control system to purchase based primarily on the communication and control software available for the particular communication aid they want to use it with. Perhaps this might be because they feel that all gaze control modules or systems work more or less equally effectively. However, this is not always the case. You will only find out how effectively any particular gaze control system or module works with any particular gaze control user by trying them out and comparing them.

One of the benefits of such dedicated modular systems is that a communication aid such as those described above can be purchased separately from the eye gaze module that fits it. Unfortunately, a similar potential problem might arise in terms of the early obsolescence of the gaze control element of the system. At this stage, as far as I'm aware, there is no guarantee that future communication aids such as those described above will be compatible with the existing eye gaze modules designed to fit them. Therefore, when a new version of the communication aid replaces the existing one, there is a danger that the gaze control module that fits it (often costing thousands of pounds) will also need to be replaced by a new one.

Add-on systems

Add-on systems include the Alea Intelligaze, the Quick Glance TM 4 and the LC Edge. These are



systems that will work with virtually any Windows computer and, in certain cases, on a Macintosh too. They come with their own interface software that, amongst other utilities, offers pointer control. Add-on systems can have certain advantages over all-in-one and modular systems.

A dedicated gaze-based Windows control interface

The vast majority of people who use gaze control are initially introduced to it through the use of a grid-based interface that offers a 'centralised dwell select' feature, such as *Communicator 4*, *The Grid*, *Qualilife*, etc. However, if they improve sufficiently, they may well be able to use eye gaze for direct pointer control at some stage too once they have built up their gaze control skills. When this happens, they will need to have a Windows control interface that is as well-designed and comprehensive as possible in terms of tailoring it to their personal abilities and requirements.

Choice of computer system

Many people who are able to use direct pointer control may well want to use it with powerful, memory hungry software. Whether they want to use it for employment or whether they want to use it for leisure, e.g. video games, an add-on system can be used with the computer of their choice. Instead of being 'locked into' using whichever computer system that is integrated into their dedicated modular system (described above) they can have whichever computer system they choose, whether a tablet computer, laptop or desktop system.

Future proofing

As described above, an add-on system can, in principle, be used with virtually any Windows computer. Therefore, after two or three years when it's time to upgrade the computer you still have the add-on gaze control system which can simply be plugged into the new computer.

What do I want to do with my gaze control system?

Communicate socially? Access the web? Control the environment? Etc. All of these things can be done on more or less any of the available eye gaze systems, given the right application. In comparison with other control devices, the only thing that gaze control is not generally 'allowed' to do is control the wheelchair (due to health and safety issues).

Of course, additional criteria need to be taken into account before choosing a gaze control system, such

Case study – Paolo

Paolo is someone who uses direct pointer control along with a simple on-screen keyboard. He has ALS/MND and has no involuntary head movement. This lack of involuntary movement combined with excellent visual acuity and a high level of motivation means that he has the ability to control the on-screen pointer that is as quick and effective as using a mouse. As a result, he can access mainstream software quickly and effectively and has been able to continue his day job as a web-designer. Furthermore, he has been able to continue to pursue his hobby as a musician by writing music using the professional standard composing program, *Cubase*.

The 'Magnification lock' Feature

One of the techniques that Paolo uses to achieve quick and accurate direct pointer control is to use a 'magnification lock' feature. With the first simulated mouse click a 'magnification box' appears within which their target is enlarged. It is then much easier for the eye gaze user to directly select their target with the second simulated mouse click. Following this, the next selection automatically enlarges the target and so on. The interesting thing about this technique is that, even though Paolo is accurate enough to be able to select very small targets on the screen, he chooses to use the 'magnification lock feature'

as reliability, quality of support, etc. The availability of online support, i.e. the manufacturer or supplier taking direct control of the gaze control system and resolving problems online, can be extremely beneficial.

The one criterion that I personally find difficult to understand, however, is when the cost of gaze control in comparison with other control methods is the primary consideration when a choice is made. Only time will tell the difference that gaze control will make to those who have the opportunity to use it in comparison with other methods. However if, as many of those I have personally worked with have begun to indicate, it is found that gaze control can, indeed, have a positive impact on posture, pain reduction, speed, academic success, quality of life, employability, etc. then its cost, compared with the benefits that might follow, might seem cheap at almost any price.

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Snapshots of Using Eye Gaze – A Professional Journey into the World of Eye Gaze

Janet Scott

In a relatively short space of time eye gaze has established itself as a viable alternative access method for computers and communication aids. It is a new addition to the access options 'kitbag'. For some people there is a genuine feeling that technology has at long last caught up with their needs (Harrison, 2010). Eye gaze has suddenly become the 'in' thing.

What are we meaning by 'access' in terms of a communication aid or low-tech communication display? Anyone using AAC to communicate requires some way of controlling the system and making a selection - this is their access method. Choice of access method is dependent on the individual's physical abilities. There are two main categories of access: direct and indirect. Direct access is the most familiar - this is what we do when we use a standard keyboard to type, when we point to an item on a menu in a restaurant. Some people are able to use direct access to control their communication aid - they may use their fingers to point, alternatively they may use another part of their body to make direct contact with the communication system e.g. typing with their toes, pointing with a fist. Other people may be able to use a non-contact direct access method e.g. looking directly at the desired object with their eyes (eye pointing). Indirect methods of access include switch controlled scanning systems and encoding systems. Indirect access systems involve a significant amount of learning before the user is proficient with the technique (for more information about accessing options the Communication Matters leaflet provides a useful overview¹).

For people with complex physical difficulties their eyes may provide the only realistic means of control; they are often able to control and use their eyes to communicate while other physical movement is effortful and challenging (Ayre, 2010). Eye gaze (or eye pointing) has been used for many years to provide a low-tech means of face to face communication. Goossens' (1989) describes working with a young girl with cerebral palsy using eye gaze, using an E-Tran frame to display pictures and toys etc. An E-Tran frame is simply a structure to hold (or display) the

visual materials. In the main, commercially available E-Tran frames tend to be made from Perspex, but they can be made from a wide range of materials - plastic piping from DIY stores, cardboard, laminate sheets... and even a broken dressing table mirror frame! However low-tech eye pointing systems are not limited to using an E-Tran frame - it is quite possible, for instance, to use a Talking MatsTM² approach via eye pointing. To give the user access to more vocabulary than can easily be accessed directly, there are a number of different encoding systems around which can be used with eye pointing, e.g. Buckley and Latham (2008).

E-Tran frames:



Simple E-Tran frame with 4 symbols³

Using the Frenchay E-Tran Frame - a colour coded spelling system⁴



Eye gaze as an access method in itself is not a new phenomenon. What is relatively new is that it is now possible to control a computer or an electronic communication aid simply by moving one's eyes.

Initially I was sceptical – I could see that this technology could be a useful method of accessing a computer for writing etc; I was less convinced that it was a viable option to provide someone with a means of communication. I felt that it would intrude on the interpersonal aspects of face to face communication, that it would get in the way of social interaction with other people because of the level of concentration and need to fix your gaze on the device. However for the SCTCI team it was obvious that this was something that needed to be investigated further - so for two years we explored

¹ Focus onAccessing Communication Aids and Computers” – http://www.communicationmatters.org.uk/sites/default/files/downloads/focuson/Accessing_Communication_Aids_A4.pdf

² Talking MatsTM – <http://www.talkingmats.com/>

³ http://www.inclusive.net/resources/units/unit4/images/4page_27.jpg

⁴ http://www.cogain.org/wiki/File:Es_a_interacting.jpg

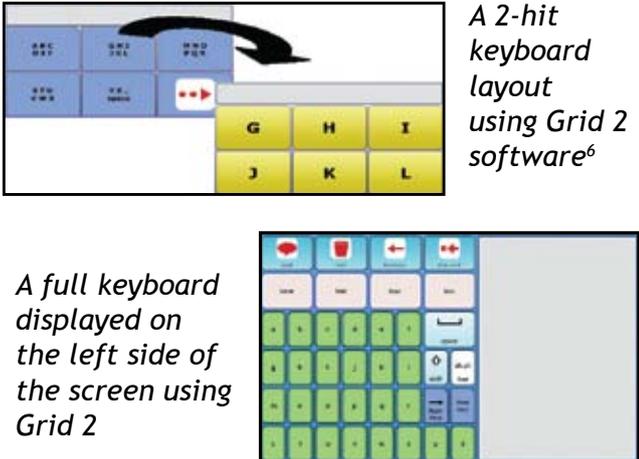
the potential of eye gaze systems and then in early 2007 we took a leap of faith and ventured into the world of eye gaze technology, with the purchase of a Tobii P10⁵ system. Initially it seemed a very precious commodity, one that was used with some trepidation - however it soon became just another tool in the assessment kit. We have successfully introduced eye gaze access to both children and adults with a range of physical, communication and learning needs associated with, for example, cerebral palsy, Duchene's Muscular Dystrophy, 'locked in syndrome', head injury, MND. My initial concerns and misgivings have been totally removed. Eye gaze technology is no more intrusive in the interaction process than any other form of electronic communication aid, and for some people it is truly liberating.

This paper will outline some of the issues that have become apparent in the time that we have included eye gaze options in our assessment.

understand 2 dimensional pictorial representations (photographs or graphic symbols) displayed on a computer screen. They need to have a realisation of cause and effect and understand that simply by looking at an item on a computer screen they will cause something to happen. Because eye gaze is intangible this can be a difficult concept for some people and it is usually best to develop eye gaze skills using low-tech materials first (see Buckley and Latham 2008 for one possible approach).

Although some people may be able to look at the screen and trigger a response from the eye gaze system, they may not actually understand what it is they are looking at. Some of the early game activities for training a new user are error free, possibly resulting in a false impression that the user is aware of what they are doing and is purposefully making a choice.

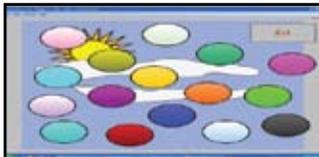
Different keyboard layouts to accommodate visual/access needs



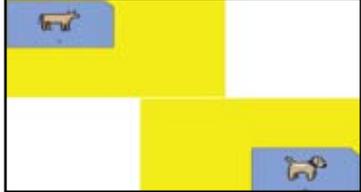
A 2-hit keyboard layout using Grid 2 software⁶

A full keyboard displayed on the left side of the screen using Grid 2

Error free games/activities



A cause and effect game using Tobii Communicator software⁷ – the user 'pops' the coloured balloons



A simple targeting activity using Grid 2 software - the user selects the animal on the screen, which makes the appropriate noise and then changes to a different animal and location

Eye gaze is not for everyone

This may seem very obvious but, as with many new and exciting technologies, there is a tendency to believe that this will be an instant solution for everyone who has difficulty physically controlling a computer or a communication aid.

Obviously for anyone to use eye gaze there must be a degree of functional vision present. A diagnosis of cortical blindness is not a good predictor of successful eye gaze use; however it is possible to compensate for areas of visual neglect, visual field defects etc by designing screens that maximize the user's visual skills. However any user of eye gaze technology has, as a minimum, to be able to

Obviously this type of activity can be very useful to motivate a young, or inexperienced, user - giving them lots of success immediately, however it is important to be aware of the limitations of this type of activity. Activities which require the user to match pictures, find the odd one out etc obviously require a greater degree of visual understanding - as well as accuracy at targeting.

Some medications may also impact on the user's ability to use eye gaze e.g. Baclofen can cause enlarged pupils⁸ which reduces the ability of the sensors to track the user's eyes, certain antiepileptic medication can affect the individual's ability to visually focus on a symbol with the intent of making a choice (Srinivasan, 2010).

5 Tobii P10 – http://www.tobii.com/assistive_technology/products/mytobii_p10.aspx

6 Grid 2 software – <http://www.sensorysoftware.com/>

7 Tobii Communicator software - http://www.tobii.com/assistive_technology/products/vs_communicator.aspx

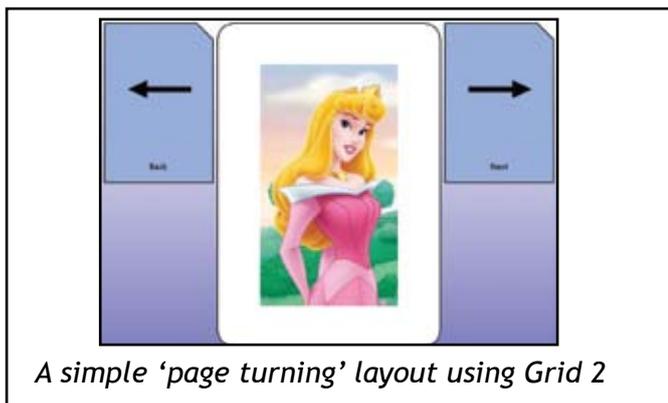
8 Effect of Baclofen on pupil size – <http://en.wikipedia.org/wiki/Baclofen>

Eye gaze access has to be learned

Very few people are able to use eye gaze access on a computer straight away - most will take a bit of time to learn what to do, and how to control the computer and not have it control you! One man I have worked with was able to activate the system, and almost immediately began spelling out what he wanted to say. He spoke continuously for about 15 minutes before typing in 'help' - he didn't know how to stop! He had previously communicated using the Frenchay E-Tran frame, and despite being very quick with this technique, was totally dependent on a competent communication partner to decode his eye movements. For the first time since his illness he was able to communicate what he wanted to independently, and it was an almost immediate love affair with the computer. However despite having no cognitive or linguistic issues, he still had to learn the operational aspects of using eye gaze on computer.

The majority of people we have been involved with at SCTCI have needed repeated practice to develop a level of competence and fluency with the system before it has been possible to say whether or not this is a viable access option. Some of our clients have gone through a stage of 'scribbling' or 'babbling' with the technology, as described by Caroline Musselwhite (2009).

The youngest child I have introduced eye gaze to was a young boy aged three. He had developed quite an effective low-tech eye pointing system with his mother, though others found it hard to 'read' his pointing since he tended to have quick, fleeting gaze. Obviously for this little boy I did not expect that he would immediately be able to communicate using an eye gaze computer - however what was interesting was that he enjoyed playing with the speech output, repeating the same word over and over and laughing (babbling with the technology). His exploration was very much self-directed, and he resisted adult direction. One of his early layouts gave him access to something akin to a picture



book, with page turning buttons - he tended simply to flick through the 'book' changing the screens rapidly. After a while he would return to a page with a favourite item on it and look for longer at this picture before flicking through the 'book' again. This was his first opportunity to be able to look through a 'book' himself.

He was provided with a My Tobii P10 at the same time as he started school and has spent the last year 'playing' with the system - now in Primary 2 he is just beginning to be able to use the system with adult direction in more formal 'learning' situations. Would he have learned to do this without having had access to the system? I do not know - it is very much a chicken and egg type of situation - his mother was adamant that he needed access to the system in order to learn how to use it. For a young child such as this, or indeed for anyone learning to communicate through augmented means, there are a number of aspects involved in becoming a functionally competent communicator. Light's competencies (1989 and 2007) are as relevant for people using eye gaze as their access method for communication as they are for any other means of AAC technology. Over this past year he has been learning how to become operationally competent with the system - knowing how to make a selection, how to access the message bar, how to clear the message bar, how to navigate between pages etc. He still needs to learn the more communicative/interactive competencies - how to use the system to express himself, how to use different language forms depending on the situation etc. This is the case for many of the young people we have introduced eye gaze to - especially if they have never managed to communicate independently before and have had several years of failure and frustration. Another young man was 14 when he first tried eye gaze. Previously he had spent 10 years trying to use a switch - different control sites were tried, different switches were tried - all to no avail. He had learned to fail - and was so excited when, with difficulty, he was able to activate the eye gaze system. He now has his own system and is learning to use it - however having had many years of learning to fail and of being a passive communicator he has a significant amount to un-learn. He has to learn how to initiate communication using a high-tech system, how to take communication turns, how to gain attention appropriately. It is obvious that he has little idea of his role in achieving successful communication.

The complexity of the task - learning to communicate using an eye gaze system, dealing with your own and others' expectations, realising that it may take some time to become proficient - is commonly

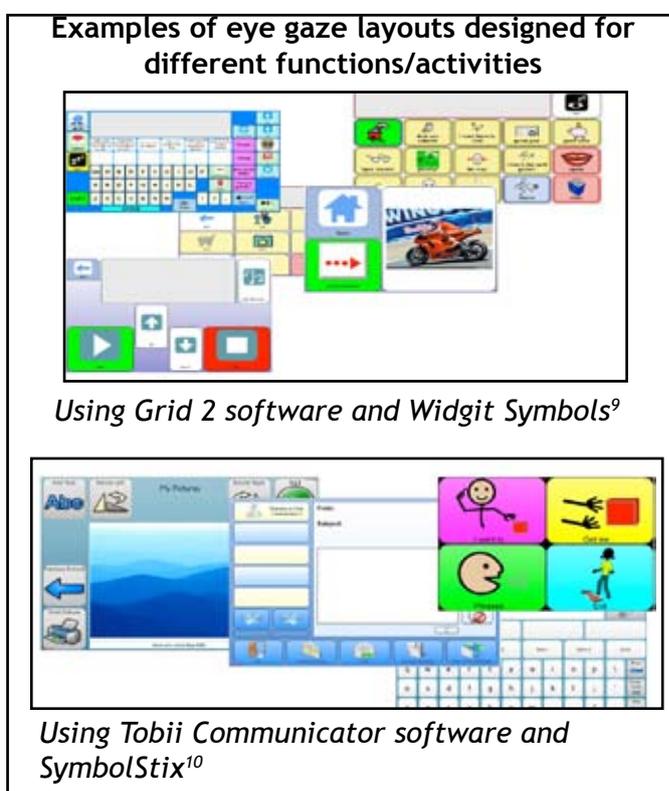
underestimated. Bergsten (2010) described a young woman who had successfully been using a low-tech partner assisted scanning system to access her various communication books. Initially when she was introduced to an eye gaze computer she loved it - she could access her photos, music etc. However once she was expected to use the eye gaze computer for more formal school work and not just for having fun, she began to refuse to use it, making deliberate mistakes etc. With this more independent access method, her cognitive limitations became more obvious and she realised that she was not able to keep up with her classmates - her physical difficulties had masked other barriers to her learning. Everybody's expectations had been that this new technology would liberate her and allow her to express everything that had been 'locked up' inside. It was important to reinstate some of the fun into using her eye gaze system with a very gradual and sensitive re-introduction to more formal activities, geared at an appropriate level.

Provision of an appropriate access method can also reveal more accurately the individual's level of ability - sometimes the person's physical barriers can mask an underlying ability just as they can highlight an inability. One child I worked with demonstrated a wicked irony by repeatedly selecting music he knew his classmate hated - this was the first time he had been able in any way to 'get back' at his classmate for that boy's loud and disruptive behaviour. The intention was clear, the satisfaction of annoying his classmate was obvious - this was the first time I had seen real functional and effective interaction.

Eye gaze is only the access method

It is easy to become seduced by the 'magic' of seeing someone using an eye gaze system and to forget that actually it is really only the means to an end - it is the access method that allows the user to speak via their communication aid, to write an email, to play music, look at photos, and switch on their TV etc. Eye gaze technology is in many ways only an expensive mouse.

For some people, eye gaze is their only means of access, for others it may be a choice, and for others it is something they may reject. Derwent (2010) described a client who found eye gaze quicker and easier than switch scanning for text input, so used this access method for writing emails, but who opted to use switch scanning for internet access because she found the text links were too small. Some of the young people SCTCI has worked with have opted to continue using scanning access for their communication aids and computer control,



even though they have the potential to become quick and accurate users of eye gaze. One boy had worked so hard over a 2 year period to develop his switch scanning skills - working through low-tech partner assisted scanning, partner dependent 2 switch step scanning, independent 2 switch step scanning, to single switch timed scanning. He is now a competent scanner even though the amount of effort required is immense - however he is very proud of this achievement and does not want to change to a different, and potentially less physically demanding, access method at this point in time.

Designing eye gaze layouts

Creating a layout for someone using eye gaze is a very similar task to creating any other screen layout on a communication aid. The same principles apply. Blackstone (1993) suggested that the purpose of the communication display is to allow an individual to say what they want to, as quickly as possible and with the minimum amount of effort. Thought has to go into how to lay out the vocabulary to help the user locate what they want - this can be in topic categories, alphabetic word lists, visual scenes etc.

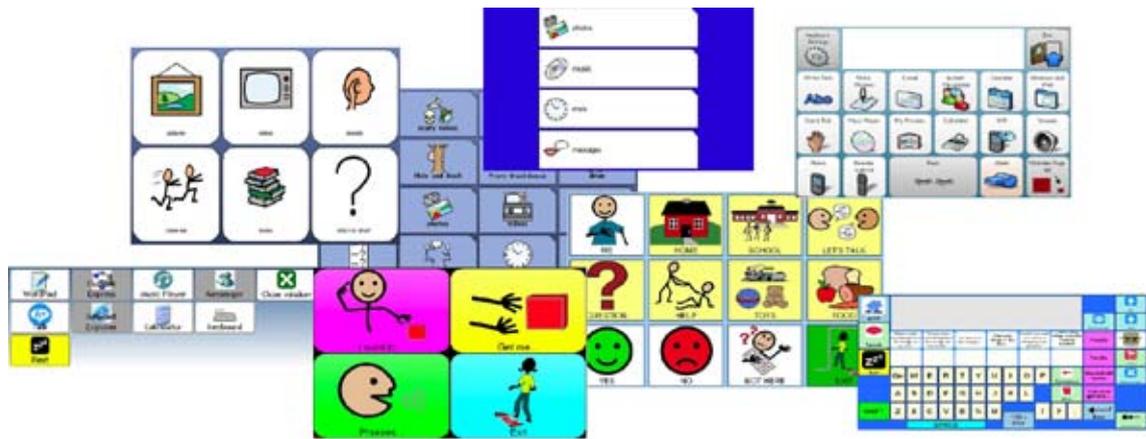
Saying what you want to

Allowing an individual to say (or write) what they want to is basically a vocabulary selection

⁹ Widgit Symbols – <http://www.widgit.com/>

¹⁰ SymbolStix - <http://www.viking-software.com/products/04/symbolstix.php>

Different communication and computer control layouts reflecting differing ages, abilities etc



Using Grid2 and Communicator software with PCS, Widgit Symbols and SymbolStix symbol sets

issue. Identifying appropriate vocabulary for a communication aid is not an easy task - it needs to be appropriate and functional for the individual taking into account their age, gender, cognitive and linguistic abilities, interests, cultural factors etc. This is no different if making up a communication display for someone to use with eye gaze.

As quickly and as easily as possible

We need to think about the number of items (symbols, pictures, text) on the screen at any one time, their size and location on the screen. Sometimes spacing the items out can help make it easier for the user to target the desired item. Some people find it easier and quicker to use a 2-hit spelling layout with larger targets rather than a standard QWERTY alphabet layout with a greater number of smaller and more closely spaced items. Just as with any other communication display maintaining consistency of location for key items can really speed up access and reduce the amount of time the user has to search for what they are looking for e.g. having all the navigation buttons in the same place on the screen, having the speak display/clear function in the same place etc. Using colour can also help the user to locate what they want quickly.

There are really only two items which we have found may be helpful in operational terms on an eye gaze display, which would not be found on any other type of layout:

- 'rest' cell - which allows the user to temporarily turn off the eye gaze camera and gives them a chance to look at the screen without activating anything
- 'eye track status' cell which allows the user to see where their eyes are in relation to the camera.

What do people who use eye gaze think?

"... It was the most excitingest thing ever!"

a young girl with cerebral palsy talking about a trial with eye gaze.

"Ever since I got word back that I was getting the My Tobii my health and outlook on life have been great. I'm delighted with the My Tobii D10. It performs actually better than I thought it would. I'm looking for employment just now but the job scene is pretty grim at the moment. Still, though, I wouldn't have dreamed of working before the My Tobii!"

a man with locked-in syndrome.

So where am I now in this journey?

From being a sceptic, I have had a total conversion to exploring the possibilities of eye gaze for the people I work with. I have seen many people who have been able to independently use eye gaze as an access method when nothing else has been possible. Regardless of age and cognitive ability it has given some people freedom in a way that other access systems have not - and for me that is the rewarding thing. It does not matter whether the individual is spelling out a message, or using pictures and symbols to communicate - what matters is that they can communicate, they can send an email, they can choose to listen to music/look at photos or chat ... they can ask their boyfriend to marry them ...

It is very much part of our daily life in SCTCI. Currently eye gaze is considered for around 25% of the people we see, and this number is increasing. We are fortunate in that we have three different eye gaze systems now, so that we can give people the opportunity to try different systems to see which one

The ‘magic’ of eye gaze technology is not to be underestimated. I worked with Chrissie in the early 1980s when she moved out of the learning disability hospital where she had lived for most of her early life. At that stage she was using a Blissymbol board. I met her recently at a ‘technology discovery day’ - she was keen to try out this new technology ...and within 20 minutes was using it to chat!



(if any) works best for them, as research indicates that it is not possible to predict with any certainty which specific system will work for which individual (Blackstone, 2009).

Conclusion: What have we learned over the past 3 years using eye gaze at SCTCI?

- ☞ it’s nothing to be frightened of - it is here now and is something that we can use.
- ☞ it’s only the access method, and that’s the easy bit - it’s what you do once you’ve proved that the person can use their eyes that takes time and thought.
- ☞ it’s really the same as setting up any other communication or computer access display - you need to think about how to lay out the screen, where to put things to make it easy for the user, you need to think about what it is that the person wants to be able to do, etc.
- ☞ it’s a really useful tool in the assessment kit, opening up opportunities for many people.

On the other hand

- ☞ it can take time for people to learn to use eye gaze as an access method - it’s not an instant ‘solution’ - so it’s important to give people time to practice before discarding it as an option.
- ☞ it doesn’t work for everyone – so it is really important for people to be given the opportunity to try out different eye gaze systems.
- ☞ ongoing support (technical and teaching/therapy) is essential – take up any offers of training and support offered by the suppliers of the equipment.

Disclaimer:

Throughout I have tried to demonstrate that multiple symbol sets may be used with eye gaze, as well as photos and images taken off the internet. There are a number of ‘host’ programs which have been designed, or adapted, to work with eye gaze and support the users - *Grid 2* and *Tobii Communicator* are examples of such programs, however these are not an exhaustive list. The communication software available in DynaVox VMax with the EyeMax module¹¹, Liberator ECO with the ECOpoint module¹² and in the Tellus 3+ with the Eyetech TM3¹³ module have all been enabled to work with eye gaze access, and are readily available in the UK.

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References

- Ayre, J. (2010) *Experiences of a new technology: eye gaze* (accessed online, 13/08/2010 http://www.isaac2010.org/documents/extended_abstracts.pdf).
- Bergsten, C. (2010) *A journey towards communication*, (accessed online, 13/08/2010 http://www.isaac2010.org/documents/extended_abstracts.pdf).
- Blackstone, S. (1993): *Thinking a little harder about communication displays*, **Augmentative Communication News**, 6:1 (accessed online, 13/08/2010 http://www.augcominc.com/newsletters/index.cfm/newsletter_100.pdf).
- Blackstone, S. (2009) *The eyes have it*, **Augmentative Communication News**, 21:3, pp3-6 (accessed online, 13/08/2010 http://www.augcominc.com/newsletters/index.cfm/newsletter_130.pdf).
- Buckley, K. and Latham, C. (2008) *Look2Talk*, ACE Centre (accessed online, 30/08/10 <http://www.ace-centre.org.uk/index.cfm?pageid=22022375-3048-7290-FE844D50652B03E3>).
- Communication Matters (2008): *Focus onAccessing Communication Aids and Computers*, (accessed online, 01/10/10 http://www.communicationmatters.org.uk/sites/default/files/downloads/focuson/Accessing_Communication_Aids_A4.pdf).

¹¹ <http://uk.dynavoxtech.com/products/eyemax/>

¹² <http://www.liberator.co.uk/products/communication-aids/ecopoint>

¹³ http://www.techcess.co.uk/3_7_eyetech_tm3.php

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Derwent, G. (2010) *Evolving AAC and assistive technology provision during neurological rehabilitation for locked-in syndrome: a case study* (accessed online, 13/08/2010, http://www.isaac2010.org/documents/extended_abstracts.pdf).

Donegan, M. et al. (2006) *D3.2 Report on features of the different systems and development needs, Communication by Gaze Interaction (COGAIN), IST-2003-511598: Deliverable 3.2.* (accessed online 20/08/2010, <http://www.cogain.org/w/images/3/32/COGAIN-D3.2.pdf>).

Goossens', C. (1989) *Aided communication intervention before assessment: a case study of a child with cerebral palsy, Augmentative and Alternative Communication*, 5,14 – 26.

Harrison, I. (2010) *Experiences and challenges with access over the years ... the road to eye gaze. A case study.* (accessed online, 13/08/2010, http://www.isaac2010.org/documents/extended_abstracts.pdf).

Light, J. (1989) *Toward a definition of communicative competence for individuals using augmentative and alternative communication systems, Augmentative and Alternative Communication*, 5, 137-144.

Light, J. (1997) *'Communication is the essence of human life': reflections on communicative competence, Augmentative and Alternative Communication* 13, 61-70.

Musselwhite, C. (2009) *Literacy for All: Language, Literacy, Learning and Emergent Writing for Students with Disabilities*, conference presentation - Augmentative Communication in Practice: Scotland.

Srinivasan, S. (2010) *Secondary effects of antiepileptic drugs on children and their implications on AAC processes* (accessed online 13/08/2010 http://www.isaac2010.org/documents/extended_abstracts.pdf).

Eye Gaze as an Access Method?

Janet Scott

Eye Gaze as an access method?

Things to think about when looking at the different eye gaze systems:

There is no one eye gaze system that is "better" than all the rest, in every way, for every user.

Questions to ask

Using eye gaze to control a computer or a communication aid is fantastic and may offer opportunities to people who have been excluded in the past, or who have found it hard to access technology in other ways.

It can look so easy when demonstrated by an expert in ideal conditions - there are things you should consider, as well as being amazed!

We need to know what to look for in an eye gaze system - we need to know what to ask when we are shown an eye gaze system for the first time. These pointers have been adapted from a very useful paper written by Mick Donegan and colleagues as part of a European research project COGAIN (Communication by Gaze Interaction). Although written in 2006 it is still as valid today. The full paper is available on-line, details are provided at the end of the article.

Things to think about - or ask about!	
The hardware - the actual device	• How portable is it?
	• Is it battery powered?
	• Can it take its power from a wheelchair battery?
	• Can it be mounted safely on a wheelchair or over a bed, for instance?
Software	• Can you use the system with other available communication or access software e.g. <i>Grid2</i> , <i>DynaVox Interact</i> , <i>Liberator</i> software, <i>Tobii Communicator</i> , <i>MindExpress</i> etc? Has this software been adapted to be "eye gaze friendly"?
	• Can you use a range of different inputs with the application software e.g. switch scanning as well as eye gaze?
Calibration	• How does the system cope with involuntary head movement?
	• Does it cope with complex visual difficulties e.g. nystagmus or a divergent squint?
	• Does the system require the user to have good control over both eyes, or just one?
	• Does it allow for the person to move away from the system and then come back to it? - or would it need calibrated every time?
	• Can you adjust the calibration process to accommodate individual needs/abilities e.g. the speed of movement, size of the target, area of the screen, colours used etc?
	• Is there any auditory feedback during the calibration process? - can this be switched off/on if needed?
How flexible is the system? - how easy is it to adapt to an individual user's needs?	• Is there any feedback about the position of the user's eye/s during operation of the system? i.e. can they "see" if eyes have gone off the screen?

How flexible is the system? - how easy is it to adapt to an individual user's needs? (continued)	<ul style="list-style-type: none"> • Is there an option to “smooth” or dampen down the user’s eye movements, making pointer move smoothly across the screen even if the user’s eyes are moving in a jerky manner?
	<ul style="list-style-type: none"> • Can the visual targets be magnified?
	<ul style="list-style-type: none"> • What kind of feedback does the user get about where their eye/s is looking? For some people an on-screen pointer is not the ideal feedback, some prefer to have the “grid cell” or border highlighted.
	<ul style="list-style-type: none"> • What kinds of selection methods are possible? - dwell, blink, select with an external switch etc
	<ul style="list-style-type: none"> • If using “dwell select” is there any feedback (visual and/or auditory) about how long the person needs to maintain their gaze?
	<ul style="list-style-type: none"> • Can the user turn the eye control on and off independently?
	<ul style="list-style-type: none"> • Can the user recalibrate the system independently, if they feel it needs it?
Output methods available	<ul style="list-style-type: none"> • Does then system offer the user a range of outputs e.g. text, symbols, speech?
	<ul style="list-style-type: none"> • Does the system offer any form of auditory feedback for the person’s own use?
Onscreen interfaces	<ul style="list-style-type: none"> • Does the system offer a range of interfaces to meet user’s specific perceptual abilities? e.g. altering the background colour of the cells, size and number of targets on the screen, layout of target areas.
	<ul style="list-style-type: none"> • Can the system be used with symbols (and which symbol systems does it support?) or just with text?
	<ul style="list-style-type: none"> • Is there a choice of text styles and colours? Can you change the font and the size of the text?

These are only some of the questions you might want to consider exploring - there may well be others, and once you start using eye gaze there will be other questions you wish you’d asked!

A further word of caution ...

The effectiveness of the actual eye gaze system is “dependent upon a wide range of variables peculiar to that specific situation. Variables include:

- The lighting conditions;
- The skill of the person using the eye control equipment;
- The cognitive, visual and physical abilities of the end-user;
- The age/mood/level of fatigue/state of health/level of motivation, etc of the end-user;
- The power/features/condition of the computer being used with the eye-control system.

Some examples of mounting systems



Mount 'N Mover (from Toby Churchill)



Daessy Positioner Mount

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Adapted from:

Donegan, M. et al. (2006) D3.2 Report on features of the different systems and development needs, **Communication by Gaze Interaction (COGAIN)**, IST-2003-511598: Deliverable 3.2. (The full paper is available at <http://www.cogain.org/w/images/3/32/COGAIN-D3.2.pdf>).

The 'Look to Talk' Project – Learning to Communicate by Eye Pointing to Low Tech Systems

Katharine Buckley and Clare Latham

Introduction

The last thirty years has seen many developments in the use of technology for people with communication needs. With these developments have come vocabulary packages that speak and the ability to select the vocabulary using eyes. Such breakthroughs have opened up the world for many with complex communication difficulties. However, whilst such technology is exciting and enabling, it is not fool proof and does not always meet every communication need. Most would therefore acknowledge that there should always be a system of communication that is independent of any technology - a low tech system. Indeed for some, this may be their only system of communication at a given point in time.

Low tech systems include such things as ETRAN frames, symbol/alphabet charts, and symbol/picture books. However, as clinicians in the field, we have found that less emphasis has been placed on how to systematically develop these low tech systems. With this in mind, the *Look to Talk* project enabled the authors to work over a two year period with six children whose only reliable access method to low tech communication was eye pointing. The authors were able to explore how and what vocabulary to introduce and how to systematically develop the skill of eye pointing to access larger vocabularies. These issues and some unexpected findings will be discussed.

The Project

Six children between the ages of three and eight were involved in the project. At the start, four of the children were under five years of age and attended nurseries. Two were in school; one in a special school for children with physical needs and one in mainstream. None of the children were literate. Each family was visited every six weeks. It was agreed that a parent or guardian, in each case here the mother, would take responsibility for using symbol communication in between visits. Each family was provided with a copy of *Boardmaker*¹ Software, a folder and page templates.



¹ Boardmaker software – 2010 DynaVox Mayer-Johnson – <http://uk.mayer-johnson.com/default.aspx>

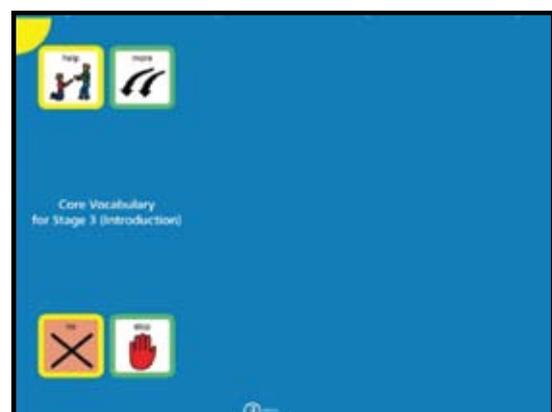
The Vocabulary

Much has been written about how to select vocabulary; from using the typical utterances of speaking children to selecting words/symbols according to different parameters. At the start of the project the authors chose to use the approach of systematically building a core vocabulary to be used alongside a fringe vocabulary, the latter relating to individuals needs and interests (Beukelman, McGuiness and Morrow 1998).

The core vocabulary chosen develops through five stages and relates to the development language meanings described at stages one to three by Coupe, O’Kane and Goldbart (1998) and stages four and five by Harris J. (1992). At stage five three Blissymbol strategies are used, combining symbols, part of a symbol, and opposite of a symbol, each of these to be used to create words not already provided. (McNaughton S (2003). Illustrations of the core vocabulary are shown below. The final illustration shows how the core vocabulary is always visible alongside a page of fringe vocabulary.



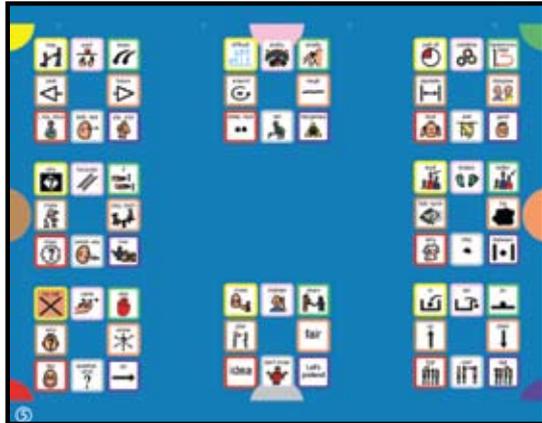
Core Stage two



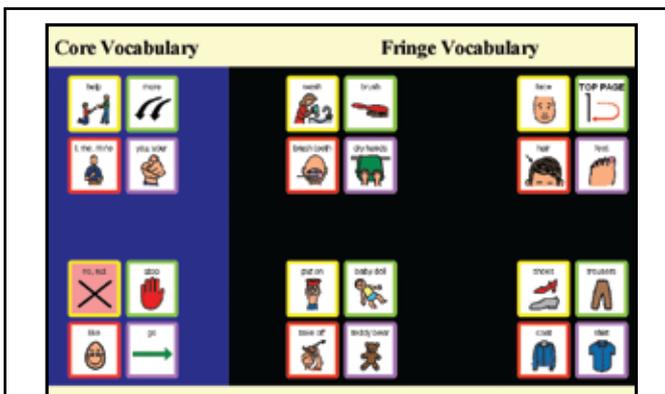
Core Stage Three



Core Stage Four



Core Stage Five



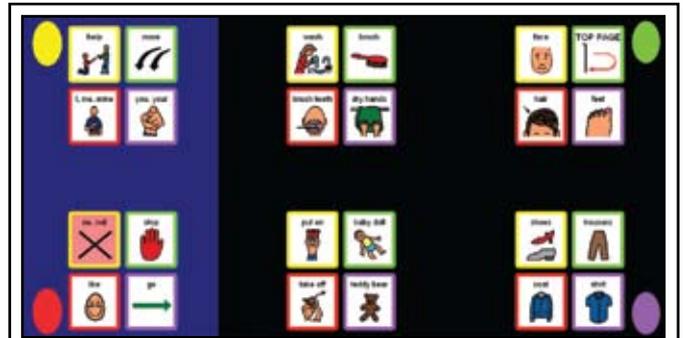
Example of Stage Two Core with fringe (for doll play) vocabulary

Over the two year period, the core vocabulary was observed to work well. One child progressed through the five stages; one started at the fifth stage and made expert use of the Blissymbol strategies outlined above. One child developed to stage three and the remaining three children worked at stages one and two. All children, whatever the stage, built up and used their communication books.

Systematic Introduction of Encoding

Encoding, the process where each symbol has a simple code, was introduced when children required more than six symbols on a page and when they could master the concept.

Encoding, like the core vocabulary, was built up systematically. We chose to use colour encoding. For example, in the illustration below, the child would look first to the block containing their symbol, then to the colour dot at the corner of the page that matches the colour surrounding their chosen symbol. We started with two colours and systematically built up to eight colours at stage five (for an example of eight colours in use, see the core at stage five).



Example of encoding with four colours

It was observed that children, who were ready to use encoding, did so rapidly. It was also observed that communication partners needed time to learn how to read the eyes of a child using encoding. One child obligingly used encoding with her close family members, but retained some pages for direct eye pointing to use with her grandparents, who she saw less frequently. It helped the communication partners to recognise that, as the child used more vocabulary and thus more encoding, they would initially find this challenging, but with time and practice, it would become easier.

Implementing the Vocabulary

Choosing and representing the vocabulary are just one part of creating a robust low tech system. The other, arguably more important, part is helping the child use it confidently. Modelling was one of the most helpful techniques we employed in *Look2Talk*.



One Mum modelling how to use encoding as she talked to her daughter

The communication partners soon gained confidence in using the symbols themselves, providing both a model of how communication through symbols can take place, and validation of symbols as a valued communication tool. We found that time

spent developing the communication skills of the communication partner was time well spent.

Additional Findings

Empowering the Eyes

All the children in the project were well supported locally and had been introduced to the concept of using their eyes to access symbol communication. The younger children had been encouraged to make choices with their eyes and to then look back to the communication partner. This is a familiar technique and one we had used ourselves. As parents demonstrated this method, we became aware that the child was coming under considerable pressure, and being asked to communicate, as it were, 'now'; this pressure coming from the enthusiasm and determination of the parent to help their child. Unfortunately, the result was counterproductive in the younger children, often making them resistive to choice making. To turn this round we asked the parents to take a step back, set up an activity they enjoyed and to pause, watch their child's eyes and simply respond to where the child was looking. The responding role of the communication partner is used in the Hanen approach (Pepper and Weitzman 2004). We termed this method 'Empowering the eyes to communicate' and it was highly successful in helping the younger children recognise their eyes were actually 'talking'.

Introducing Symbol Communication

Introducing symbols for communication can be done in many ways. Like others, we considered real communication scenarios so that the child would immediately see the 'power of symbols' and thus be motivated to use them. As we began this approach, parents paled! For example, one parent described a typical communication of, the child crying, looking to the door, looking to the kitchen, to the fridge and when the fridge door was opened, looking to what they wanted. We happily suggested making a symbol page of foods, so that this process would, as we thought, be simplified. Wrong! We became all too aware that all the parents and their children had successfully developed their own non verbal communication routines ; interfering with these by adding symbols, was both intrusive and potentially counterproductive, particularly in the early days.

Instead, we decided to take an activity parents enjoyed doing with their child, and see if, within that activity, we could enable more control for their child. Such situations included massage, singing, doll play, play doh, drawing and storytelling. Symbol pages were designed and parents were encouraged

to use their 'pause and respond' technique, together with using the symbols to support their own communications. This approach was a relaxed one and parents were in control of when they chose to use it. Some parents used it every day, others only occasionally, but it was always a fun time. Gradually these fun activities built up.



Three of the young children learning to use symbols through play

However, we were left with a nagging doubt, 'would the children use the symbols in everyday communication'? We always encouraged parents to leave the communication book in the same place so the child knew to where to find it. Slowly some of the children began to request their books. With great excitement we thought some deep and meaningful communication was about to take place. Wrong again! The first requests, from the younger children, were simply to look through the book like a picture book. The advantage, we realised belatedly, was an opportunity for them to practice and enjoy looking at their symbols. This experience was developed by suggesting parents used the books as a bedtime story; the books being full of lovely things that the children enjoyed.

After about six months, some of the children did request their books to talk spontaneously. The first communications were very special and not what we anticipated. One child requested her book and commented, 'Mummy silly' Another said, 'No more porridge', which she usually communicated through spitting out the porridge. Another child, after a particularly wild moment playing with her brother, commented, 'I like be silly' In short, given time, some of the children did ask for their books to say what THEY wanted. It appeared that children needed to be familiar with and practised in the use of their books, before they had the confidence to communicate freely.

A Hidden Resource – Siblings

At the start of the project we had taken no account of the fact that the children with communication needs had siblings. They all did! On most visits the siblings were present and from the outset wanted to be involved, or if not, demanded attention! We began somewhat uncharitably hoping they might watch a DVD or in the case of the very young sibling, have a nap. We soon realised they were a huge potential!

The first realisation was that siblings were far more motivating for the symbol user than the surrounding adults, and siblings wanted to play!

The second realisation was that, with the exception of the baby, the other siblings had found a way to communicate with their sister or brother, usually involving yes/no questions. Turning this round and helping the sibling to actually watch where their brother or sister was looking on the communication page, opened up the quality of communication they could have. The adverse affect being, it was not always the way the sibling wanted it to be! As one brother wailed, 'She has just told me to be quiet!'



Siblings getting involved



The third realisation was that the symbol user learned very quickly from their sibling. The siblings had more life experiences and the symbol user seemed keen to make use of these, taking up their ideas in play and storytelling. As the siblings didn't neatly join us at the beginning and stay till the end of play, the ideas were simply dropped in but were, without exception, always used by the symbol user.

Finally, by the end of the project, the youngest siblings in particular were rapidly becoming expert symbol communicators, providing excellent modelling; possibly because they had not become dependent on the more restricted yes/no questioning. It was

both helpful and heart warming for parents to realise they could, like other parents, leave their children to work out their games together, through the communication book.

Conclusion

It was, without doubt, a privilege to work in the homes of children, whose only access to low tech communication was through eye pointing.

Systematically introducing core vocabulary and encoding worked well and is a recommendation from the project. It appeared that children needed to learn, from the communication partners, not just symbols, but the system of their symbols to communicate effectively.

There are many ways to introduce symbols to children, but the project highlighted the need for some time for symbol users to lead communication, while parents and siblings just respond. The project also highlighted the importance of play as a method of introducing symbols, and suggests caution when introducing symbols in everyday routines. Patience was richly rewarded, when some of the children asked for their books to communicate what they really wanted to say.

Finally, in all the families, the siblings were a rich resource of ideas and, with help, became superb communication partners. The siblings also appeared to have a real need to be involved.

*Clare Latham
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References

- Beukelman, McGinnis and Morrow 1991 *Vocabulary selection in Augmentative Communication, In Augmentative and Alternative Communication*, 7,171 - 185.
- Coupe, O'Kane, J. and Goldbart, J (1998) *Communication Before Speech* London Fulton Publishers.
- Harris, J. (1992) *Language Experience and Early Development* Hove: Laurence Erlbaum Associates.
- Latham C. (2004) *A Guide to Developing and Supporting a Communication Book* Published by the Ace Centre.
- McNaughton, S. (2003) *Blissymbol learners, their language and their learning partners; development through three decades In Von Tstzchner Augmentative and Alternative Development Issues* S and Grove, N (Eds) Whurr Publishers Ltd.
- Pepper and Weitzman (2004) *It Takes Two to Talk; A practical Guide for Parents of Children with Language Delays* Hanen Centre 3rd Edition.

Perspectives on Using Eye Gaze

Andrew Lawson, with Nicola Woodside & Janet Scott

Background:

This background has been written by Nicola Woodside and Janet Scott, Speech and Language Therapists.

Andy is in his mid-thirties. Three years ago he suffered a major trauma to his brain which resulted in him being “locked in” - his cognitive function is intact but he has been left with a profound physical disability and no functional speech. While he was in hospital Nicola introduced him to the Frenchay E-Tran frame - this allowed Andy to “say” what he was feeling, but he was totally reliant on his communication partners’ skills and interpretation. He still uses this system today, when he is out and about and his eye gaze computer is not available.

He was referred to SCTCI for an AAC assessment - which involved looking at how he would access a high-tech communication system. Although he could use switch scanning he found this an extremely tiring, slow and frustrating method for accessing a communication system. In contrast he was extremely quick to learn how to use an eye gaze system. Within five minutes of being shown how to use the My Tobii he was able to “talk”, express his feelings, ask questions, be humourous etc. From his first trial with the system, Andy wanted one. Funding was not easy to achieve, but eventually the system was funded via his local NHS Board. However this was really only the beginning of a long journey, which is still ongoing. There has been significant support

required from Speech and Language Therapy, as well as technical support from SCTCI. Three years down the line, Andy still receives support from his local Speech and Language Therapy service and from SCTCI approximately once a month - more often if there is a problem with the My Tobii. Initially there were significant training requirements, in both the hardware and the software, for Andy himself, his family, carers, friends - and the local Speech and Language Therapy Service who had not used this technology before. Andy obviously has no language support needs; the ongoing support requirements for a user who needs to be taught what communication is about, who needs to be taught vocabulary and how to build sentences etc are significantly greater.

Andy is a joint honours graduate in English and History, with an employment history in TV production. Having access to a communication system he can use easily has had a significant impact on his life. The eye gaze system has allowed him to access life long learning opportunities, he has undertaken creative writing projects and communicates regularly not only with his family and friend via email, but also with former colleagues exploring future employment options.

Andy is keen to use his experiences to help others, and contributed the following statement to the AAC Funding Campaign to the Scottish Government.

Nicola Woodside & Janet Scott

I became voiceless in 2007. My voice was my life. I worked in TV, Jonathon Ross was my hero, I'd won prizes 4 my public speaking. I thought my worst nightmare had occurred.

Then I got my e-tran frame. It was easy but cumbersome, I needed some way of recording my thoughts, some way of offloading. I was shown My Tobii as a last resort. I instantly wanted 1. It has changed my life.

I can hold a conversation, I can write. I feel alive. I used 2 sit alone & try 2 sing the Neil Diamond song “I am, I said”. It would end in tears. Now I am, no matter what anyone says, pathetic, I know, but my identity was inexorably linked to my ability to record my thoughts. So, if anything, My Tobii saved my sanity.

I am so lucky my cognitive processes were spared damage, but without My Tobii that would have been more of a curse. I've found becoming disabled very hard & my company has often been challenging, but My Tobii has enabled me 2 step outside myself & gain some perspective on my new life. I'm sure my carers r very grateful.

I've given My Tobii a name: we're THAT close. I only hope my HAL isn't psychotic.

I'm now thinking of ways I can contribute 2 society.

Andrew Lawson

Experiences of a New Eye Gaze User

Linda Mercer & Linda Page

Linda gave me some form of aid [I don't even remember the name] it was slow, even slower than the special onscreen keyboard I was using – *WiViC*. It is very slow because I use the mouse but it has WORD PREDICTION & ABBREVIATION which I find very helpful. I'm afraid I kidded on I was trying the aid Linda gave me but I think she cottoned on and took it away!

She came back with Mark and Janet (from SCTCI) and an eye gaze for me to try. Boy was I scared, but I needn't have been. They showed me how it worked. It was fantastic. I took to it right away. It was so fast I couldn't believe it. Mark had to speed it up for me. It was fantastic. I could have conversations!

Sadly I only had it a week, then Mark came to collect it .

Then came a BIG shock Linda said they would try and buy me one. I was over the moon until Linda told me the price. I never thought for a moment I would see an eye gaze but Linda told me not to worry.

After several months Linda told me she had found funding and the eye gaze system was on its way

Now I have an eye gaze system, I'm delighted and cannot thank Linda enough. Mark and Janet too. It is hard work but Linda is a great help and very supportive. Seeing [by accident] what it can do has made me eager for Mark to show us its hidden talents.

I only know how to type and 'speak' at the moment, but even being able to do it fast is great.

Linda Mercer, Eye Gaze User

Linda had a stroke in 1984 and lived in hospital settings until September 2009 when she moved into her own apartment. I visited Linda at home in November 2009 at her request. She was running her own home and meeting many new people and was keen to look at voice output communication.

Access to a communication aid was going to be challenging, as Linda's only movement is her right arm and this is very slow and laborious. She was using *WiVic* which she operated by mouse movements. This allowed her to keep in touch with family and friends by email, however it is only now that I know her well, that I have any concept of how long it takes Linda to write even a one line email using this method.

I did indeed try a dynamic screen device operated by single switch scanning, as a short term measure to give Linda access to voice output communication while we made a referral to the Scottish Centre of Technology for the Communication Impaired (SCTCI). I discussed the possibility of eye gaze as an access method with Linda when we made the referral.

As Linda reports, the initial visit and subsequent trial loan of an eye gaze system was very successful, and I knew how sad Linda was at the end of the assessment loan. Linda was an ideal candidate for an eye gaze system to access voice output communication as well as computer access and environmental control.

It would make an amazing difference to her. I set about applying for the funding!

With the support of the Speech and Language Therapy Head of Profession to fund the system, I highlighted eye gaze communication systems and their benefits, with specific reference to Linda at an event I was presenting at. I was given support to go ahead with funding from the Director of Allied Health Professions and the Chief Executive of NHS Ayrshire and Arran. This was essential due to the cost of the system as the order had to be signed off at director level.

Linda has now had her Tobii C12/CEye system for a month and is thrilled with it. She is increasing her skill in using the system and her speed of communication. We are just about to add on the 'other features' that she is so excited about to allow her to use it for email and environmental control. This has been a very exciting month for Linda, and for me!

With thanks to Janet Scott , Speech and Language Therapist, SCTCI Co-ordinator and Mark Scott, AAC Technologist, SCTCI.

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To Eye-Gaze or not to Eye Gaze? The Fife Experience!

Sandra Miller

Introduction

This discussion is focused around high-tech eye-gaze – a method of access that is available to clients who have poor, inconsistent or non-viable methods of access due to some gross and/or fine motor deficit, but where they have functional use of their eyes to indicate choices - and where it fits in with a Local Authority provision such as FACCT.

Background

Fife Assessment Centre for Communication through Technology - henceforth referred to as FACCT, for obvious reasons! - is a specialist centre covering all of Fife, working with clients with severe oral communications difficulties. It offers an all-age service in Augmentative and Alternative Communication (AAC) - where we might augment current communication by other means, e.g. symbols in a communication folder, or a simple voice output communication device. However, where speech is not a viable, functional option, we may offer an alternative method of communication altogether, relying on technology to speak for them. This may range from being a fairly simple communication device to a very high-tech piece of equipment, accessed either directly via a mouse/joystick/touch screen or indirectly via a switch and some scanning system.

Funding

The FACCT Service is currently funded by Health, Education and Social Work and therefore can offer the lifelong service described earlier. It offers a 'one stop shop' approach e.g.:

- assessment;
- recommendation of appropriate device;
- purchase of device;
- purchase of warranty and cost of repairs;
- training for core team e.g. parents/carers/ school staff/ adult services personnel;
- technical support, when appropriate or possible;
- replacement or upgrade if/when appropriate.

This has its many plus points, the biggest one being that clients who have a device recommended for

them have never needed to worry about funding, since the cost was able to be met from the FACCT budget, even if it meant waiting for a short time. However, with rising costs overall; at best static or, at worst, reducing budgets; and with the additional cost of high-tech eye-gaze in comparison with other systems, it raises difficulties of a type we, as a Service, have never before had to face. This is obviously because we are working within budget restraints.

In other Scottish AAC Services, where assessment and recommendation are offered, (many with additional core team training/initial support included), but not the purchase of the equipment, clients may have to make application to Education, Health or Social Work for funding - or even fund-raise themselves. This means that Local Authorities and/or Health Boards will only see very few, if any, applications for funding coming across their desks. In Fife, they ALL come across ours!

Referral

Normally a client would be referred to the FACCT Service under the direction of / with advice from a Speech and Language Therapist. The client caseload can be very varied:

- lifelong conditions affecting functional speech e.g. Cerebral Palsy (CP);
- Autistic Spectrum Disorder (ASD);
- degenerative illness e.g. Motor Neurone Disease (MND);
- learning disability with attendant communication difficulties;
- brain trauma leading to communication deficit e.g. road traffic accident (RTA); cerebrovascular accident (CVA / stroke).

It should be noted that in many of these cases there is no cognitive impairment and the client can come to us having had previously intact communication skills e.g. those with MND, CVA or RTA.

As would be expected of all possible FACCT referrals, some preparatory work prior to referral can be required of therapists on the prerequisite skills appropriate to the client's ability e.g.

- shows some intention to communicate;
- understands cause and effect i.e. the two-

way nature of communication;

- ensuring the client has symbolic understanding;
- has a basic, visual vocabulary;
- understands categorising.

Developing a Criteria for Eye-Gaze

Because of the above discussed issues around funding, the FACCT Service was asked to draft a set of criteria to be met, before eye-gaze might be considered. These are attached as Appendices 1 and 2.

Access! Access! Access!

One of the main issues surrounding the eye-gaze conundrum is that people forget that eye-gaze in itself is a method of access. It does not allow a client with previous difficulties in understanding the basics of categorisation, or who have a poor understanding of symbolic representation, to suddenly be able to overcome these difficulties. A better access method will allow them to do just that - access! This, in our experience, has been more of a difficulty where a parent's perception and that of the professional of where a child's level of ability to communicate lies, differ. The parent sees the technology and/

or access method as the barrier, not the child's level of learning disability and/or communication impairment.

There of course are other methods of access that do not require switch access e.g. a head mouse. This system replaces a conventional mouse and lets you take control by moving your head, as the name might suggest! Most systems work using an infra-red camera that is placed above the screen of the communication device. This follows a small reflective dot so that you can move the mouse pointer by moving your head. The pointer movement can be adjusted for speed and sensitivity. This can actually offer a better option in some cases as it can be used with many ordinary PC programmes without worrying about integrated software. However, it does rely on a level of head control that may not be an option for some clients.

Some Questions/Issues/Dilemmas/Things to Keep You Awake at Night!

1. What if a client has a system that is working reasonably well e.g. a switch scanner, who is a good user and a bright child, ready to go into Secondary Education? Eye-gaze may offer a much quicker and more efficient method of access.

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- Do we let the child try it, be able to use it well, but risk having to say ‘we can’t afford it’?
- Or do we not mention that a possible better, more efficient method exists at all?
- How do we measure what is ‘good enough’?
- How do we answer the parent when they say, ‘You never told us about this!’

2. An elderly client with a significant level of learning disability and limited social opportunities but who can use a device with a 20 cell, symbolised, dynamic display and who, on her first attempt, uses eye-gaze with little difficulty and loves it... Can the Service justify the cost?

3. A child or adult who comes to a service with significant motor issues and who demonstrates the ability to use eye gaze effectively. Would eye gaze be introduced from the ‘get-go’ or would switch scanning be the first choice access method? It is more affordable but much more effortful. Is it time well spent when eye-gaze may be easier and more immediately functional. However, it is also worth remembering that clients also need to have another method of access to allow communication in different environments where eye gaze is not appropriate.

4. What happens if a parent buys a high-tech eye-gaze communication system that would not have been recommended by the FACCT service, as the client has been assessed and does not meet the criteria? What do we do when that parent comes expecting the Service to support it?

- Do we support the parents by building their capacity to support their own child, but not get directly involved
- What happens if that child is still of school age? Who supports the school staff?

ARGH! THE LIST GOES ON!

We pose these questions as we have come up against some of them and don’t yet have the answers. We all, of course, are bound in some way or another by financial restraints. As part of that, we also have a responsibility to the general public to ensure that the monies spent on any device bring sufficient ‘added value’ to justify the expenditure.

To Sum Up, Then...

Eye gaze technology in all its varied forms is a wonderful addition to the many tools available to us in our work with communication impaired adults and children. It is not the answer to everyone’s prayers but could be a huge improvement for many. It doesn’t work for everyone but is great for some and perhaps the only choice for a few. For a Service such as ourselves, working with a finite budget, there is no doubt that we have to balance being able to meet the needs of the many against the needs of a few. So, what is ‘good enough’?!

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Criteria for Eye Gaze Technology

November 2009

This guidance had been drawn up by a multi agency advisory group, with representatives from Health (SLT), Education (Educational Psychology and Education Support Officer), the ICT ASN Team and the FACCT Service.

Criteria

1. Clearly indicate that a client is successfully working through appropriate progressive activities to gain the skills necessary to successfully use eye gaze, e.g.
 - a consistently use staged, low tech methods of eye pointing, where the communication partner is not party to the correct response:
 - i E-Tran frame with small numbers of choices;
 - ii Making appropriate /correct choices from increasing numbers of symbols/text/ numerals etc by using partner assisted scanning;
 - iii Establishing a consistent method of indicating a choice e.g. looking back at communication partner/vocalisation etc. Again this must be with all communication partners and in all situations.
 - b evidence consistent, successful use of any high-tech system put in place i.e. successfully and consistently transferring those skills developed in low tech activities onto high tech;
 - c navigate through a number of dynamic display screens to access a variety of communication messages.
2. Indication that the client demonstrates communication intentions, not only with those closest to them e.g. family members, friends, but across a wide group of people and in a variety of locations and situations.
3. Evidence that the client has the physical ability to successfully implement eye gaze technology e.g:
 - a to maintain head in an upright posture for period of time;
 - b to be able to scan, focus and dwell on cells/icons for the necessary length of time required;
 - c to sustain the appropriate level of concentration required to complete an age appropriate task.
4. Evidence a level of cognitive ability to enable the client to use the system to an acceptable level, significantly increasing their access to communication, learning and activities of daily living:
 - a use of appropriate communication software;
 - b understand categorisation;
 - c demonstrate consistent compliance to device use.



Addenda:

- 1.1 An assessment for eye gaze technology will only be suggested/supported by appropriate professional staff (FACCT/ICT SEN/SLT etc) where they deem the pupil/client to have the prerequisite skills discussed previously in this document (Par 1-4).
- 1.2 Any possible recommendation to begin the eye gaze assessment procedure will be discussed with the Advisory Group and a joint decision made before any procedure is undertaken.
- 1.3 Recommendation for eye gaze technology will only follow assessment by the appropriate Fife professionals.
- 1.4 There can be no presumption that FACCT, or other appropriate professional staff, will be involved with a client who has procured an item of eye gaze technology, other than one recommended by themselves.
- 1.5 Where a recommendation for an item of eye gaze technology is made but funding is offered by any other agency/charity, discussion with the Legal Department of Health, Education and/or Social Services may be required to seek advice. Senior Managers will lead these discussions to ensure that all involved parties' interests are safeguarded.
- 1.6 There will be no presumption of assessment and/or funding being made available where a client is deemed to have an access method that adequately meets their present needs. However, future assessment may be considered if the client's access method becomes less functional and /or appropriate for their needs.
- 1.7 Any assessment for eye gaze technology will include, where appropriate:
 - Parents;
 - FACCT;
 - ICT ASN Team;
 - Appropriate therapy staff - OT, PT, SLT;
 - School staff;
 - Care Home staff;
 - Day Centre staff;
 - Carers.
- 1.8 Any recommendation to purchase a piece of eye gaze equipment will go before the Advisory Group for discussion and ratification.

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Introduction

Low tech eye gaze and eye pointing - which basically just means looking! - has to be the cheapest and easiest of all possible systems of access to the curriculum, and to augmentative communication. It is not always used as widely as it could be in schools.

High tech systems using eye gaze technology as the access method are new and exciting. They are just becoming technically simple and reliable enough to be usable in schools, and (almost...!) affordable within education.

On the one hand, we all want to celebrate that such systems are coming within reach of pupils in schools. Eye gaze technology certainly has a 'Wow-factor' and currently enjoys celebrity status in the AAC and Assistive Technology field. There seems something almost magical about the 'look, no hands' aspect of the technology. Parents, naturally, want to know if their child can benefit from this apparently revolutionary new equipment.

On the other hand, we also need to be cautious to ensure that school staff and parents do not foster unrealistic hopes. As with all innovations, often hyped by the media, there may be a tendency to believe that eye gaze technology can solve 'every' problem for every child. The AAC in education professional's task is to work out where hype, hope and practical reality meet.

What is Eye Gaze?

Terminology - 'Eye gaze' seems to have become the generally accepted term, coming from the technology end - I don't know why, really. But I actually much prefer the term 'eye-pointing'. Eye pointing to me seems to stress the deliberate and intentional act of making a selection by using the eyes, which is the really important part of the whole concept (whereas 'eye gaze' somehow sounds a bit random).

Eye Gaze is a System of Access

Eye gaze is essentially only an access system. It is not a communication system; it is not a curriculum. It may overcome some physical problems experienced by the child (and conceivably some motivational

issues), but if a child has developmental delay, learning difficulties and/or difficulties with some of the fundamentals of communication, changing to a different access system will not solve those difficulties.

Staff still have to assess the child's level of ability, identify an appropriate augmentative communication system for him/her, and select and organise the right vocabulary. Time and expertise still have to be put into introducing and teaching these to the child. The child needs to have attained a certain developmental level before he/she can use such a system effectively, to communicate.

The curriculum will still have to be differentiated and in many cases entirely personalised for the child. Integrating new technology into classroom interaction, teaching and learning, is always a challenge.

So while eye gaze may indeed offer some children valuable new opportunities for learning and communicating, it is certainly not a 'miracle solution' to all problems.

Staff and parents may sometimes see successful acquisition of the latest eye gaze technology as the end point of a long struggle. In truth it is just the beginning.

Who are Eye Gaze Technology Users?

Some children with physical disabilities have speech and have already acquired and demonstrated some level of linguistic and literacy competence. They therefore do not need eye gaze for augmentative communication but only as an access method to overcome physical impairments and to let them interact with the computer, write and record their work. This group is the least controversial eye gaze user group, as success can be more easily predicted, and within a reasonable time frame.

Other children have no functional speech and therefore require an effective access system to an augmentative communication system (as well as to writing - but that may only come much later). This group poses more of a challenge, as users are likely to be facing a long and very steep learning curve, where they are required to acquire mastery

of operational and linguistic, social and strategic competence at the same time, often starting from a very basic level. (At the same time they are probably also being taught to read.) It is also harder to predict whether a child will 'take off' towards accelerated progress with communication skills, or whether lack of speech and poor access have been masking underlying cognitive impairments that will prove a barrier to progress.

Amongst this group of pupils needing AAC, a variety of scenarios may apply:

- Some children may use only low tech eye pointing, while some may use both low tech and high tech eye gaze systems, for all communication and for all education.
- Some older pupils may have struggled for years with single or double switches and scanning as their method of access to curriculum software and AAC and be trying out eye gaze as a more direct, less effortful and faster access method. They should retain their switches, though, for times when the eye gaze computer is not appropriate or available to them.
- Some younger children may be just starting school as the very first generation to - perhaps – go straight on to eye-gaze as their main access method, by-passing switches altogether. This is rather unknown territory, so far, and both exciting and potentially controversial.

So it's nonsensical to talk about 'an eye-gaze user' as though that was single recognisable type of pupil – and, of course, no two children are the same anyway!

Eye Pointing vs. Hand Pointing

If they have any upper limb control and hand function at all, many children try instinctively to point to materials with their finger hand or even fist - and many adults seem to find that a more natural and desirable method of indication than eye pointing. 'Why should we use eye gaze when the child can point?' staff may ask. Well, three main reasons, usually:

1. In order to hand point, a child with cerebral palsy may need to use their whole shoulder and arm. This can involve their whole upper body and may stimulate a number of undesirable reflex patterns (eg full body extension, asymmetrical neck reflex where their head turns away as their arm/

hand stretches out) and overall result in a massive upheaval of their whole seating position and stability. This is likely also to disrupt their concentration and listening.

2. Hand pointing as described above may be very slow and extremely fatiguing.
3. Hand pointing may not be not accurate enough. Inaccurate hand-pointing basically means that only a very few large and widely separated targets can be offered - sometimes only a choice of two or three per page.

So while hand pointing **may** be adequate to make a very basic choice from two or three, or to answer a simple worksheet type question in class from a very limited set of possible answers (eg. perhaps basic number work, or word recognition), it is not adequate when the set of choices expands in number.

But in order to communicate, the child requires a large vocabulary, so we are looking for a system that allows as many as possible targets per page, and pointing that is quick, accurate and minimally effortful, physically.

When technology gets added in to the mix, eg. a touch screen, things can get worse, as technology is less intelligent and less forgiving than a human partner! In order to reach the desired target, the child may drag part of their hand over other undesired items, which then activate, and may speak or animate, or change screen page etc. before the intended target is reached. A possible end result of all of this is confusion – neither the child nor the adult may be clear about what exactly the child is pointing to or what they originally intended to 'say'.



Child using a touch screen

All this has taken a lot of words to describe, but it is immediately obvious if you compare videos of certain children. When they use their hands they are unable to maintain stable sitting, and are often

struggling, sweating and exhausted after a few efforts. Physical effort is so great that looking and listening and thinking would be difficult. When they use eye gaze they are able to sit still and maintain a good and hopefully reflex-inhibiting posture, stay calm and able to concentrate.

Cognitive Developmental Levels

Low Tech

Just looking at things is a very early skill to develop (0-6 months as eye focus matures). However, eye pointing, which is looking at things around the room **with an intention to communicate something to another person** is different and a later developmental skill (probably around a 12 month level). Eye pointing is linked developmentally with the development of referential understanding (**joint shared attention**), and social intention - which together are usually referred to as **communicative intention**.

The basic level of eye pointing is 'literal' - the child points to the door, it means they want out. 'Symbolic' eye pointing is the next step, and often requires shared background knowledge. For example a child may keep looking at her left hand and fingers (and only family would know that means she wants to talk about her sister's wedding). Where that shared knowledge is present, the system can be very powerful, in context. Some families develop a complex 'code' whereby directional looking can indicate a whole range of things, symbolically. For example, if the boy looked upstairs (to the bedroom), this meant bed, sleep, rest, bedtime, time to stop etc. Looking towards the kitchen meant I'm hungry, food, drink, cook, fridge, eat, Mum, family sit together etc.).

Looking at a picture or symbol of something that is not physically present in the room, in order to communicate with another person is a higher level skill which brings a degree of context independence, and personal & social independence too. This is full **symbolic representation**, a key precursor of language. Recognising a photo of a familiar person or object comes first, then gradually generalisation occurs, to allow understanding that a coloured or black and white picture can represent or 'stand for' the real thing itself. Children acquire understanding of symbolic representation at different ages (12-36 months in typically developing children) and some children with severe/profound learning difficulties may never fully acquire it.

The point to be aware of here is that just because

eye pointing or eye gaze may be easier physically for a child with disabilities than speech or using their hands, it is not necessarily cognitively simple.

Once a child has acquired joint shared attention and communicative intention, it is possible to try and use eye pointing in play, with real objects and toys, to support the development of symbolic function and understanding of symbolic representation, which is an argument for low tech eye pointing to be started early with developmentally young children.

High Tech

The strongest evidence that a child is ready for eye gaze technology for communication would be mastery of a low tech version of a symbol communication system.

If assessment of a child only included their physical ability to look at items on a screen, but failed to explore their level of communicative intent and symbolic function, the introduction of eye gaze technology for communication might fail.

A high-tech system could be used at a lower cognitive level for exploratory and sensory experiences, although the pathway from here to the acquisition of symbolic function is not that obvious.

Different Tools for Different Purposes

Just as all pupils use a variety of different tools and formats in different learning situations (oral answers, pencils, pens, curriculum software, word-processors, multiple choice tests, essays etc.) pupils with complex communication support needs need more than one system to help them to communicate, participate in class, interact socially, learn, demonstrate what they have learned, and record their work. Experience shows that low tech methods are often faster and easier for busy staff to implement, and make the child less likely to 'stand out as different'.

They may just eye point to a few pictures ranged in front of them on a desk or table but might find it easier to use an 'eye transfer' frame' (E-Tran frame) which can be hand held or free standing (to leave partner's hands free to manipulate other materials). A lot can be achieved using ordinary transparent acetate sheets.

So while top of the range eye gaze technology may be a component of a child's 'system', it will very likely be only one amongst a range of techniques and technology used in school.



The simplest tools are the best. A top tip is to supply the communication partner with a pack of 'blu tac' and a bag of clothes pegs, so that 'everything' can be attached to the E-Tran frame as necessary.

Usability & Effectiveness in an Educational Situation

The low-tech version of eye gaze communication is, naturally, cheaper and more straightforward to implement than the high tech version. It is quick to use and can be extremely effective. But there are key issues that staff in schools need to take account of:

- Eye pointing is harder for the communication partner to read, than it is for the child to do.
- Typically, the few people who spend most time with the child and know him/her best will perceive and interpret eye pointing sensitively and skillfully. But less familiar people may completely miss a child's eye movements or fail to understand their significance.
- Even very experienced communication partners can easily miss a child's eye movements, as these are often very fleeting. Most developmentally young children do not have the insight to evaluate whether or not their signal has been picked up, or the knowledge that they need to repeat it, if not.
- Children who have skilled communication partners (eg. Mum) often learn to communicate quickly with their eyes - but may be too immature to realise that they need to slow down for less familiar people.

All this can give rise to uncertainty and anxiety in school staff, so careful training in the early stages and lots of practice in 'no fail' play and games will be an important part of the induction period to engender relaxed confidence in both the child and the communication partner.

Education staff sometimes reject eye pointing as a valid method of communicating because they feel it is too 'intangible' or subjective.

Teachers look for 'hard' objective evidence and may feel that the communication partner is somehow making up the child's responses. This can arise particularly if one communication partner is apparently able to 'get more out of' the child than others.

However, suspecting collusion is not the most constructive approach. Low tech eye pointing is known to be a partner-based skill. 100% independence is perhaps not possible at all times. It is the work that is being done and the experience of communication that is most important.

If necessary, eye pointing can be measured for objectivity by asking the child questions that their partner is unable to hear and then asking the partner to read back the child's answers (which the partner could not guess or make up). Observers sitting in and/or video can also be used, if desired, though these may not work well as the close eye contact between the partners is part of the process of successful eye pointing

Unintentional Prompting

The truth is that, with any form of partner assisted communication method, it is possible for communication partners to prompt or lead the child's answers albeit unconsciously or unintentionally. This can happen, for example, through the partner changing their own behaviour and voice as they offer or point out the possible alternatives: "What do plants need, to grow? You show me from these – this? – this? - **THIS?** - this?". If they are finger pointing to the options, drawing the child's attention to each before asking them to eye point to their chosen answer, the partner can sometimes unconsciously linger longer on the correct answer. The partner can sometimes even just flick their own eyes quite unconsciously to the expected or desired answer, as they ask a question. Children can be astonishingly quick to pick up on these clues!

To avoid this situation arising it would be wise to ensure, as many schools do, that the child is not always with the same auxiliary or classroom assistant and that a small team of at least two or three auxiliaries gain experience of working with the child in situations where eye pointing is used. This is very important also for the child, so that he/she learns from the start to communicate with a range of people.

It is also important for teachers themselves to invest some time in communicating with the child directly instead of always leaving it to auxiliaries. Experiencing it themselves is the only way that they will understand the 'alchemy' of reading another person's eyes and eye movements. That way too, they can perform their own 'reality checks'.

Training Effective Communication Partners and Ensuring Consistency

Learning to use eye pointing with a pupil is not necessarily something that 'comes naturally' to different adults. To ensure good practice and to avoid situations where doubt is cast on the validity of the system, there need to be a few clear 'ground rules'. All regular communication partners need to be taught and need to practise the method.

Consistency is vital. It is extremely important that all different communication partners are taught to follow the same procedure more or less exactly, so that the child learns it once and for all and can be confident that there is no significant variation between partners.

Ground Rules

Partners need to:

- Know the correct position(s) that they should sit in, in relation to the child, and always use these. (Probably, directly opposite, when using an eye gaze frame, though as a child and communication partners become familiar with each other and confident in the shared system, a more side by side position can work out.)
- Know the starting routine. For example: both partners look at each other and engage eye contact. This means - 'I'm ready to start communicating / start listening'. Perhaps partner could feedback by saying 'Ready? OK, off you go'. Child eye points to first item and holds gaze on it. Partner points with finger to the item indicated and says the word or message, then their interpretation eg. "story book. You're telling me you want to look at a story book?"

Some interaction conventions will help, such as:

- Especially in curricular use, the child's system needs to include an agreed signal for 'I don't know' / the answer is not here. This could be another symbol, available for eye pointing, or it could be a natural gesture,

such as drooping the head, or looking at the desk.

- A signal for 'finished' might be helpful, for children who are at the stage of indicating a sequence of symbols. It could just be re-engaging sustained eye contact
- Techniques need to be established for use if communication via eye pointing breaks down. For example, a partner can ask things like -
 1. 'Do you know? If you don't know the answer, look down at the desk.'
 2. 'Can you see the picture you want on your frame (page etc.)?'
 3. 'Are we still talking about X?' 'Have you started talking about something different?'

School Uses for Low Tech Eye Pointing

- Playing (for every 'work' task you ask the child to use the frame for, make sure there is at least one 'fun' activity);
- Making a choice between two or more (up to about 8) items;
- Answering questions / filling in an answer on a worksheet;
- Teaching and using new vocabulary;
- 'Chat' about the day, friends etc;
- Answering questions on, and retelling a simple story that has been read. Filling in missing words at the end of each phrase. 'I'll huff and I'll puff and I'll blow your-----';
- Indicating matching pictures /words; odd one out;
- Indicating their preferences by eye pointing to like/dislike sides on a 'Talking Mat';
- Making a selection from a topic board of equipment needed or choices about play;
- And many more.

Unaided

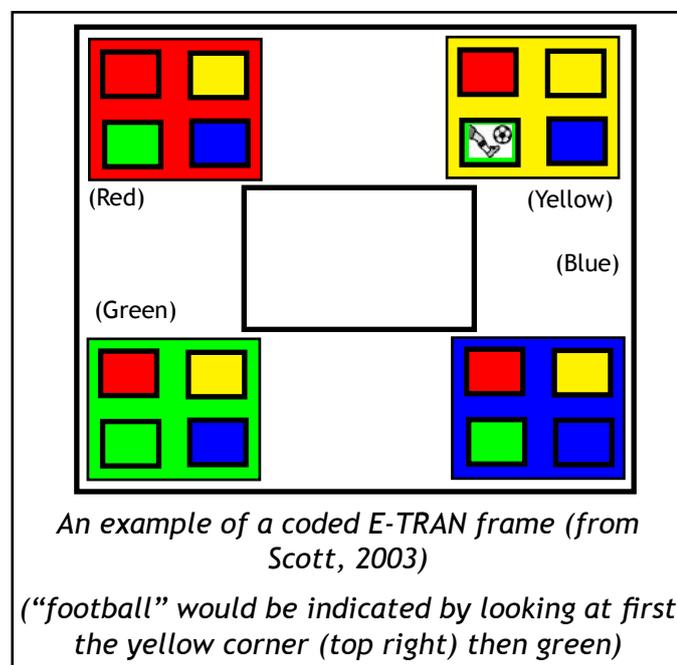
- Choice of two - hold out a first and then a second hand as you say the choices, so that each possible choice 'goes with one or other hand. Then ask child to eye point whichever hand matches their choice. Add a third position by nodding with your head to the space in between the hands.
- Choosing - eg. snack, or lunch - by eye pointing to the real thing, in canteen.

Aided

Rather than making new symbol materials for every classroom exercise, it can often be more practical for the assistant to photocopy the Worksheet or page in a book, ideally blowing it up somewhat on the copier (c. 140%) and then cutting it up and sticking bits on the frame for the child to select as answers. Similarly, photocopy story books and stick bits round on an eye gaze frame to provide the vocabulary needed to answer comprehension questions.

Scanning, and Encoding

It is beyond the scope of this brief chapter to go into details about the various 'advanced' for low tech eye gaze techniques. (See e.g. Goossens' & Craine (1987) or Scott (2003) for more information on such techniques). Suffice to say that the system is not limited to just 4, or 8 symbols on a frame. There are clever but simple techniques available to extend the range of vocabulary available to the child. One system is manually pointing to each option in turn ('partner assisted scanning') on a more densely packed page of symbols, until the child signals 'Yes'. Another system is encoding, usually involving coloured blocks, whereby the child carries out a two or even three stage pointing operation to select first the block of symbols, then the position within the block, then the desired symbol itself.



Physical Planning

In order to use eye gaze successfully, the child needs to be 'organised' physically - well positioned and seated, stable, ideally with head up and more or less in the midline. Many children find head control difficult and may need a head-rest or neck support

on their chair. Collaboration with physiotherapist or OT will therefore be important.

It is not impossible for a child to eye point (low tech) when their head is drooping or in a variety of different positions, but this is not to be encouraged - it is very hard for anyone else to read, and it may set up a pattern of poor posture which is both harmful to the child and also difficult to change, later. Some of the modern high tech systems are also fairly forgiving of head position and even head movements, but obviously the best results long term will be obtained from the best starting point.

Materials and equipment need to be appropriately positioned. There is no one 'set' position, but obviously materials have to be placed at eye level, and ideally as stably as possible. Wobbling around and continually changing position are not good features. Height adjustable tables are useful.

Effort

Although much less physically tiring than struggling to use another access method, using eye gaze technology can still be very tiring, largely due to the unremitting visual concentration required. You should try it yourself so that you experience and appreciate this! Short sessions and long breaks are indicated, especially for younger and more physically involved users.

Low tech eye pointing is less effortful, but sessions still need to be short. Children need their eyes for many functions other than answering questions, and indicating their needs and views.

Implementing High Tech eye gaze technology in school

Although it has already been stressed eye gaze is only an access system, school staff and parents tend nonetheless to have unrealistic aspirations of eye gaze technology. These can get transferred to the child as unrealistically high expectations of immediate success, ie. pressure. While a bit of a challenge can be stimulating, nobody performs at their best under massive stress. A child could easily feel themselves to be a failure if they cannot succeed at first (especially if they've also been hearing about how expensive this equipment is and how lucky they are to be given it to use!).

In fact, like everything else, it will take time and work for the child to learn to master the new eye gaze technology. While they are learning, tasks presented therefore might need to be slightly less challenging, so that the child is only coping with one

difficult thing at a time. A period of time spent on activities that are mainly exploration and discovery, with no 'right' or 'wrong' answers, will be very valuable, until the child has built up operational competence and self-confidence.

How early?

Introducing technology of any sort can be enabling for the child, but can also sometimes act as a barrier. For this reason, while one wants to ensure early intervention to give every child the best possible start, low tech eye pointing is definitely the best starting point, starting from pre-Nursery age. In my own view, it is not necessarily advisable to introduce very high tech equipment into the earliest years of education (although this, I know, is a potentially controversial view!). Staff time and attention may get directed to the technology instead of to the child and his/her programme. Decisions on timing the introduction of technology will be dependent on the characteristics of individual children and particular educational settings.

Augmentative Communication in Schools

One reason why implementing eye gaze for augmentative communication in schools can be difficult is that some teachers and schools have not yet accepted the key importance of language and communication, nor adapted their practices to support augmentative communication in general - whatever access methods are used. So introducing eye gaze, whether low or high tech, could be just adding an extra layer to a situation that is already loaded against AAC use, or at best confused.

Gail Van Tatenhove highlights the fact that most schools, extraordinarily, do not have any clearly defined programme for teaching or assessing language and communication (though they undoubtedly have a curriculum for everything else, from Maths, through to PE). (The 'Core Vocabulary Classroom', Presentation, at CALL Scotland 5 October 2010)

Teachers sometimes see communication primarily as a tool for accessing the curriculum (and for providing evidence of learning) or as an aspect of literacy. They may overlook entirely the need for the child to develop the personal and social functions of communication and restrict use of eye gaze to 'work'. But for individual children with no speech, acquiring basic language and communication skills is not only vital to their personal development and well-being but also a fundamental of learning and education. Without this foundation in place, higher level learning will be inaccessible. Children have

to 'learn to talk' before they will be able to 'talk to learn'. Yet many classrooms may offer AAC users a very limited number of real opportunities to communicate during the school day. Without access to an adequate core vocabulary, opportunities for rewarding interaction, and lots of repetition and practice, pupils who use AAC seldom achieve the communication results that we want for them.

With this somewhat depressing backdrop, an individual child's particular access system/method of communication may be somewhat secondary, but nonetheless anything that could make communication easier will be welcome. Perhaps a greater appreciation of the value of eye gaze, in both low and high tech form, can have a positive effect on schools' perception of AAC as a whole.

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References

- CALL Scotland *Eye Pointing and Using an E-Tran Frame* (accessed online 21.10.10) <http://www.callscotland.org.uk/resources/Quick-Guides/Assets/Downloads/Eye-Pointing-and-using-an-Etran-Frame.pdf>.
- Edie – *using alternative access to AAC* (accessed online 21/10/10) <http://www.talkingpoint.org.uk/sitecore/content/TalkingPoint/Lets%20All%20Talk/Case%20Studies/Edie.aspx>.
- Goossens', Carol A. and Craine, Sharon S. (1987) *Overview of Nonelectronic Eye-gaze Communication Techniques. Augmentative and Alternative Communication*, Vol 3, Issue 2.
- Liebal, K. & Tomasello, M. (2009) *Commentary on Infants appreciate the social intention behind a pointing gesture: Commentary on "Children's understanding of communicative intentions in the middle of the second year of life"* by T. Aureli, P. Perucchini and M. Genco, *Cognitive Development* 24 (2009) 13-15.
- Scott, Janet (2003) *Designing Communication Boards and Displays* in Wilson, A (ed.): *Communicating with Pictures and Symbols*, CALL Centre, Edinburgh.

Using Eye Gaze to Support Communication: A Select Bibliography

Allan Wilson

There is no shortage of research literature on eye gaze technology for communication. A simple search for the phrase “eye gaze” on Google Scholar brought up 21,100 results in October 2010. This search can be refined to try to achieve a more manageable number of results, for example by adding “communication” (producing 14,200 results), or by adding both “communication” and “augmentative” (6,290 results). This is still, rather a lot to plough through, particularly as many of the articles may make only a passing reference to eye gaze as a method of communication.

The COGAIN Project

Fortunately, the COGAIN Project’s online ‘wiki’ (http://www.cogain.org/wiki/Bibliography_Gaze_Interaction) has a comprehensive bibliography of research articles with a definite focus on the use of eye gaze technology. There are links directly to most of the papers, allowing easy access to the research over the internet. The main Gaze Interaction Bibliography is divided into three sections:

- *Eye-Controlled Systems and Gaze-Based Interaction for People With Disabilities* - Most of the papers that will be of interest to those working with people with disabilities are included in this section.
- *Gaze-Aware Systems, Attentive Interfaces and Applied Eye Tracking* - The articles in this section look at more general applications of eye gaze.
- *Eye Tracker Development and Gaze Tracking Implementation – Systems, Hardware, Software, Algorithms* – This section contains the ‘technical’ articles with a focus on details of hardware developed in research projects and the software algorithms developed to provide access to the hardware.

The COGAIN site also includes bibliographies of reports and presentations arising from the work of the project.

Rather than repeat much of the work of the COGAIN project, this article focuses on some of the useful and interesting material that has not been referenced on the COGAIN site.

Literature relating to ‘Low Tech’ Eye Gaze to Support Communication

The COGAIN project brought together many of Europe’s leading experts on eye tracking integrated with computers for a project on assistive technologies for people with motor impairments. The focus on technology made it reasonable to exclude references to articles on eye gaze in a low tech context, but low tech methods often provide a starting point for the use of a high tech system.

Goossens’ and Crain (1987) emphasise that “Communication through eye gaze is a skill that develops early in infants” and that for some people with severe physical disabilities who cannot speak or use gestures “frequently, eye gaze remains intact as a potential avenue for communication exchange. The authors then describe in considerable detail a number of formats that can be used for communication exchange by eye gaze, including the use of the eye gaze vest, the laptray, the transparent display and the mirror/prism communicator. Many of the methods they describe are still in regular use today. The article also considers the different ways to encode messages so that they can be accessed by eye gaze using a laptray or transparent display.

Having described various means to conduct a communication exchange in the article above, **Goossens’ (1989)** goes on to provide a detailed case study of an intervention with a six-year-old girl who has cerebral palsy and very little intelligible speech. In this case, eye gaze and switch training were introduced in parallel, providing her with an immediate means to communicate her wants and needs, while developing the skills she would need to use a switch-accessed communication aid. Her parents were trained in the provision of spoken language stimulation and were taught how to use an eye gaze communication vest, supported by slide protector eye gaze displays for situations in which the vest could not be used. The article covers the development and use of displays in detail, providing lots of practical ideas that can be used in other situations.

Scott (2003), though not specifically relating to the use of eye gaze, has useful guidance on the setting up of communication displays that is very relevant to the use of eye gaze. Different methods of coding

messages for a communication board or display are described, including methods suitable for use with an E-Tran eye gaze frame.

The use of an E-Tran frame to support communication is explored further in **Sigafoos and Couzens (1995)**. This empirical case study focuses on the use of an E-Tran communication system with a six year old boy with cerebral palsy and moderate learning disabilities. The authors describe a transition from selecting real objects to choosing from images on an E-Tran frame, accompanied by prompting which was gradually withdrawn. They conclude that “Eye gaze may represent a viable mode of communication for children with multiple disabilities”.

Harris (2008) is a short article describing an investigation into the relative merits of three low tech communication methods: Auditory Scan Alphabet Chart; Eye-Communication Frame; 6-Grid Alphabet Chart. The latter two were specifically designed for communication by eye gaze / eye pointing. The article provides useful descriptions for implementing both methods. The author hoped to identify whether any one method was preferred, but concluded that “it is difficult to predict the preference of an individual in terms of low-tech AAC methods and that, where possible, choice should be considered.

Literature on High Tech Systems

As stated above, the best source of information on research into eye gaze technology is the Cogain Project web site, but there are a few useful and interesting articles that have not been included in the bibliographies on the site.

Curry and Woodward (2007) report on the use of a My Tobii systems with two primary aged pupils, one in a special needs school, the other in a resource base in a mainstream primary. Both boys had athetoid cerebral palsy, but had good eye pointing skills, understanding of language and were motivated to communicate. Both boys trialled the system for three weeks, with progress being carefully measured throughout the period. The loan was considered a success in each case, with the boys finding eye gaze nearly three times faster than using a switch. The article summarises the successful rationale used to seek funding from the LEA to provide a system for each boy.

The case study offered in **McMorran (2010)** provides a different perspective of the use of eye gaze as the system is used primarily for computer access, rather than communication. She describes a cognitively able

pupil with athetoid cerebral palsy affecting all four limbs, but whose speech is relatively unaffected. At nursery and in her early years in a mainstream junior school she used switches and a range of software, including Clicker 5, Penfriend and Office to record her work, but this method was too slow for her and an eye gaze system was purchased when funding unexpectedly became available. The article charts the successes and difficulties encountered over the next two years until the pupil “is producing the quantity and the quality of work which genuinely represents her potential.”

A number of researchers, including **Kocejko et al (2009)**, have attempted to adapt ‘off the shelf’ technology, like webcams, in order to try to produce a more affordable eye gaze solution than many of the commercial products. The authors describe the use of a pair of webcams with software algorithms for pupil detection and screen position detection.

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References

- Curry, Hannah and Woodward, Sarah (2007) *Using an eye gaze system with two primary school pupils with severe accessing difficulties*. **Communication Matters** Vol 21 Number 3.
- Goossens', Carol A. and Craine, Sharon S. (1987) *Overview of Nonelectronic Eye gaze Communication Techniques*. **Augmentative and Alternative Communication**, Vol 3, Issue 2.
- Goossens', Carol A. (1989) *Aided Communication Intervention before Assessment: A Case Study*. **Augmentative and Alternative Communication**, Vol 5, Issue 1.
- Harris, Catherine (2008) *Give me a Choice! In Praise of Low-tech AAC*. **Communication Matters** Vol 22 Number 3.
- Kocejko, T., Bujnowski, A. and Wtorek, J. (2009) *Eye Mouse for Disabled*. **Human-Computer Systems Interaction** Volume 60, pp 109-122.
- McMorran, Ruth (2010) *Head Switches to Eye Gaze: a Bumpy Journey!* **Communication Matters** Vol 24 Number 1.
- Scott, Janet (2003) *Designing Communication Boards and Displays in Wilson, A (ed.) Communicating with Pictures and Symbols*, CALL Centre, Edinburgh.
- Sigafoos, Jeff and Couzens, Donna (1995) *Teaching Functional Use of a Communication Board to a Child with Multiple Disabilities*. **British Journal of Developmental Disabilities** Vol XLI, No. 81.

The Eyes Have IT

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