

For individuals who use switches with computers, Voice Output Communication Aids and/or Environmental Control systems the speed of access can be frustratingly slow. It is therefore important we consider all the influencing factors to ensure we achieve effective switch access.

Introduction

For many individuals with severe physical disabilities switching offers the only method of accessing technology. For a switch to be used successfully an individual needs to work towards good physical control of the switch and the many perceptual and cognitive skills required when scanning. An individual should have the opportunity to use a switch to operate a range of activities from an early age as possible.

What is a switch?

A switch is a device for making an electrical connection between two contacts. Most of us use 'switches' every day without thinking about it e.g. turning on a light or the radio. Switches enable the user to interact with their environment.

There are many switches on the market that can meet the needs of individuals with disabilities to enable them to interact with their environment.

Why use a switch?

- If physical skills are not adequate to use other access methods
- If cognitive skills mean that other access devices are too complex and draw individual's attention away from the task
- Or, for both the above reasons.

Are switches the answer?

- Have all other potential access methods been considered which may be easier and/or faster?
- Has the individual's seating and positioning be addressed satisfactorily? Poor seating/positioning can dramatically affect motor ability and thus the ability to use considered access methods

What can be achieved with a switch?

- Control of the environment
- An effective method of communication
- Access to learning
- Access to leisure opportunities
- Independent mobility

The switch user:

A switch user needs to be able to:

- Hit the switch when they want to
- Not hit the switch when they don't want to
- Use the least physical effort
- Be able to sustain attention on what they are controlling
- Use the switch without causing physical harm

When should we introduce switching?

Children with physical and sensory disabilities have decreased opportunities to establish contingency awareness. When contingency awareness is not established, the child does not learn that he or she can control the environment or the behaviour of others. The child may become passive and be at risk of developing learned helplessness. Seligman (1975) described learned helplessness as a condition in which a child lacks motivation to attempt to effect environmental change, which leads to feelings of helplessness. Eventually the individual will no longer attempt to control their environment and may ultimately become depressed and/or turn their actions to themselves in the form of self-stimulation.

In normal development the establishment of contingency awareness occurs in the first few months of life. However, with children with disabilities we often oversee the importance of assisting the development of this contingency awareness at such an early age. We may need to assist by giving them a larger more stimulating reward to suit their sensory needs or by giving them the means to effect their environment via the use of switches.

Factors influencing switch access and skill development:

- Motor
- Perceptual skills
- Sensory skills
- Motivation
- Distractibility
- Preference
- Positioning: individual, equipment & resources

Switch Assessment

As individuals with physical disabilities abilities continuously change it is important that the establishment of a switch position is not a one of activity but a continuous process of trial, monitoring, evaluating and modifying.

To help consider all the influencing factors in deciding the most appropriate switch and position for an individual ACE Centre-North has devised a 'Switch Assessment and Planning Framework for Individuals with Physical Disabilities' available to download from www.ace-north.org.uk

Team Approach

To establish the most appropriate switch, switch position and switch mounting for an individual, the professional working with the individual should have a good understanding of the equipment, how it is operated by a switch, the physical motor capabilities of the individual and how the technology can enable them to gain control of their environment. This is best addressed by the combined expertise and knowledge of the individual's multi-disciplinary team, e.g. teacher, occupational therapist, physiotherapist, speech and language therapist, parent, learning support assistant and the individual themselves. There may need to be compromise between professionals to ensure the individual is using the most successful method for them. When the best switch position has been established, the individual is more likely to be motivated to develop their switching skills.

Positioning

"It is possible to grossly underestimate an individual's motor capabilities if the individual is not properly positioned and supported"

Beukelman & Mirenda 1992

A pre-requisite to establishing an appropriate switch and switch position is that the individual is positioned in a stable functional position.

A good positioning system should:

- Enhance performance with technology
- Provide support without restricting necessary movement
- Provide stability to enhance physical function
- Reduce abnormal reflexes or minimise the impact on voluntary movement
- Enhance the individual's ability to attend to the task
- Be compatible with long-term positioning goals for the individual through the maintenance of correct posture aiming to prevent future physical difficulties.

When assessing an individual's positioning needs it is important a multi-disciplinary team approach is adopted. This is especially important when considering switching systems, to ensure all issues are considered e.g. their switching method or the mounting of equipment that could impact on the most appropriate positioning system for that individual.

However, when working in a team compromise is often required to ensure the individual is provided with the most functional seating (positioning) system for their needs. What in theory may appear to be the perfect position for an individual, may not in practice allow them to access switched resources and systems effectively. Therefore compromises will have to be made to ensure optimum function for the individual in terms of accessing the switch whilst ensuring an acceptable position.

It is also essential to consider the positioning of the resources. Ideally, equipment (e.g. toy) should be directly in front of the individual (the exception being individuals with visual field deficits) and at an appropriate height. It is recommended that equipment be placed on height adjustable tables/trolleys to achieve this, particularly if the individual is using a number of different seating and positioning systems.

Choosing the right switch

Although there is a wide range of switches available on the market experience shows that simple contact switches such as the Jellybean Switch and Buddy Button Switch will provide effective access to the majority of individuals with physical disabilities. The important factor in ensuring that these switches are effective is to have them firmly fixed in the most appropriate position for an individual. However there are individuals who will require a specialised switch to gain effective control of it to allow development of their switching skills.

Ideally for an individual with severe and complex needs we would look to identify one switch position that is used to access a range of activities throughout the day. This will allow the individual to establish an effective motor pattern to operate the switch. In time this will make the action of pressing the switch quicker and require less effort allowing the individual to concentrate on the activity they are accessing, rather than the process of pressing the switch. However, there are exceptions when a switch position may need to be varied, for example when the individual's tone changes from day to day or from hour to hour. In this situation there may be a position that is the most effective in the mornings but another is more effective in the afternoon.

Contact switches e.g. jelly bean, platform switch

These switches are the most common. Factors to consider when choosing a contact switch are:

- Target area - size depends on accuracy of movement
- Sensitivity : pressure needed to operate switch
- Travel: how much movement (if at all) the switch moves before it operates
- Feedback given from the switch e.g. auditory click
- Design: robustness, hard or soft, moisture resistance (if positioned near the mouth)
- Safety (e.g. if using head switches won't cause accidental damage to face/eye).

Non contact switches e.g. mercury tilt switch, muscle twitch switch

These can be technically more difficult to set up. They have little or no feedback and generally need a higher cognitive ability

Mounting of the switch

The switch needs to be positioned so the individual can operate it quickly, when they want to, consistently, reliably and with minimal effort.

It is vital to be able to firmly fix the switch in the desired position. A range of mounting systems are available.

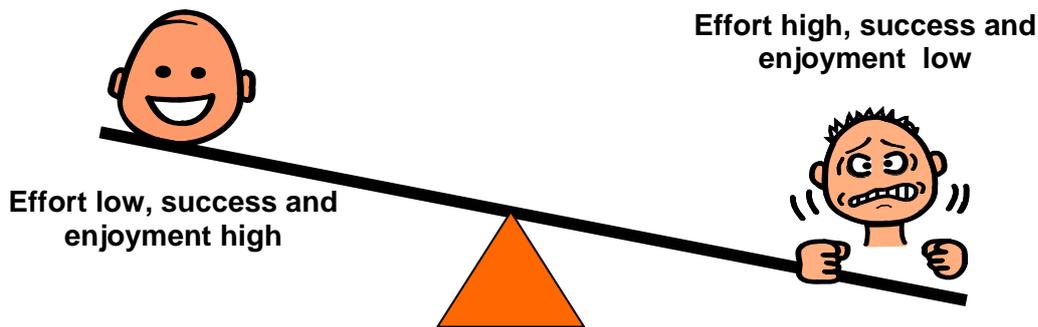
Evaluating Switch use

Can the individual:

- understand what a switch press can achieve?
- perform a movement to activate switch(es)?
- activate the switch at the right time?
- hit the switch when they want to?
- not hit the switch when they don't want to
- repeat switch press time after time?
- sustain attention: maintain attention on what they are controlling?
- use the switch without causing physical harm?

Fundamental rules:

- The chosen switch method needs to be the easiest, the quickest and the most reliable. Over time this may change.



- Use a team approach
- Make a record (written and/or pictorial) of switch position, the action used to operate the switch, level of participation, and progression.
- Give the individual time
- Be aware of your prompting, cues and support
 - Waiting is important! - For some children waiting is a cue/prompt in itself
 - For others more prompting will be necessary
 - Aim to provide as little prompting as possible
 - Wait, Verbal, Modelling, Physical – Light. J.
 - When using verbal prompting aim to direct prompt at outcome of action, rather than the action itself.
 - **Physical prompting:** Initially a child may need physical prompting to press the switch; this may start off with hand over hand but should be slowly reduced to, for example, a nudge of the elbow. Like with any activity the physical prompting should be reduced over time so eventually the child is achieving the activity without any physical prompting
 - **Verbal prompting:** when an individual is learning to use a switch to achieve an award it is important that the language used with them is consistent and appropriate. Do we say 'press the switch', 'hit the switch', 'hit the button' or 'turn on the activity'? We all tend to use a combination of these verbal prompts, which can be very confusing for the individual. So decide on a prompt that is to be used and stick to it. Ensure all those working with the child know the prompt so consistency is achieved. It may be more motivating for the child if 'turn on the tape', 'make the car go' etc is used, rather than 'hit the switch'
 - We need to consider the amount of verbal prompting we are giving as some individuals may be responding to the verbal prompt rather than understanding that they can cause the effect with the switch. Like with any activity the verbal prompting should be reduced over time, so eventually the individual is achieving the activity without any verbal prompting.

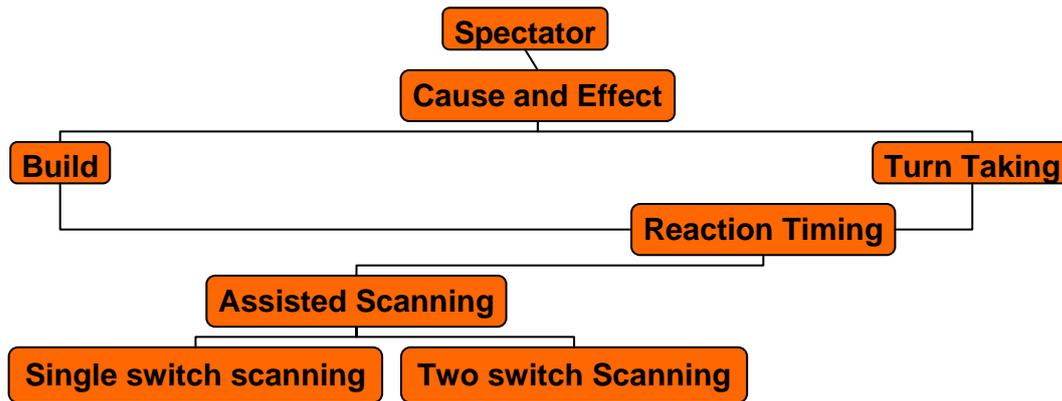
More Fundamental rules:

- Lots of opportunities to practise
- A range of appropriate activities to develop the skills
- A consistent approach of – positioning of individual, switch, and other resources, prompting and activities to achieve target skill level
- Training for staff and the individuals
- Support – for individual, staff including preparation time to prepare resources

Common Misconceptions

- Assume only use of hand(s) for switch use
- Assume progression to two switches is desirable
- Assume visual skills necessary for switch use

Skill Development



Decide where the individual is in terms of switching skills progression. NB Many attempts have been made at laying out progression.

Beware of progression with steps concentrating on increasingly sophisticated physical skills...look for progression that involves increasingly more sophisticated level of engagement – emphasis on cognitive challenge rather than physical!

Different stages of development may be identified as determined by challenge of activity and activities available. Through these stages different resources and strategies will be needed.

- **Spectator:** The individual is mainly watching, listening or passively responding. The use of technology will enhance sensory awareness; provide visual, auditory or tactile stimulation in an exciting and motivating context. This can take place individually or in a group situation. Have equipment set up how they would use it.
- **Cause and effect:** can be described as where the individual learns that a particular movement will have a consistent effect and hence repeats the movement. Technology allows the individual with minimal responses to develop cause and effect and thus interact with their environment. An individual develops an understanding of 'cause and effect' via a switch i.e. when the switch is pressed there is an understanding that it will cause something to happen. To allow an individual to develop cause and effect with a switch they require opportunities to practice, to develop familiarity with the switch, and understand the concept of cause and effect. This practice should be incorporated into their daily routine with activities that are appropriate and motivating. Activities might include:
 - Battery operated devices
 - Mains powered appliances
 - Simple speech output communication devices
 - Software on computer

Cause and effect versus Attention diverting

We need to be sure that individuals have a true understanding of cause and effect and that it is consolidated. Often it is interpreted that an individual has cause and effect however on closer scrutiny they enjoy the reward provided by the switch alone, and then their attention is diverted to the reward e.g. toy. When this stops they will revert back to the reward provided by the switch itself. We often refer to these individuals as '*switch bashers*'. A child that demonstrates a clear understanding of cause and effect will press their switch and look and/or listen for the reward and show pleasure from that reward. When the reward has finished they will press their switch again for the reward to be repeated. In this way the child demonstrated anticipation that something is going to happen and intent in ensuring that they receive the reward.

- **Build:** The individual becomes more discriminating; each switch press adds another part to the activity until completion is achieved
 - Software on computer

- **Turn Taking:** my turn your turn
 - Simple speech output communication devices
 - Software on computer - Working alongside a peer using a mouse, switch user makes selection

- **Reaction Timing:** a time to press, a time not to press
 - Mistimed hits – anticipation; unwanted hits; Increase tone/unwanted movements/abnormal patterns of movements/reflexes
 - Start with stationary, move onto moving target – slow & large target area
 - Simple speech output communication devices e.g. joining in a story
 - Software on computer

Scanning: The facts

Types

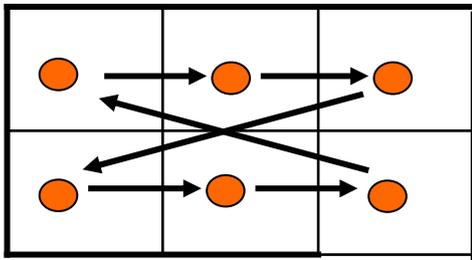
- *Automatic scanning - single switch* - relies on the device doing the scanning while the individual does the choosing (selecting) with their switch
 - o Requires less physical movement but must have timing and a good attention span
- *Step scanning - two switches* - one switch moves the scan, the second switch chooses (selects)
 - o Requires more physical movement and can be fatiguing
- *Directed Scanning (also known as Inverse scanning) - single switch* – user holds down switch to move scan and releases to choose
 - o Requires more physical movement and ability to release with timing
- *Switch encoding: uses one or two switches* and an extended version of Morse code to write text and control the computer.

Control demands for different types of scanning: adapted from Beukelam & Mirinda (1992) and Cook & Hussey (1995)

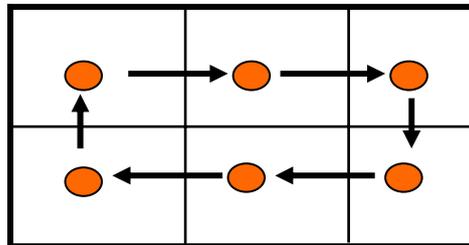
	Automatic scanning	Step scanning	Directed scanning
Wait	High	Low	Medium
Activate	High	Medium	Low
Hold	Low	Low	High
Release	Low	Medium	High
Motor fatigue	Low	High	Low
Sensory / cognitive	High	Low	High

Scanning Patterns

- Simple Scanning
 - Linear scanning/Circular Scanning
 - Only use with a limited number of choices; inefficient beyond 10-12 items
 - Cognitively easy to learn
 - Extremely slow

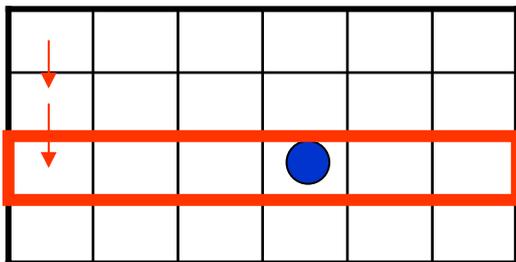


Linear scanning

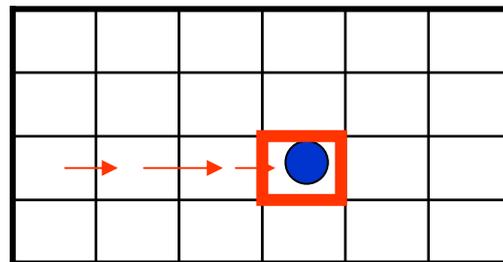


Circular scanning

- Group - item scanning
 - Axis change can be a problem – mastery of transition from one axis to another can be a huge frustrating leap. Even when the individual has mastered the basic concept, double hitting the first cell can be a persistent problem.
 - Row-Column (most common)
 - Some experts report children as young as 4 (developmentally) achieving success with Row-Column scanning.
 - If a grid contains more than 4 cells then a row-column scan method will result in a faster rate of selection

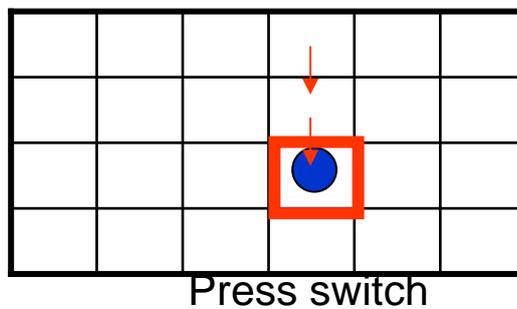
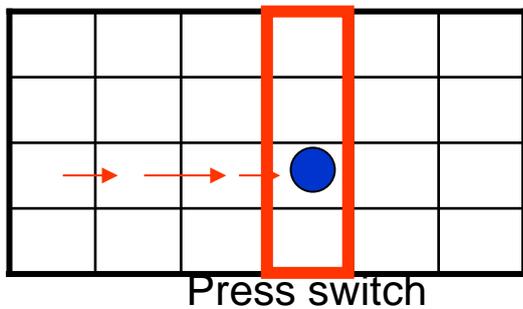


Press switch

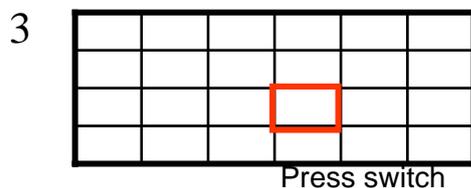
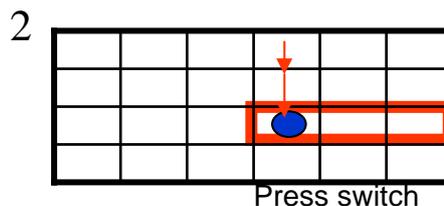
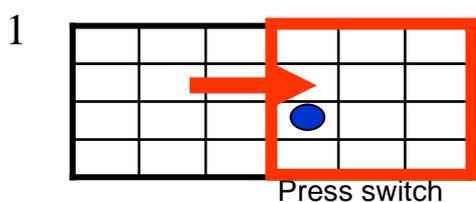


Press switch

- Column – Row



- Nested Scanning
 - Cognitively the most difficult but offers greatest efficiency



The CALL Centre website has an Interactive Switching Tutorial that allows you to see the various types of scanning and scanning patterns in action.

Website Reference: http://callcentre.education.ed.ac.uk/sat_interactive/home.htm

Scanning settings, techniques, features

In addition to the type of scan chosen and the scan pattern, there are several other features of scanning which can be manipulated to make the access method more suitable for an individual. These are as follows: -

- *Scan Speed:* The timing of an automatic scan. Determines the speed the scan moves across the cells
- *Visual Feedback:* The way in which the cell is highlighted to show it is been scanned or selected
- *Auditory Feedback:* As the scanning highlight moves across the screen, a spoken cue can be given for each cell
- *Acceptance time/delay:* Sets how long the switch needs to be held down before the input is accepted and registered by the device

- *Post acceptance delay (debounce)*: Sets the time that must elapse between each switch press. When the switch has been pressed, the software can be set to ignore further unintentional presses
- *Transition Delay*: A pause time can be set, after a switch has been pressed so that the person has time to orientate themselves before the scan moves forward or changes direction
- Outline or fill scan
- Cancelling the scan
- Next scan item
- After selection start at beginning or next item
- Scan delay on first item or add an extra empty cell at beginning of row

Selection set and design

The items available from which the individual can make a choice e.g. *letters, symbols, words, messages*. The selection set can be presented in a visual, tactile or auditory mode.

The design of the selection set needs to be carefully considered to ensure efficient access for the individual. The individual's physical skills, perceptual skills, sensory abilities and communication abilities will all need to be considered to inform on decisions about the most appropriate design of the selection set.

The following factors for the selection set should be considered:

Type of item: Pictures, Symbols, Words, Letters, Functions

Size of individual items: The size of individual items will be dependent on an individual's visual skills and motor abilities and access technique

Display Size: The overall size of the visual display involves compromises between the number of items that must be displayed, the size of individual items, the spacing of items, mounting and portability factors and physical capability of the AAC user (e.g. is it to be carried around or if a wheelchair user ensuring display is not be too large to obscure vision). The overall size of display must accommodate the range of movement of the individual if using direct access to the display

Number of items: Number of items available on the display. The number of items will be dependent on an individuals motor abilities and access technique and language level. Consideration of encoding and multi-level displays needs to be made to increase the efficiency of an AAC system

Spacing: Consider the spacing between items in light of the individuals visual and motor control capabilities

Arrangement of items: The most frequently used items should be placed where it is easiest / quickest for the individual to access.

Rather than put messages in hard to reach places consider multiple linked overlays within the users most accessible arc of movement. For indirect selection methods the use of smaller selection sets with linked subsets will be more efficient

Colour Contrast: The colour contrast of items to background and of different types of items can make access easier

Activation feedback: visual or auditory feedback to the individual to indicate they have made a choice

Acceleration Techniques

- Selection set and design
- Frequency based
- Using a letter frequency keyboard with row-column scanning with a 1 second scan a communication rate of only 2.5 words per minute is produced
- Smaller selection sets make use of linked subsets
- Abbreviation expansion
- Word prediction

Auditory scanning

- Who will it benefit?
 - Visual impairment
 - Difficulties in coordinating “looking” with the physical movement required to press the switch
- Auditory cues
 - What should they say?
 - Content cue – a portion of the message
 - name of symbol
- Different voice and volume control
- Can auditory cue be spoken through a earpiece/headphones
- Organisation of selection sets

Scanning with low tech communication systems

Listener Mediated Scanning (*also sometimes referred to as partner assisted scanning*)

If users are unable to point to individual symbols, it doesn't necessarily preclude the use of a low-tech communication book or board. An alternative method of access could be for the listener to point to the symbols and the user to make a selection using their *yes* and *no* responses. The listener points to each category on the index page in turn while the user would make a selection by indicating *yes* when the desired item was being pointed to. The listener would then turn to the page with messages and vocabulary for the selected category and then point to each item in turn, again waiting for the user's *yes* to make a selection. This method of selection is called **listener mediated visual scanning**. The system can be refined still further by the use of sub-categories within categories.

Listener mediated auditory scanning is where an auditory prompt of the choices on the selection set is given. This can be useful for an individual with a visual impairment or an individual who has difficulty in maintaining visual attention for listener mediated visual scanning.

The one switch/two switch conundrum

- For automatic scanning (one switch) the user needs timing skills i.e. have to be able to activate the switch at the right time/within a given time frame.
- Consider two switch step scanning when
 - Introducing scanning – Assisted scanning
 - Users are unable to achieve good timing skills.

Moving onto Scanning

Moving an individual onto scanning can be difficult!

Individual needs understanding of choices

Ability to select target from selection set / array – may be presented visually or auditory

Functional Visual and Perceptual Abilities

Following a moving target

Maintain gaze on a fixed target

Find target on grid – visual discrimination

Developing scanning skills

- Task analysis
 - identify tasks
 - establish performance components
 - motor skills
 - sensory skills
 - cognitive skills: memory, attention, motivation, problem solving, abstract thinking, organisation, initiation
 - perceptual skills
 - emotional & social demands
 - cultural / contextual demands
 - determine viability
 - investigate potential
- Target item
- Distracters
- Auditory prompt
- Use of two switch step scan initially

Pre requisites to the introduction of scanning

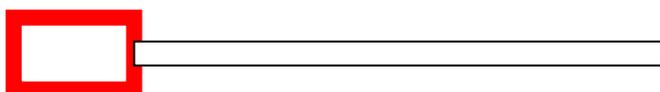
- Seating and positioning must facilitate functional movement
- Control site, type of switch, movement to activate switch must be well established
- Switch and device (VOCA/computer) must be well positioned
- Scanning instruction may require conceptual task analysis

Introduction Ideas:

Take scanning to objects – teddy is the scanning – moving along a line of objects, Big Mack “thats the one”

Light moving along line of objects / symbols

Introduce red card frame over symbols



Assisted Scanning

Consider when

- Introducing scanning
- Users are unable to achieved good timing skills

Takes away the need to make an early decision between one or two switch scanning and takes some pressure of you & the individual

What is assisted scanning:

It is the use of 2 switches with a simple step scan where you (the communication partner / support worker) takes control of 1 switch and the individual takes control of the other switch. The Individual may take control of the scan or select switch.

Individual might scan if:	Individual needs to:	You'll need to
Sustained attention a problem	Stop at will	Watch for the individual's signal
Finds accurate timing difficult	Signal to you to stop	Talk about desired selection
Tends to be impulsive and selects first one in each row		Facilitate stop (verbal prompt) if needed

Individual might select if:	Individual needs to:	You'll need to
Repeated movements are difficult	Sustain attention	Watch for the individual's level of engagement Adapt scanning speed to match this
Tires easily	Keep away from select switch until needed	Talk about desired choice if individual not selecting
Has some timing ability	Select with some timing skill	Facilitate selection (verbal prompt) if needed

- Assisted scanning can be used for a long time
- It can be efficient
- It can keep frustration down, and motivation up
- **But it's not independence**
- Some individuals can move directly from assisted scanning to independent scanning: 1 or 2 switch
- Others need a more phased approach
- Assisted scanning can be used for Low-tech systems

Moving on with scanning

What does the user want to achieve?

Move onto group-item scanning

Most common row-column scanning: axis change may be a problem

Consider layout of selection set to ensure efficiency.

When evaluating possible access methods the following questions should be considered:

- *How easily is the individual using the device?*
- *What is the speed of the overall response?*
- *What is the accuracy of the overall response?*
- *What is the frustration / tolerance for the method?*
- *How reliable is the method?*
- *Does the method cause any short and/or long term fatigue?*
- *Does the method cause any significant increases in tone or change in position?*
- *Are the movements used dominated by abnormal reflex patterns?*

From the access methods evaluated identify:

- Best option
 - further evaluation of this option is the advisable to ensure the user can use it over a period of time
- Any option that offers future potential with further practice / training
 - "It is often necessary for the novice user to develop motor skills with the control interface before it can be used effectively as an input to an augmentative communication device" Cook & Hussey (1995)
- Any options that could be used for limited activities
- No go options

Although ideally a switch user will have one main method of access that they will become proficient in using, there are situations where additional access methods need to be considered and identified. This could be minor changes to the main access method but could be a completely different access method.

We may need to look at additional access methods for:

- different contexts/ environments
- different positions e.g. lying down
- when the individual becomes fatigued

In Summary...

Developing switching skills is complex with many facets to it

Requires good task analysis

Required a team approach

Need to be clear about what the individual wants to achieve with a switch

Keep it fun and motivating!!!