iPad: efficacy of electronic devices to help children with autism spectrum disorder to communicate in the classroom

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Children with Autism Spectrum Disorder (ASD) are known to have difficulty in social communication, with research indicating that children with ASD fail to develop functional speech (Lord and Rutter, 1994). Over the years a number of Augmented and Alternate Communication (AAC) devices have been used with children with ASD to overcome this barrier and to facilitate communication. This article examines an Indian AAC tool called AVAZ (meaning sound), which is the first of its kind in India. The project reported also looks at the effectiveness of using AVAZ and the use of iPads by children with ASD in the classroom. Additionally, the article examines the suitability of using iPads for all learners in the spectrum. Twenty children between the ages of 4 and 10 years were selected to trial the use of AVAZ. They received three sessions weekly of 45 minutes over a period of 10 weeks. The feedback of the special educators who trained the children was analysed. The findings of this small scale study indicates that the children preferred using the AVAZ app and the iPad to pen and paper. Huguenin (2004) too indicated similar reports in using Information and Communication Technology (ICT) in enhancing children's motivation to learn and communicate. The trainers felt it could be used as an educational tool, and many more educational concepts

could be added. Research also suggests that ICT can be used as a tool to tutor for educational purpose (Means, 1994). The AVAZ app could be recommended to children with ASD who are included in mainstream schools. This study was conducted at Sankalp, a special school in Tamil Nadu, Chennai.

Key words: alternate and augmented communication, autism spectrum disorder, information and communication technology, social communication.

The Context for the Study

Sankalp is an institution involved in remedial instruction for children with disabilities including Dyslexia (Learning Disability) and Autism Spectrum Disorder. It was set up in 1999 at Anna Nagar, Chennai, as Sankalp, The Open School for children with Dyslexia, and Sankalp, The Learning Centre for Children with Autism Spectrum Disorder. The Centre is registered with The State Commissioner for the Disabled under the State of Tamil Nadu, India & The National Trust Act of India. The institution caters for up to 140 children with Autism in the age group of 3yrs to 18yrs. All the children have been diagnosed with ASD using the the Indian Scale for Assessment of Autism tool (ISAA, 2008).

Most of the children with autism have difficulties in communication (Lord and Rutter,1994). Since children with autism require training in communication, there was a need to explore communication tools for enhancing this aspect of their learning. The use of computers has shown positive results when used by children with autism (Beukelmon and Mirenda, 2001). Hence the plan to introduce a new electronic communication device such as the use of iPad was launched in the academic year 2012. Apart from the use of IPad, an app called AVAZ, specifically developed to assist children with communication difficulties, was downloaded. AVAZ is an app and an electronic AAC (Alternative and Augmentative communication) tool which can be used by people who are verbally challenged. This app is compatible only with an iPad.

The findings described in this study assisted in making decisions about whether the Sankalp Trust needs to obtain more devices and plan further training on the iPad. In pursuit of its vision, Sankalp continues to take up new challenges to

help children overcome their learning needs and achieve their potential. This study reports just part of that vision.

Purpose and rationale of the study

The aim of this initiative was to evaluate the effectiveness of electronic devices as assistive tools to improve communication in children with Autism. Special educators were the main providers of feedback in this study. Research shows that abnormalities of language are often among the first problems to arouse concern among parents of children with ASD (Howlin and More, 1997). It is estimated that about half of all children with ASD will fail to develop functional speech (Lord and Rutter, 1994). Augmentative & alternative communication (AAC) strategies are very helpful for persons with ASD. AAC can be used either to supplement existing speech or to develop expressive communication (Beukelmon and Mirenda, 2001). Hence there is a need to impart training to communicate by using augmented tools. Some of the electronic AAC devices which are available are: *Go Talks,* which is a battery powered AAC device, and *Voice Output Communication Aid* (VOCA) and *Dyna Vox*, which are both electronic voice output devices.

One such similar electronic AAC tool, which is of Indian origin, is AVAZ, which helps children to express their needs & emotions. Since it is an Indian device it is easily available and can be used among a larger group of children with ASD. Another important reason for using AVAZ is that it can be used to communicate one's needs, to express one's thoughts and to speak out one's feelings. AVAZ is designed to adjust to each person's level of vocabulary. It can be used to make sentences that the person intends to say. AVAZ has picture icons which one points at and which can also be used with the keyboard to type out one's needs and feelings.

Literature Review

Autistic spectrum disorders are a heterogeneous group of neuro-behavioural syndromes characterized by difficulties in the development of social relationships and communication skills, limited or severely impaired imagination and extremely repetitive and rigid patterns of behaviour marked by the presence of usually strong narrow interests. The term "spectrum" implies a range of severity

from mild, to almost normal function in many areas to the most severe in which social function appears to be impossible. Across the spectrum the 'Core triad' of impairments is noticed. The triad of impairments are social skill, communication skills, and thought & behaviour, along with sensory processing difficulty (Howlin and Moore, 1997)

Children on the autism spectrum have limited or non-existent interest in, or desire to socialize with others (Sigman, Ungerer, Mundy, and Sherman, 1987) They show little interest in interacting with younger sibling and may resist cuddling or smiling. Infant interactive games like "peek-a-boo" and nursery rhymes are ignored. The toddler may not watch other children and will not run up to play with them. The autistic child is sometimes described as socially "aloof", will often ignore other people, and may seem unable to distinguish between objects and people (Wing and Gould, 1979). Interactions initiated by the child serve only to achieve the child's immediate wants and needs, Play is typically solitary, and often repetitive and restricted to a single type of object or activity. The child cannot imitate, and may not wave or smile responsively.

Language has both non-verbal and spoken components, both being impaired in the autistic spectrum disorders. Impaired non-verbal communication skills manifest as poor interpersonal synchrony, poor eye contact, an "empty" gaze or actual gaze avoidance, inappropriate body language such as unawareness of personal space (standing or sitting too close for conversational comfort), and absent or inappropriate use of gesture or facial expression, which may include smiling that seems unrelated to current experience. Autistic children characteristically use even familiar adults as though they were tools, bringing them, or just their hand, to the desired object and using the adult's hand to grasp for them the desired object. Pointing to desired objects is often absent or acquired very late. If gestures are used, they also tend to be used to achieve material goals rather than to express feelings. The understanding as well as the use of non-verbal language is impaired, so that the child may not run toward the parents outstretched arms, and will not follow the parent's gaze or pointing finger (Howlin and Moore, 1997)

The combination of impaired communication and social skills gives a strong impression of lack of desire to communicate (communicative intent) (Prizant and Ryddell, 1993) Expressive language is not simply delayed in autism; it seems to follow an abnormal or deviant developmental path. The child may repeat words or phrases just heard but not understood (immediate echolalia) or may suddenly repeat a sentence heard a day or two before (delayed echolalia). Because the child

has little awareness of the boundaries between self and others confusion of pronouns (I/You, We/They) are characteristic. Many children resort to repetitive questioning to attract and maintain adult attention, to achieve a better explanation or response to a request, or to reduce anxiety. Autistic children may ask the same irrelevant or inconsequential question for hours or days on end. Pre-linguistic skills of orienting to speech sounds, declarative pointing, and joint attention skills, seem to be lacking in children with ASD.

There is lack in development of Language skills in the area of comprehension, where the children with ASD have problems in understanding and interpreting the idea and concepts that are being communicated (Twachtman, 1990). In the area of semantics the children have problems in encoding meaning relevant to conversation and have word retrieval difficulty. In the area on syntax they have difficulty in pronoun, verb ending and tenses. A severe deficit in pragmatics can be identified in children with High Functioning Autism even if their expressive language is otherwise perfect.

Many children with High Functioning Autism develop significant expertise in some specific area such as railway or airline timetables and the calendar. Some have an excellent "photographic" memory for places or things. Kanner in 1943 noted that they have excellent rote memory but it iss dissociated from meaning.

Some children with autism are Hyperlexic, which is characterized by a preoccupation with print and is noted before the age of three years. In some cases hyperlexic children can read what they see, although usually without understanding.

It is in this context of understanding and supporting the growing need to improve the language abilities of children with ASD that Alternate & Augmented Communication intervention has evolved. According to Hodgdon (1995; 1996) and Quill (1997), the use of AAC tools is beneficial, especially the tools using the visual modality. Although research indicates the usefulness of AAC's, many parents of children with Autism at Sankalp have expressed their concerns, especially parents of younger children with autism. They are apprehensive about using an AAC device as they feel that it restricts their child's speech output.

Alternate & Augmented Communication (AAC)

The goal of AAC intervention is to assist individuals with communication difficulties to overcome their inability to communicate and meet their needs to

express (Beukelmon and Mirenda, 2001). AAC devices can be divided into two broad areas: aided devices and unaided devices.

(i) Unaided Devices

Unaided AAC strategies included manual signs and gestures. The efficacy of this approach is questionable as many signs were not understood by everybody. In my experience at Sankalp when the children were taught to use signs many children had difficulty in mastering the signs as they lacked imitation skills. The few children who did pick up signing were not understood by the caregivers and the general public. The reason for this could have been due to lack of knowledge of sign language of the caregivers and the general public. The failure could be also associated to the characteristics of an ASD child where they have poor imitation skills and the lack of eye contact (Mirenda, 2001).

(ii) Aided Devices

The most common aided, low tech augmented tool used are pictorial or written schedules, to help children follow through a particular activity (Quill, 1997; Wood *et al.*, 1998). The other AAC tool which is widely used is Picture Exchange Communication System (PECS): this is a structured behavioural intervention programme. It uses visual/graphic symbols for communication (Frost and Bondy, 1994). Picture symbols are used to initiate communication. A set of picture cards are separated into categories and kept in books with Velcro strips. Picture symbols are used to represent items the student wants and the student is taught to request them by pointing or presenting the picture to receive a response.

Bondy and Frost (2002) state that once the child masters using the PECS, the picture symbols can be used in various setting including while traveling. But in my experience with the PECS booklet it is a challenge to use it as it is very unwieldy, and also that it involves many small picture cards, the chance of losing& damage to the cards are high. For many children handling large number of cards in a single page becomes a challenge.

Recent years have seen an increased focus on new developments in information technology, resulting in the emergence of a number of aided devices which are reliant on advances which use computer assisted instruction. The popularity of digital culture along, with the trend towards economic globalization, the advancement of information technology and the development of knowledge

based society has led to the implementation of computer assisted information skills to cope with the challenges in every aspect of life. (Johnson and Martin, 2003). Advances in the development of specialized software has also led to improvement in implementing the use of technology. Assistive Technology (AT) can play a major role in overcoming barriers faced by persons with developmental delays. There are various AT devices for supporting vision, for hearing, for learning and studying and for communication.

AT devices for communication help people who are non-verbal or have limited speech. AT devices like voice output, picture/photographs and word cards help children with ASD. Some examples of such high tech devices are:

Go Talks: these are battery powered AAC devices. The messages are pre-recorded. An overlay of pictures/words or symbol is created. The pictures help the user to remember where to find the messages. The user can use this device by pressing the picture to play the message.

Voice Output Communication Aids (VOCA): VOCA is a portable computerized device that produces synthetic or digitized speech outputs. A variety of visual graphic symbols are used to represent messages which are activated with a finger, hand, or optic pointer. Lancioni *et al*. (2001) indicated positive effects of the use of VOCA to strengthen their communicative behaviour.

DynaVox: Dyna Vox is another electronic (voice output) device, similar to a laptop with a touch screen, The device can have pages focused on commands, attributes, photos of exact items (Sanger and Henderson, 2007)

AVAZ ('Voice')

AVAZ means 'voice' in Hindi. It is an AAC (Alternative and Augmentative communication) device used by people who are verbally challenged. The voice output is an Indian voice. It was developed in 2007 by a group of alumni students from Indian Institute of Technology (IIT) Madras, India, who got together to start a company called Invention Labs, focused on making inventions that were particularly relevant to the Indian context. They made a number of prototypes of the device and tried it with a few special schools in Chennai (Madras). In December 2010 the first version of AVAZ was launched which was a lightweight portable tablet. The research & development team at Invention Labs is constantly working towards improving and

adding new features to the existing device. AVAZ is currently available as an App which can be downloaded to and is compatible with an iPad.

AVAZ is very similar to *Dyna Vox,* with one important exception: AVAZ caters specifically for the Indian population. The picture icons are all specific to Indian culture, for example. In the food category it carries all Indian food items, hence it is familiar and makes it easier for the Indian user. The recorded voice output, too, is an Indian voice and this again makes it easier for the Indian user as the accent is familiar. It also has options to be used in five Indian languages. It is the first electronic AAC device with the latest technology available in India

AVAZ can be used to communicate one's needs, to express one's thoughts and to speak out one's feelings and is designed to adjust to each person's level of vocabulary. It can be used to make sentences that one intends to say. AVAZ also has the capacity of expressing any English sentences and can be customized to speak in five other Indian languages. It would appear to be a natural replacement for picture cards, flash cards and charts. In sum, it can be thought of as an electronic speaking version of picture cards. Since AVAZ generates speech it also stimulates imitation in some children, which in turn stimulates their intention to talk.

The system can be used in two modes: a text mode if the person is comfortable with alphabets and sentences, and picture mode if one prefers a visual approach. In this version of AVAZ, the Text mode and Picture modes have been integrated so that both can be used and it is easy to switch from one mode to the other.

Project Implementation

Twenty children assessed with High Functioning Autism between the ages of 4 to 10 years were selected for the trial of the use of AVAZ. These children were selected as they showed specific interest in manipulating the iPad. All 20 children have been diagnosed, using the ISAA tool 2008, as falling within the higher range of cognitive ability. They had been placed on an academic programme and follow the Tamilnadu State Board Curriculum. They were familiar with the icons and keys on the IPad. Out of the 20 children 8 of them used one word to communicate.

The children received three sessions weekly of 45 minutes over a period of 10 weeks. Four special educators of Sankalp trained these children during school hours. The

trainer's experience in teaching the children to work on AVAZ was recorded on a feedback form. The programme was organized in four stages, as indicated in Figure 1.

Summary of Findings

All 20 children were found to be suitable to use AVAZ after administering the AVAZ suitability evaluation check list (see Figure 1 of appendix). The interest towards using the device was evident among all the students as they indicated purposeful usage of the tab. They tried to press the icons and waited for the response. The teachers noticed that the attention span of the children who had short attention span had improved. They were able sit on task with the tab without distraction. The children looked forward to the AVAZ session.

Out of the 20 children, four of the children completed step 1 independently. A further 11 children progressed to step 2 but needed prompts (physical or verbal prompts). The five children who had prior knowledge and practice working on the computer could easily adapt and navigate the AVAZ touch screen independently. They could work through up to step 4 independently. They could answer prepared questions which were both open and closed ended.

Experience of the trainers using AVAZ - A Discussion

Introducing AVAZ had created new avenues for the children at Sankalp. The trainers shared their experiences in using AVAZ by filling out feedback forms. According to these trainers there was an improvement in the children's interest to use the touch screen technology. The children preferred the AVAZ tab to pen & paper. Huguenin (2004) indicated similar reports in using Information and Communication technology (ICT) in enhancing children's motivation to learn and communicate. The children were found to be independent and occupied with the device. It kindled their interest and attention. The trainers felt it could be used as an educational tool too, and many more educational concepts could be added in the picture mode. Research suggests that ICT can be used as a tool to tutor for educational purpose (Means, 1994; Forlin, 2004). AVAZ could be recommended to other schools and to parents of children with Autism, but since teachers and parents have their own apprehensions about the use of electronic devices (Buzhardt, Abbot, Greenwood and Tapia, 2005) both teachers and parents would require adequate intensive training before they tutored the children. On completion of the training sessions the trainers reported a change in the parents' earlier attitude of having restriction on using AAC devices.

Step 1: Getting started
Introduce the child to the device & its features
Switch on the device
Press the icon-AVAZ for autism
Press icons of Basic/ Advanced/Quick
Start with Basic and introduce categories (e.g. greetings, food, recreational locations)

Step 2. Identify and point
Point to various items in the sub-category example: under food category, point to breakfast, lunch & dinner.
Point to yes & no questions
Point to pictures when questions are asked

Step 3. Teach Navigation
Teach navigation of the touch pad from home page to scroll move on to categories & sub categories. Answer to questions by pointing to pictures.

Step 4. Teach the use of Keypad
Teach the use of text mode to answer the questions type one word or phrase or sentence.

NB. Step 1 and 2 is with assistance by the Teacher, is with help either physical prompt or verbal prompt. Step 3 and 4 child is independent, and can navigate the icons on the touch pad and point or type the answer when asked.

Figure 1. The AVAZ system

They felt that the parents were convinced that using AAC devices makes a change in communication for children with autism.

Summary and overview

This small scale study indicated that children with autism are often drawn towards technological devices and that, there is need to take advantage of this fascination to make changes while implementing interventional plans. The findings have clearly indicated the importance of using electronic devices such as the IPad and the AVAZ app for communication to tap their hidden potentials. The evaluation study did have certain limitations. It was conducted in a school setting and hence cannot necessarily be seen as generalizable to other contexts. For AVAZ to be used as a communication tool children have to use it in various settings. The children would need to be trained to use the app and communicate outside school environment at home, while in shops, restaurants, social functions, visits to family

& friends etc. The children also need regular extensive practise in using AVAZ to improve their ability to communicate. For this to be successful, parents support would be required. Parental training and acceptance would be of utmost priority. Secondly, as mentioned, the students chosen for this study were children with high functioning autism and were the students who showed interest using the iPad. Children with autism having lesser cognitive abilities found it challenging to manage the iPad and hence were not selected for this study. Further investigation would have to be carried out to establish and generalize the benefit of AVAZ for all children with autism. Finally, since the AVAZ app is only compatible only with an iPad, it may not be affordable by all parents in India.

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Appendix

Name of student:XXX   **Name of teacher: XXX**

Assessment date: 9/7/2016

CRITERIA : Yes (Y) No (N) Sometimes (S)	
Pre-requisites (for both Picture mode and Text mode) (if any 1 or 2 are present)	
On-sitting for at least 15 min	Y
Has medium to high cognition (used the ISAA score)	Y
Uses non-verbal communication to communicate basic needs (intent to communicate is present) even if the child takes the adults hand & places on the object	Y
Ability to understand & follows instructions of pointing, switch on/off, press delete etc.,	Y
Suitable for Picture mode	
(if any one of the following is present)	
ability to respond to yes / no questions	Y
ability to do choice-making	S
ability to point to pictures to communicate – Independent / Physical prompt / Verbal prompt needed	Y independent
Ability to understand and respond to simple questions (what did you eat today? how did you come to school? etc.)	S
Shows interest to computer / laptop or electronic gadgets	Y
Has basic knowledge of computer skills	Y
Suitable for Text mode	
Can spell 4-5 letter words	Y
Can respond to simple questions by typing one word answer	Y

Report

	Your Response
Is the child suitable for AVAZ? Yes / No –	yes
What mode of operation is recommended? (Picture mode / text mode)	both
Any other details :	

Figure A1. Continued

Diagnosis	
Medical diagnosis (CP/MR / Autism etc.)	Autism
Hearing impairment – Y/N	N
Visual Impairment – Y/N/Partial	N
Motor abilities	
Gross Motor control	Good
Fine motor control	Good
Other Details	
Strengths of child	Music, is good at humming tunes
Interests of the child	Is interested in operating the computer
Any sensory issues?	no
Possible cause of behavioural issues, if known	
Communication Abilities	
Language Skills	
Receptive languages understood	Y
Expressive languages used	S
Speech	
Is the child verbal / Non-verbal	Verbal
If verbal – unclear speech?	Y
If Verbal – 1 word/2 words/ simple sentence / compound sentence?	2 words
IF NV, what are modes of comm.- Gesture / sign language/ Vocalization / Picture Chart /Eye Pointing/facial expression etc.)	
If AAC Devices used, which devices?	No
Give examples when his communication has not been easily understood	
Any other details	

IMPACT OF AVAZ - *
Key :
1-Regression,   2-No change   3-slight improvement
4- Significant improvement   5-remarkable improvement

	XXXXX	After 3 months	After 6 months	After 9 months	After 1 year
- Independence in using the device	4				
- Confidence	3				
- Curiosity	3				
- Intent to communicate	2				
- Memory (can remember the sequence)	3				
- Able to use AVAZ with caregivers / family members / teachers/therapist	3				
- Navigation of the device	4				
- Familiar with categories & sub categories Eg: Food/ School etc.,	4				
- Answers questions – Points to Picture/types words/ types sentence	4				
- Speech ability / output	4				
- Spelling	3				
- Vocabulary	2				
Others (specify)					

Figure A1. AVAZ USER PROGRESS (Sample Form)