Assistive Technology Resources for Children and Adults with Disabilities

Closing The Gap

Solutions

December, 2014 / January, 2015
VOLUME 33 - NUMBER 5

Eye Gaze Technology for Girls with Rett Syndrome: From Trials to Conversations

Application and Independent Study in Reading Comprehension for Two Students with Sensory Challenges

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One-year online subscription $110 per year; One-year student online subscription (Electronic Textbook) $50.

All subscriptions from outside the United States must be accompanied by a money order or a check drawn on a U.S. bank and payable in U.S. funds. Purchase orders are accepted from schools or institutions in the United States.

PUBLICATION INFORMATION

Closing The Gap (ISSN: 0886-1935) is published bi-monthly in February, April, June, August, October and December.

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contents december, 2014 / january, 2015

volume 33 | number 5

Closing The Gap

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Eye Gaze Technology for Girls with Rett Syndrome: From Trials to Conversations

ABSTRACT

Eye gaze technology represents the best means of access to an AAC device for many girls and women with Rett Syndrome (RTT) as it builds on their natural use of their eyes to socially engage and connect with others. However, this technology is not always being used to unlock the girls' hidden communication and learning potential. Girls are having the opportunity to participate in trials using AAC devices with eye gaze technology, but these may not be successful due to the page layout or criteria for their performance. Even when girls gain access to an eye gaze system, they are often provided with access to limited vocabulary sets until they demonstrate mastery. It is important for educators and clinicians to implement page layouts and strategies that have been found to be effective in supporting girls in moving beyond choice making and requesting by engaging girls with RTT in conversations.

Image 1: Photo of a 3-year-old girl sitting on her Dad's lap during her session with Judy Lariviere at Katie's Clinic for Rett Syndrome & Related Disorders at UCSF Benioff Children's Hospital Oakland. She is using the Tobii I-12 with Judy's eye gaze trial page set in Tobii Communicator.

BACKGROUND

Eye gaze technology is "opening up the world" of communication and literacy learning for individuals with Rett Syndrome (RTT).* Eye gaze technology gives girls and women with RTT easy and independent access to their "voice" by capitalizing on their eye movements that they naturally use to socially engage and connect with people. Essentially, their eyes represent their index fingers for pointing; eye gaze technology gives the girls a direct means of access to a dynamic display Augmentative and Alternative Communication (AAC) device, which enables them to independently navigate across pages to express what they want to say, when they want to say it and how they want to communicate what is on their minds and in their hearts. Given the high cost of eye gaze technology for an AAC device, it has often been viewed as the "cadillac" of access methods. As a result, eye gaze technology has only been considered after a girl or woman has demonstrated limited progress or lack of success with hand or switch use. However, at this point in time, there is no other access method that most girls and women with RTT can learn as quickly and effortlessly as eye gaze technology. This significant progress has been demonstrated in over 250 initial eye gaze trials during which girls and women with RTT, ranging from 2

JUDY LARIVIERE, M.Ed., OTR/L is an Assistive Technology Specialist and Occupational Therapist with a Master's degree in Special Education who has worked in the field of Assistive Technology, including Augmentative and Alternative Communication (AAC), for the past 26 years. She is the Communication Specialist at Katie's Clinic for Rett Syndrome at UCSF Benioff Children's Hospital Oakland. Over the past 18 years, Judy has worked with many girls and women with Rett Syndrome (RTT); identifying their best means of access to technology for communication and literacy learning, while also implementing tools and strategies to support their educational progress. She has designed various eye gaze page layouts specifically for girls with RTT and has used these successfully with over 250 girls and women. Judy presents at conferences nationally and internationally about her work with children and adults with RTT. In addition, she is a full-time Professor as an Assistive Technology Specialist in the Disability Resource Center at Skyline College in San Bruno, CA. Currently, Judy is working in collaboration with Pati King-DeBaun in developing an online AAC interactive curriculum called "Teach Me AAC - Conversation, Language & Literacy (CLL) for Rett Syndrome," which will be available soon. Judy also has developed customized eye gaze trial page sets for girls and women with Rett Syndrome, as well as Eye Gaze Video Players and Eye Gaze Music Players for children, as well as teens and adults in Tobii Communicator. These are available through www.assistivetech4all.com.

WHAT IS RETT SYNDROME?

Rett syndrome is "a rare genetic postnatal neurological disorder that occurs almost exclusively in girls, but can be rarely seen in boys" (http://www.rettsyndrome.org/about-rett-syndrome; Accessed October 12, 2014). Rett Syndrome results from a mutation in the MECP2 gene on the X chromosome; given there are over 200 mutations of the MECP2 gene, individuals with Rett Syndrome present with a diverse range of abilities. Apraxia and severe physical challenges affect their ability to speak, walk, eat and, in many cases, use their hands. Cognitive assessment in children with Rett syndrome is extremely difficult; recent eye tracking research and detailed descriptive accounts of what girls and women are expressing spontaneously using an Augmentative and Alternative Communication (AAC) device with eye gaze technology are providing insight into their true communication and learning potential.

Image 2: Tobii EyeMobile with Main Page from Pati King-DeBaun's Dynamic Communication Book for Girls

to 40 years of age, have learned how to use my customized eye gaze trial page set. The layout of my customized eye gaze trial page set is designed to build on their natural patterns of eye movement horizontally across a page and then either up or down. Given this eye gaze trial page is set up in Tobii Communicator, it works on all Tobii Eye Gaze systems.**

I have also used this same page set with girls and women with RTT using Tobii's PCEye Go on a Windows-supported tablet as Tobii EyeMobile (as shown in Image 2) or on a laptop computer. The PCEye Go represents a significantly less expensive eye gaze system that plugs directly into a USB port on a Windows-supported tablet, including the Surface Pro 3, or on a laptop computer running the Windows operating system. The PCEye Go provides a more affordable eye gaze option for school districts and families to use with computer-based technology they may already have to enable girls and women with RTT to have independent access to their "voice," which often stays locked within using other methods of access.

Over the past five years, ever since eye gaze technology was introduced as a means of access to portable, battery-operated AAC devices, an increasing number of girls and women with Rett Syndrome have had the opportunity to trial and use eye gaze technology to support their communication. Use of eye tracking technology has capitalized on the girls' and women's natural use of their eyes for communication. As a result, girls have quickly learned how to use their eyes to make intentional and appropriate selections. I have used my customized eye gaze trial page sets that build on a girl's natural and spontaneous use of horizontal eye movements with over 250 women and children with RTT through my private practice and Katie's Clinic for Rett Syndrome & Related Disorders at UCSF Benioff Children's Hospital Oakland. Typically, they are communicating using eye gaze technology within the first 20 minutes of being introduced. In the many years that I have worked with individuals with Rett Syndrome, assessing and implementing a wide variety of access methods, including hand use for direct selection and two-switch access for step scanning, eye gaze technology by far represents the quickest and easiest access method for most girls and women with Rett Syndrome to learn. They naturally use their eyes to communicate. When girls are capable of touching or make selections with their hands, observation reveals that they lead with their eyes first and then their hands follow. In addition, out of the 150+ girls and women with whom I have worked through Katie's Clinic for Rett Syndrome & Related Disorders, I have only seen one or two girls effectively use their hands to directly access a communication-based app on an iPad. If girls are using their hands, often their communication skills are limited by their motor abilities rather than by what they are capable of expressing. Through the use of eye gaze technology, girls and women with RTT are making dramatic changes in their expressive communication.

*Given this author has only used eye gaze technology with girls and women with Rett Syndrome (RTT) and has not yet had the opportunity to conduct eye gaze trials with boys with RTT or MECP2-related disorders, this article will focus on its use and application to girls and women with RTT.

**Given the recent release of NuVoiceTM 2.0 software for Prentke Romich Company's (PRC) Accent 1200 with NuEyeTM Tracking System, I will now be able to program the same page layout with the shape and layout of buttons on a page that supports the natural eye gaze movements of girls and women with RTT. As a result, this same page layout and eye gaze trial page sets will be available for girls and women very soon.

CONSIDERATIONS FOR SUCCESS

There are several special factors that are important to take into account when working with girls with RTT in order to support their success in their communication and literacy learning experiences. **Apraxia** represents one of the most significant challenges that individuals with RTT experience. Rettsyndrome.org defines apraxia as "difficulty with the usually automatic planning done by the brain to execute voluntary movements." (http://www.rettsyndrome.org/for-families/glossary, accessed on 10/19/2014). Another way to view apraxia is the difficulty with completing motor acts, particularly in response to a command or request; it affects the ability to organize one's body in order to give an observable response or complete a motor act. Apraxia does not mean a girl with RTT cannot understand or do; it interferes with her response to a request to do something, especially when this is out of context of a natural

situation. Apraxia affects all motor movements, including those of their eyes. A girl's absence of a response or a delayed response to a request, particularly when it is out of context of a natural situation, is often misinterpreted as her inability to understand what is being asked of her or that she has not yet learned the concept and needs additional repetition; a girl's apraxia often accounts for these misinterpretations.

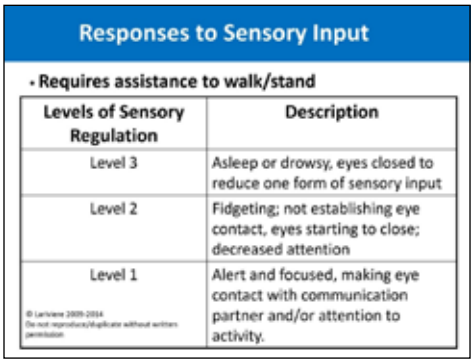
It is important to recognize that when a girl spontaneously initiates a movement, based on motivation or a strong emotion, typically the effects of apraxia are reduced. For example, during extended eye gaze trials, when girls are using a loaner AAC device with eye gaze accessory at school and at home, teachers and therapists always comment that the girls "can always find their music page," even when they need to navigate through several pages to access it. One example of this is a 10-year-old girl who had completed an extended trial with a Tobii C12 with CEye Module using my Eye Gaze Trial Page set and there were delays in submission of the funding due to changes in the family's insurance. Eight months later, when she had a trial session with a Tobii I-12 using the same page set, she immediately made the following selections: "Goodbye," to go to this page where she selected "Goodbye" and "Gotta go" and then looked at me to clearly communicate what she was thinking. When her teacher walked over to her and responded, "I don't think so," the girl immediately selected "Something's Wrong," and on this page selected, "I need a break," and then on the "Break" page, selected the button, "I want to listen to music" and then selected her favorite music video on this page. It is important to note that this represented an indirect path to get to her music page, but she remembered this from her eye gaze trial eight months earlier. Girls with RTT are always highly motivated by their favorite music and/or videos. Most often, a second favorite is books.

A strategy for working around a girl's apraxia is to provide "gentle" guidance or just talk with her naturally, rather than giving direct commands telling her what she needs to do and then wait quietly, observing any response the girl gives, regardless of how subtle it may be. Acknowledge a girl's response and give meaning to it. For example, when reading a book, the statement, "Oh, I see a beautiful butterfly with purple wings" will be much more effective than "Look at the butterfly" or "Find the butterfly." Another approach is to acknowledge when you see a girl looking at something by saying, "I see you looking at the butterfly," and then make a comment about it, such as "It has beautiful purple wings." Quite often, as soon as you acknowledge what the girl is looking at, you will also see her smile in response to your statement or spontaneously look to you in agreement. This same approach can be used when a girl is using an eye gaze system and you are reading a book with her. You can model the use of comments, core words or descriptive words on her eye gaze device while you are talking about a book you are reading to her. Then wait and observe her response, which may be using her natural gestures or selections on her eye gaze system.

Always acknowledge and give meaning to any and all communication attempts

Sensory regulation represents another important consideration when working with girls with RTT. A girl's difficulty in modulating sensory input can result in her being overly responsive or under responsive to different forms of sensory input. The various forms of sensory input that an individual processes include visual, auditory, tactile, proprioceptive or sense of body in space without vision, vestibular or sense of movement, as well as taste and smell (Biel, 2014; Biel & Peske, 2009). One form of sensory input that is rarely talked about, but plays a major role in a girl's attention and engagement in any activity is interoception (Taylor, 2006). This refers to the perception of hunger, thirst, gastrointestinal functioning, level of fatigue based on quantity and quality of sleep and stress or anxiety. Additional information about sensory processing challenges can be found at http://sensorysmarts.com/index.html.

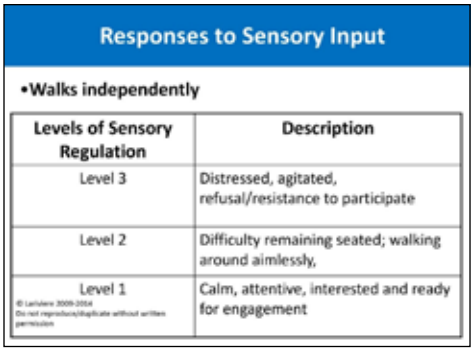
Given a girl's level of sensory regulation influences her ability to communicate, learn and demonstrate "what she knows" through a motor response, I developed charts that describe a girl's level of sensory regulation to use as guidelines for determining when a girl is ready to communicate, participate and learn. These charts have been used in classroom and therapy settings to assist educators, clinicians and parents in identifying a girl's level of sensory regulation. The charts resemble a rocket ship getting ready to blast off, so girls are "ready" when their responses to sensory input are at Level 1.


Responses to Sensory Input

• Requires assistance to walk/stand

Levels of Sensory Regulation	Description
Level 3	Asleep or drowsy, eyes closed to reduce one form of sensory input
Level 2	Fidgeting; not establishing eye contact, eyes starting to close; decreased attention
Level 1	Alert and focused, making eye contact with communication partner and/or attention to activity.

Image 3: Lariviere's Responses to Sensory Input Chart outlining observations across various levels of sensory regulation for a girl who requires assistance to walk or stand.


Responses to Sensory Input

•Walks independently

Levels of Sensory Regulation	Description
Level 3	Distressed, agitated, refusal/resistance to participate
Level 2	Difficulty remaining seated; walking around aimlessly,
Level 1	Calm, attentive, interested and ready for engagement

Image 4: Lariviere's Responses to Sensory Input Chart outlining observations across various levels of sensory regulation for a girl who walks independently and can stand up from a sitting position independently.

Separate charts were developed for girls who require assistance to walk or stand as shown in Image 3 and for those girls who walk independently (see Image 4) as these two groups of individuals with RTT often have different sensory profiles and responses to sensory input.

It is important for educators, clinicians, parents and other communication partners to continually observe for signs that indicate when a girl's sensory system is moving out of a regulated state, i.e, from a "green" Level 1 to a "yellow" Level 2 as shown in Image 5. Once these indicators are recognized, it is important to give her some form of sensory break to get her back into Level 1 before continuing with

the lesson or therapy session. If the signs are missed or a girl in a classroom setting is not given a snack or something to drink until the scheduled "snack" or "lunch time," then the girl's sensory system will typically move into a "red" Level 3 of sensory regulation. As a result, a girl may fall asleep or just close her eyes to cut out the sensory input.

> **Access is the key to unlocking the true communication potential of individuals with Rett Syndrome.**

TRIALS WITH EYE GAZE SYSTEMS

Even though more girls and women are having the opportunity to participate in trials using AAC devices with eye gaze technology, these may not be successful due to the page layout or criteria for their performance. In addition, all AAC devices with eye gaze technology are NOT the same. When looking at eye gaze systems, it is essential to take into account the girl's positioning and natural movement patterns in relation to the size of the eye gaze system's track box. The track box is an invisible area in front of the eye tracking cameras located in the eye gaze accessory within which a girl's eyes, head and body can move while her eyes continue to be tracked. The dimensions of the track box are unique to each eye gaze system and are expressed in terms of height for vertical movements, width for lateral movements and depth for forward and backward movements. The track box dimensions are expressed in terms of the optimal distance that a user's eyes must be positioned from the eye gaze accessory and typically range between 24 and 27 inches. It is essential to match the eye gaze system to the girl's spontaneous and natural eye gaze patterns, head and upper body movements, as well as positioning in sitting or standing. A bigger screen is not always better. A girl's range of natural eye movements may be smaller and may not require the use of a larger screen.

Just because a girl is an independent walker does not mean she cannot use an eye gaze system for communication. In this author's experience, many girls walk up to an eye gaze system that is positioned on a table in a commonly used room at home (i.e., living room, kitchen, etc.) that they can access independently. In these situations, the eye gaze system is positioned at the correct height and distance from their eyes so they can stand and make their selections to initiate interactions.

Over the past five years, many eye gaze systems have become commercially available for portable, dedicated AAC devices and, more recently, for Windows-based tablets, laptops and desktop computers with external monitors. Although this article will focus on a few systems that have been used by this author and found to work consistently for the most number of girls and women with RTT, there are other systems out there. Even though these systems will not be discussed in this article that is not to say that these eye gaze systems will not work for them. It is incredibly important that for any eye gaze system that is being considered for a communication system, eye gaze trials need to be conducted with it. Equally important is to try at least two different eye gaze systems with an individual with RTT so that a comparison can be made based on ease of access.

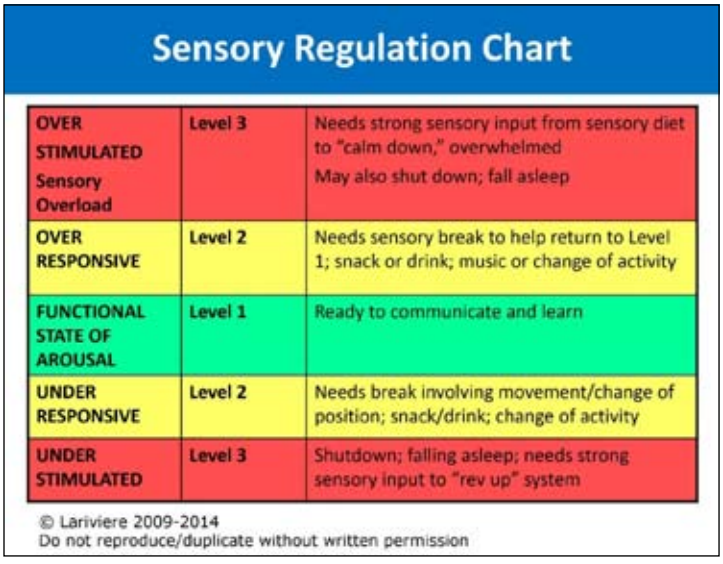


Image 5: Lariviere's Sensory Regulation Chart provides an integrated color-coded version of the various levels of sensory regulation based on how a girl is processing sensory input in her environment. This chart includes a description of some of the strategies that can be used to support a girl in returning to a Level 1 of Sensory Regulation when she is ready to communicate and learn.

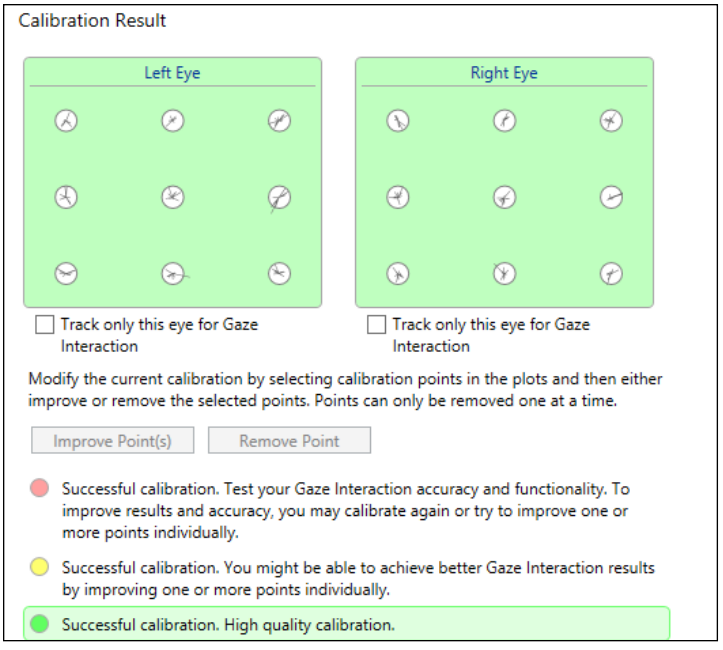


Image 6: Screenshot of a Calibration Result with a Successful 9-point Calibration on a Tobii I-12. The markings in the center of the circles indicate that the individual fixed and held his/her gaze on the presented visual stimulus during the calibration process.

In order for a girl with RTT to be successful in any task or activity, it is important to balance the motor demands with the learning and/or communication demands. When conducting eye gaze trials, this represents a new access method for a girl that has increased motor demands. Although this is not standard practice when using eye gaze technology, I do not have a girl calibrate the eye gaze system during her first eye gaze trial session(s).

Guiding principle: For girls to be successful, the motor demands need to be balanced with the learning and/or communication demands.

Having a girl maintain her gaze on a series of five buttons in a specified order, even when a highly motivating photo or video is used, taps directly into her apraxia. Rather than having the girl use a poor calibration or tire her eyes very quickly during the calibration process, I have one of her parents complete a 9-point calibration of the eye gaze system, given their eyes represent a close genetic match to their daughter's eyes. This way, the girl uses a high quality calibration as shown in Image 6. After a girl's parent calibrates the system, then I position the eye gaze system by finding the girl's eyes in the Track Status window. I reposition the device so that her eyes are displayed in the middle of the Track Status Window and the indicator (i.e., white arrow) is in the green section to indicate that the device is the proper distance from the eye gaze system for optimal tracking of the girl's eyes as shown in Image 7.

Essentially, girls need to perform two motor actions when using an eye gaze system. They need to visually scan across the screen to find the button they want to select and then they need to maintain their visual attention/fixation or dwell on the button for a predetermined time in order to select it. Therefore, it is important to lower the communication and learning demands. When applying this principle to initial eye gaze trials, I often program in photos of family members and the girl/woman in my eye gaze trial page sets and take the girl to this page first. Research with girls with RTT supports that they naturally look at people and focus on their face and eyes rather than at objects (Djukic & McDermott, 2012; Djukic, McDermott, Mavrommatis, & Martins, 2012). Having a photo page with family members helps a girl to start using this technology right away as she naturally will look at her Mom, Dad and other people or pets in her family. I use this as an opportunity for the girl to introduce me to her family members, as well as herself. In addition, I program highly motivating content by integrating the girl's favorite music videos as motivators, along with less familiar ones so that I can see if she is being successful with the access method by selecting her favorites. Girls are always able to find and select their favorite video. This approach also helps to minimize the effects of apraxia during the eye gaze trial given the girls have a strong emotional connection to their family and their favorite music video that they can recognize by a screenshot of the character from the TV show (e.g., Dora or Doc McStuffin) or movie (e.g., Elsa from the movie, Frozen) or song artist (s) (i.e., One Direction or Taylor Swift for older girls). During the eye gaze trial, I also model how to stop a video or start it again when it finishes and how to select a button on the page that takes her back to a music selection page where she can choose a different video. After she has selected a video two or three times, I navigate to the "comments" page for her and verbally name the choices for her while pointing to each button. I always make sure to point to the top portions of the buttons from above so that I don't block the eye gaze accessory, which is typically positioned at the bottom of the device. In the majority of cases, a girl will select the comment that corresponds to her repetitive selection of a particular video.

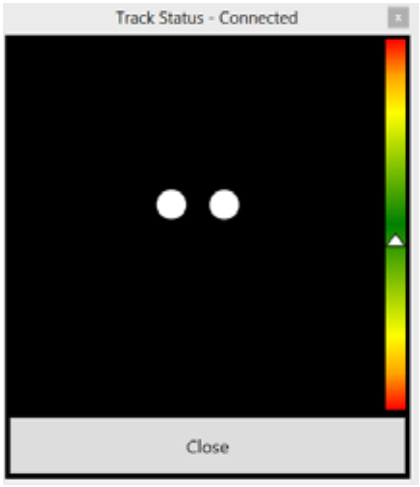


Image 7: Screenshot of Track Status Window on Tobii I-12 showing that the eye gaze system is connected. The two white circles show the position of the girl's eyes in relation to the eye gaze accessory or cameras. The white arrow in the middle green portion of the vertical bar on the right side of the Track Status Window indicates that the device is positioned at a suitable distance from the girl's eyes.

When using eye gaze technology with girls, I typically set the dwell between 500 and 600 milliseconds, but will adjust it to a shorter or longer dwell time so that it correspond to a girl's natural length of visual attention or fixation on a button. The length of dwell does not represent a motor skill that needs to be improved or incorporated into an IEP goal. In all of the eye gaze trials I have completed with girls and women with RTT over the years, I have never set the dwell to one second or longer. This length of dwell is too long for a girl to physically maintain her visual focus and attention on a desired button before it is selected. I consistently use the red clock as the form of visual feedback that girls and their communication partners receive. Using the clock as visual feedback enables the girl's team to see when she is partially dwelling on a button but not looking at it long enough to select it. This provides valuable information about the length of the dwell and whether its length is matched to the girl's natural length of gaze or fixation. In addition, the clock also provides information about the girl's natural gaze pattern and if she is experiencing difficulty in accessing the outer buttons on a page, as shown by partial circles, while she looks at the buttons but never maintains her gaze for a sufficient length of time to select the button(s).

In May 2014, Tobii ATI released Tobii Gaze Viewer, a tool that records where a girl is looking across pages over time, up to a 30-minute session. Tobii Gaze Viewer also records the audio during this process. Images and videos of heat maps and gaze plots can be created that show exactly where a girl is looking on the screen at any point in time and her gaze patterns when she is looking at various buttons across the pages in Tobii Communicator. I now use Tobii Gaze Viewer during a girl's eye gaze trial to document a girl's natural eye gaze patterns. It also documents evidence of a girl's selections throughout the eye gaze trial that can be later analyzed for data to support the funding process. Even though Tobii Gaze Viewer represents a useful tool for documenting results during eye gaze trials, I also recommend videotaping the session(s) as this allows for observations relating to how a girl uses her natural gestures or unaided communication in conjunction with the selections she makes when using an eye gaze system. These forms of communication reinforce that her selections are intentional and have meaning.

Whenever you use an eye gaze system with a girl, it is important for the interactions to be natural and meaningful. It is not "target practice," so asking a girl to "Look at this…" or "Find a specific

picture" taps directly into her apraxia and does not reflect a girl's true potential or ability to use an eye gaze system. Given eye gaze represents a new means of access to her "voice," there will be errors or mishits in her selections. However, typically a girl will indicate in some way when she selects a button that she did not want. One example of this relates to an eye gaze trial with a 29-year old woman with RTT at Katie's Clinic for Rett Syndrome & Related Disorders. She had a previous one-month trial with the DynaVox EyeMax with the assistance of a Speech Language Pathologist in her community. Based on her difficulties in calibrating and using this eye gaze system, it was determined that she could not use eye gaze technology. Prior to her clinic appointment, her father provided me with some titles of songs she listened to on a regular basis. These music selections consisted primarily of songs by Patsy Cline. I included a few of these music videos in my eye gaze trial page set that was set up in Tobii Communicator for use on a Tobii eye gaze system. I also included some music video clips from American Idol when Scotty McCreery, Lauren Alaina and James Durbin competed. Although this young woman initially selected familiar Patsy Cline songs, she then started to explore other options and frequently selected songs by James Durbin. At one point during the trial, she was observed to select a song artist, after which she immediately navigated back to the music choices page. While she was trying to select a button on the far right of the screen to get to music videos with James Durbin, she accidently selected the button to the left of this and again navigated immediately back to the music options page where she successfully selected James Durbin and then selected the music video, "Will you love me tomorrow?," which was positioned to the left of midline. As soon as the video started, she vocalized her pleasure with playing the music video she wanted to watch. Prior to this time, she had been quiet and completely focused on the eye gaze system while making multiple selections to navigate to the page with music videos of when James Durbin competed on American Idol.

There are some adjustments that I have frequently made during initial eye gaze trial sessions and extended ones to further reduce the motor demands associated with using eye gaze technology and, thereby, improve a girl's ease of access to support her communication. When I observe that one of the girl's eyes moves inward, a condition known as esotropia, or deviates outward in exotropia (http://en.wikipedia.org/wiki/Esotropia, accessed October 17, 2014), I change the settings so that the eye gaze system only tracks the girl's eye that does not display this condition. Given this adjustment may limit or narrow the range of eye movements a girl can track across the screen, I reduce the size of the window in Tobii Communicator and position it in the location of the device's screen that corresponds to her natural eye gaze patterns as shown in Image 8.

Tobii Communicator has a feature called Page Set Properties that can be accessed through its File Menu to allow for these adjustments for improving a girl's ease of access using the eye gaze system (Please see Image 9). Even though part of the device's or computer's desktop is displayed outside Tobii Communicator, the girl's selections continue to be restricted to the buttons displayed on a page within Tobii Communicator.

When a girl's team, including her parents, identify which eye gaze system is best suited for her based on the eye gaze trial sessions and extended trials, ease of access should drive this decision first.

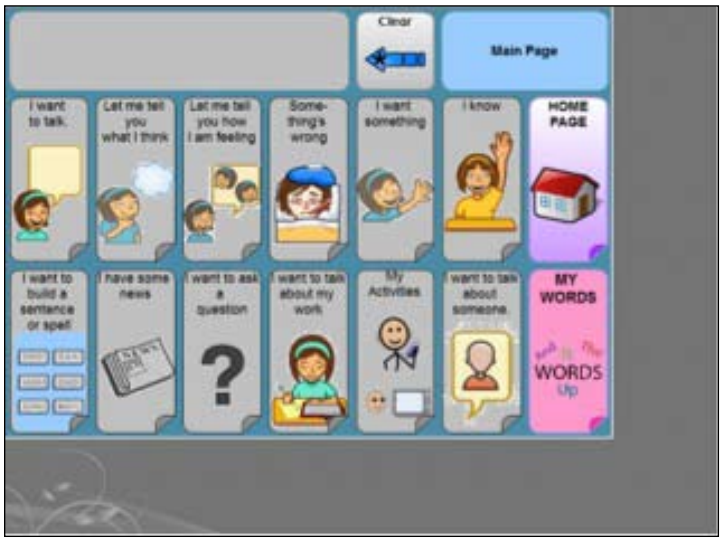


Image 8: Screenshot of Run View of Tobii Communicator with the height and width of the pageset set to 80 percent relative to the screen size and positioned in the top left corner of the screen.

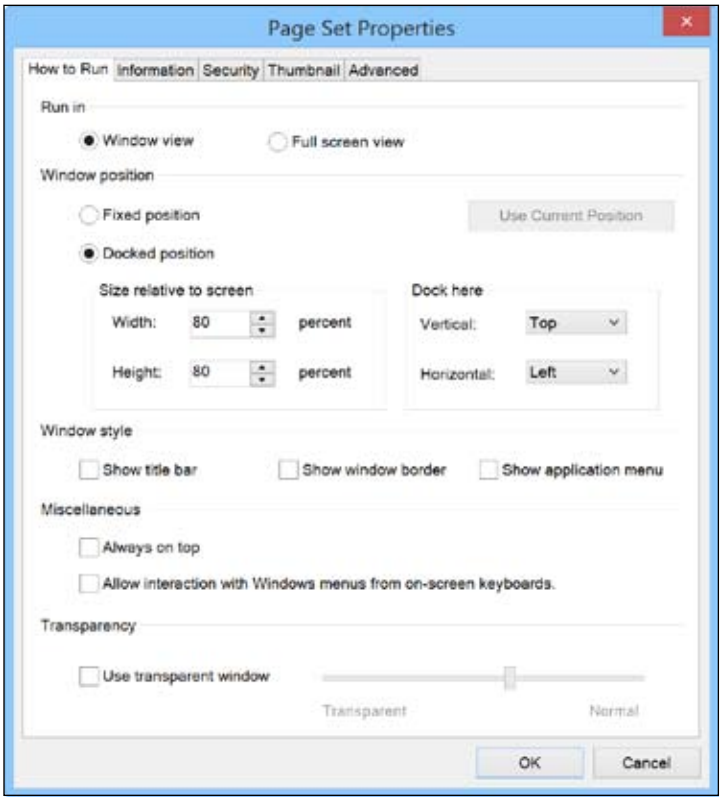


Image 9: Screenshot of Page Set Properties feature in Tobii Communicator showing settings for reduced Window/Run View with 80 percent width and height and the docked position of the top left corner of the screen.

Some of the factors to take into account during this evaluation process include the ease with which a girl has selected buttons in all areas of the screen across different pages and on different days when her responses to sensory input have been determined to be at a level 1, so she was focused and engaged and how the eye gaze system "tracked" her eyes when the position of her eyes changed (i.e., with head movements, moving her head and trunk forward or backward in a chair, walking up to eye gaze system from different angles, etc.). If a girl's access was the same across the two eye gaze

systems trialed with her, then other considerations, such as the language system or familiarity with programming a specific AAC device, can assist in determining the "just right" device for the girl. Then the application for funding process begins for that device.

I could write an entire article on conducting eye gaze trials, as there is so much to take into account and adjustments that can be made to support a girl's ease of access based on observations of what a girl is selecting or not selecting. I am in the process of developing an online course through Rett University that will provide detailed information about setting up and conducting eye gaze trials with various eye gaze systems, calibration, positioning, what to include in a report when applying for funding for a speech generating device with eye gaze accessory through insurance or state funding, comparisons between dedicated AAC devices with eye gaze accessory as compared to tablets with a USB eye gaze system, various mounting options, IEP goals, the role of software applications to teach cause-and-effect, tracking, etc. for windows control through eye gaze technology. I will also outline and demonstrate in detail the steps involved in setting up an AAC device with eye gaze technology when it first arrives and strategies for engaging girls in conversations. This online course will be available through Rett University http://www.rett-u.org/.

FUNDING HAS BEEN APPROVED FOR AN EYE GAZE SYSTEM. NOW WHAT?

At this point in time, there is no need to reinvent the wheel when programming vocabulary on an eye gaze system incorporating Tobii Communicator for a girl or woman with RTT. It is important to think of "more rather than less" in terms of the number of buttons on a page and the number of pages a girl can learn to use. Even when girls gain access to an eye gaze system, they are often provided with access to limited vocabulary sets, primarily based on making choices and expression of wants and needs, until they demonstrate mastery. In some cases, I have seen pages with only two very large buttons on a page, representing only two choices. Many years ago, when I was first consulting with Pati King-DeBaun at Standing Tall in New York City, she had just developed her Dynamic Communication Book to use with the students with complex communication needs in this setting (King-DeBaun, 2012). Pati developed the Dynamic Communication Book as a communication system that incorporates vocabulary to support conversation, literacy and language. At that time, the Dynamic Communication Book was in printed form and set up in Mayer Johnson's Speaking Dynamically Pro in a traditional rows and columns format, as shown in Image 10. At that time, Pati gave permission for me to program the Dynamic Communication Book for Girls in Tobii Communicator in the copyrighted eye gaze layout that I had designed specifically for girls and women with RTT based on their natural eye gaze patterns (Please see Images 11 and 12). Pati's Dynamic Communication Book incorporates core phrases, vocabulary words organized by categories, context-based pages for various activities, including shopping, watching TV and, talking on the phone, sentence starters for present and past tense, and an alphabet. When girls, teens and young women have used the Dynamic Communication Book for Girls on Tobii eye gaze devices, they have made dramatic progress in their communication skills over a relatively short period of time. The core phrases have enabled girls to naturally and spontaneously initiate and participate in conversations with their communication partner by making comments, asking questions, describing

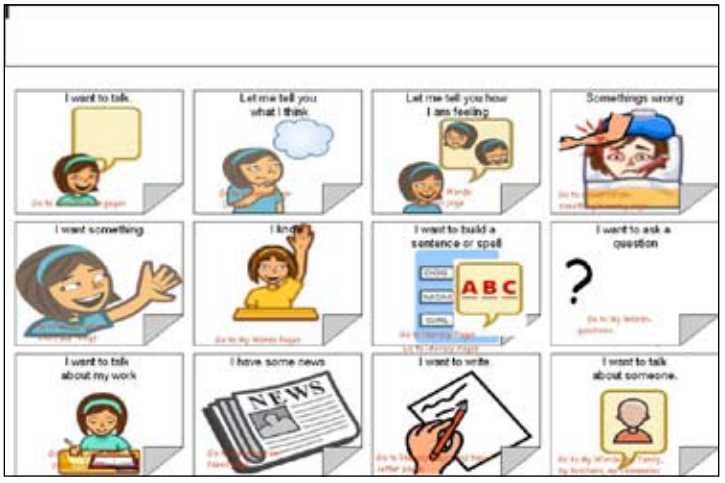


Image 10: Screenshot of the start page in the Dynamic Communication Book for Girls developed by Pati King-DeBaun. This page is displayed in Mayer Johnson's Speaking Dynamically Pro.

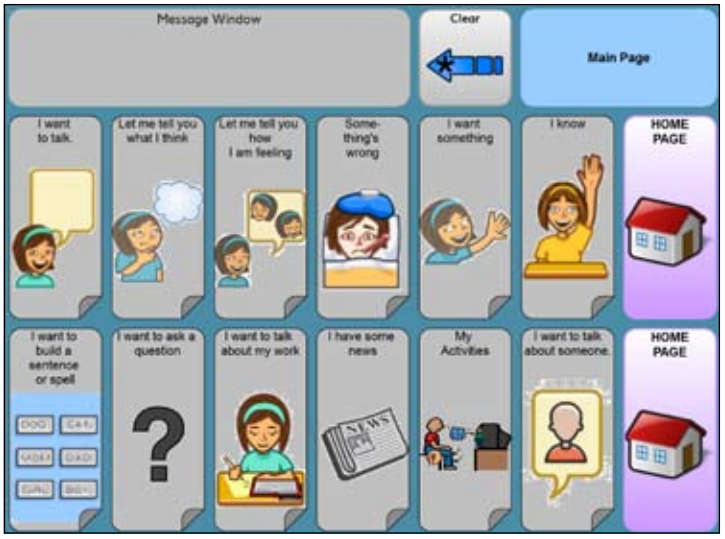


Image 11. Screenshot of the start page in the Dynamic Communication Book for Girls developed by Pati King-DeBaun. This page is displayed in Tobii Communicator.

Image 12. Screenshot of the Conversation page in the Dynamic Communication Book for Girls developed by Pati King-DeBaun, in Lariviere's eye gaze layout. This page is displayed in Tobii Communicator.

events and directing another's actions. They have become more of an equal partner in conversations when using core phrases. The girls are highly motivated, interested and engaged in social interactions when using the Dynamic Communication Book, so their true communication potential is being seen at home and at school. These reported findings with girls with RTT reflect those found in research that supports use of core phrases for increasing other AAC users' spontaneous interactions and engagement with communication partners (Erickson, 2007). As a result, girls and women with RTT need access to phrases so they can spontaneously initiate and participate in conversations with their peers and communication partners. These phrases are also needed on devices that primarily have core words as their language systems.

Girls also benefit from having activity-specific or context-based pages so they can direct another's actions, express their opinions through comments and ask questions during play-based activities and to support their active engagement at home school and in the community. Some of the activities in The Dynamic Communication Book include playing house with a doll, dress-up, cooking and shopping (as shown in Image 13). I have customized a version of The Dynamic Communication Book for girls who are around 9 years old and up that incorporate age-respectful comments, and additional activities, such as getting dressed, talking about movies (as shown in Images 14 and 15), music and fashion.

SCRAPBOOK OF LIFE EXPERIENCES

Given we all like to share stories and pictures about our life experiences, as evidenced through the extensive use of social media, it is equally important for girls with RTT to have access to pictures on their device so that they can talk about their life experiences as well. This form of scrapbook can be set up in many ways on a girl's eye gaze system. I typically have a separate page set for "News" that is integrated into the girl's home page and linked into The Dynamic Communication book's "News" page so that she can access this from different locations. When parents share photos with me about major events in a girl's life, such as birthday celebrations, vacations, holidays, events at school, etc., I link these to a button on her topic-based news page (as shown in Image 16) and then have it automatically open to a page displaying the larger version of the picture. I integrate "hot spots" on these pages so that the girl can talk about the photo by naturally looking at different parts of it. Given a girl's natural tendency to look at photos of herself and other people in the photo, I program the hot spots so they disappear after she looks at and selects a hot spot, as shown in Image 17. This avoids repeated selections of the same hot spot over and over again. When a girl navigates or receives assistance in navigating away from this photo page, the hot spots on the photo become active again so she can talk about the photo again when she returns to this page. I have used the scrapbook on a girl's eye gaze device to support writing for a purpose that can be integrated into a girl's picture selection for a topic and then writing about the picture in the form of a label or caption or a sentence talking about her experience. I use the core words and sentence starters in the Dynamic Communication Book to support a girl in her beginning writing experiences in conjunction with partner-assisted scanning to an alphabet flipbook for invented spelling of words.

Having these scrapbook pages integrated into a girl's communication system allows for modeling of and/or a girl's spontaneous

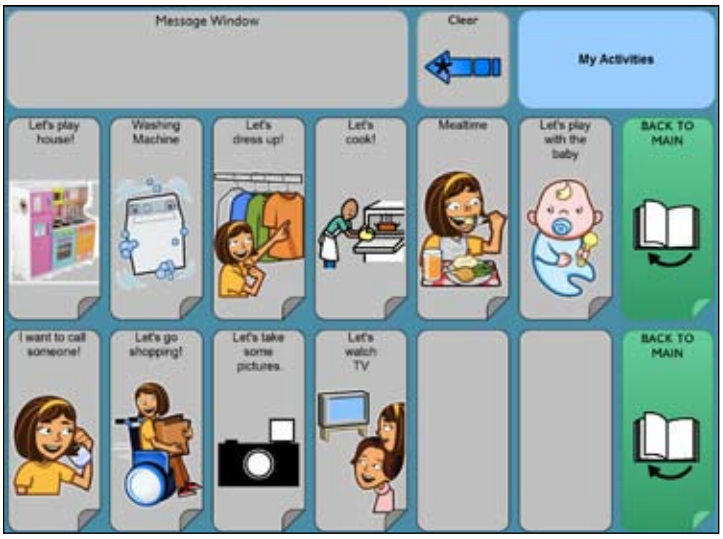


Image 13. Screenshot of the Activities page in the Dynamic Communication Book for Girls developed by Pati King-DeBaun, in Lariviere's eye gaze layout. This page is displayed in Tobii Communicator.

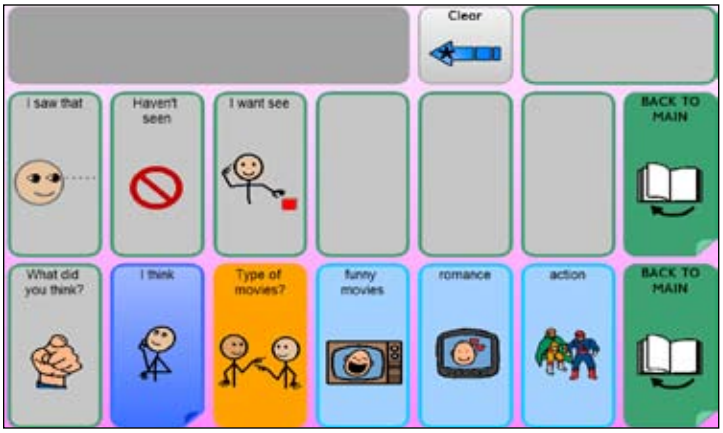


Image 14. Screenshot of the Movies page developed by Judy Lariviere in the Dynamic Communication Book for Girls developed by Pati King-DeBaun, in Lariviere's eye gaze layout. This page is displayed in Tobii Communicator.

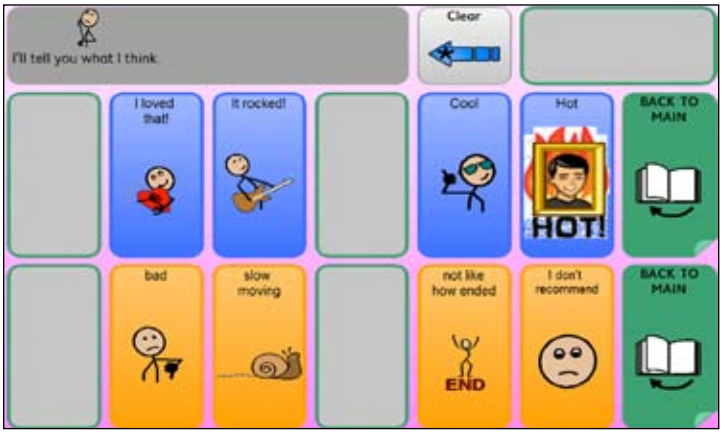


Image 15. Screenshot of the Movies Comment page developed by Judy Lariviere in the Dynamic Communication Book for Girls developed by Pati King-DeBaun, in Lariviere's eye gaze layout. This page is displayed in Tobii Communicator.

expression of text-to-self connections that demonstrates reading comprehension or her understanding of a topic being taught in an inclusive educational setting. An example of this relates to a teenager who was taking a 10th grade biology class with her

peers in September. The teacher put up a picture of a butterfly on his computer that was projected on the white board in the classroom. As soon as she saw this butterfly, she immediately navigated through multiple pages on her Tobii C-12 with CEye Module until she accessed her scrapbook with the news page that related to her experiences during a class trip to the Natural Museum of Science in May of that same year where she visited a butterfly emporium. While she was in the butterfly emporium, a butterfly landed on her wheelchair and head and on one of the paraprofessional's phone (Please see Image 18). There were pictures of these events included in her scrapbook pages. In this situation, she spontaneously demonstrated a connection between the topic of butterflies and her own life experiences.

ACCESS TO A LANGUAGE SYSTEM

Girls also need access to a language-based system with core words and vocabulary for generating language. All eye gaze systems have these, such as Unity for Prentke Romich Company's Accent 1200 with NuEyeTM Tracking System and NuVoiceTM 2.0, SonoFlex, Picture Word Power, LiterAACy for the Tobii I-series or Tobii EyeMobile. Having independent access to a language system that is integrated into their communication device allows them to generate novel messages that may not otherwise be programmed in their device. I have several stories about how girls have spontaneously initiated communication and navigated to different pages within a language system to create a message ranging between 1 and 4 words "in the moment" that is completely relevant to the context of the situation. For example, a teenager was sitting in her wheelchair and was pushed into her Math class by her paraprofessional. Her Tobii was positioned on her wheelchair mount and turned on so she had access to her voice. A group of Math teachers at her school had shaved their heads as a fund raiser for "Locks for Love." As soon as this teenager saw her Math teacher, she immediately navigated to Picture WordPowerTM from her conversation page set and navigated to places and selected "barber" and looked at her teacher. A 10-year old girl was very excited about a music recital in which she was participating with her class for the school. She wore a dress to school. As soon as she sat down at her desk, she immediately navigated to Picture WordPowerTM and combined symbols and words to create the following message: "I am pretty. I want to sing." Without having access to a language system with extensive single word vocabulary and having use of the words modeled to them throughout the day in natural contexts and at home and school, these girls would not have been able to communicate what was on their minds. Typically, these girls demonstrate the best use of their language systems when they are in a natural context that is emotionally charged for them as this helps them to minimize the influence of their apraxia on their selections, using their eyes.

Presuming competence allows you to truly see what girls are communicating and learning! Their selections have meaning! If unsure, share the information with their parents for insight.

Girls also use their communication systems to share information or an account of something that happened in their life with their communication partners. It is important for communication partners to always presume

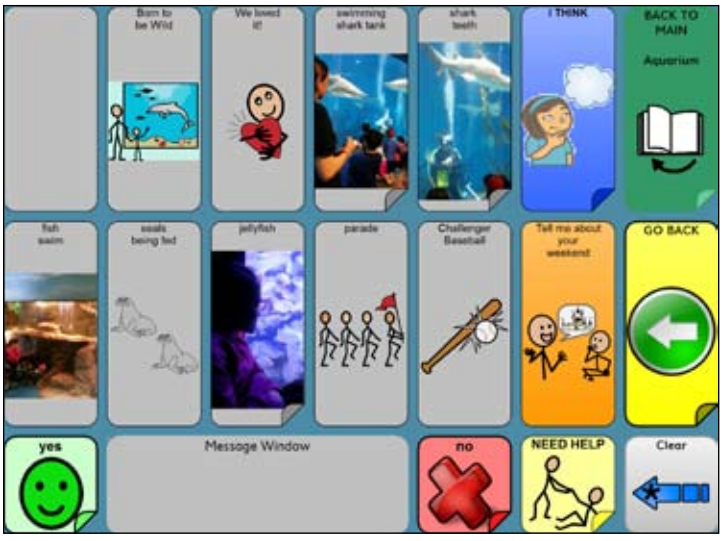


Image 16. Screenshot of a News page about a teen's trip to the aquarium developed by Judy Lariviere. This page is displayed in Tobii Communicator.

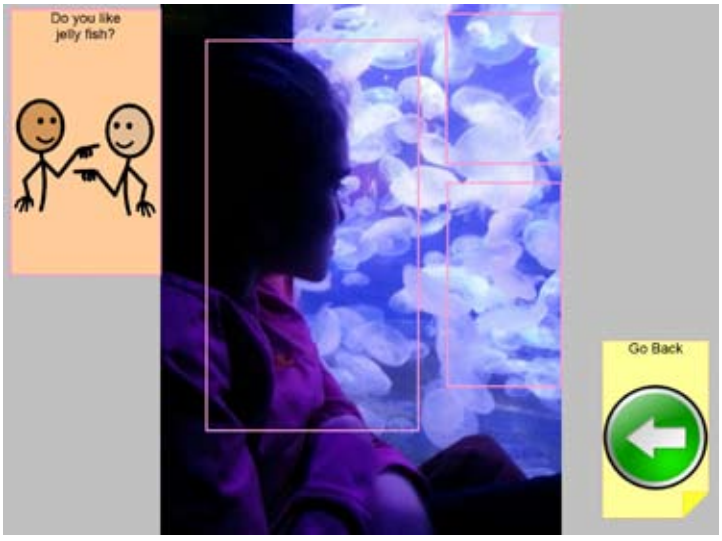


Image 17. Screenshot of a Photo page with "hot spots" related to a teen's trip to the aquarium developed by Judy Lariviere. This page is displayed in Tobii Communicator.

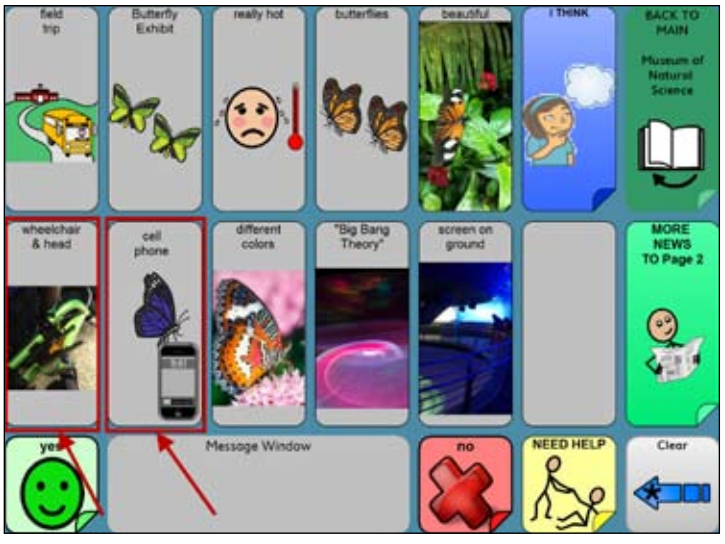


Image 18. Screenshot of a Scrapbook or News page about a teenager's class trip to the Museum of Natural Science developed by Judy Lariviere. This page is displayed in Tobii Communicator.

competence when working with girls with eye gaze systems. Even though something they say may seem out of context, their selections always have meaning, even if it is not relevant to the immediate situation. For example, one day a teenage girl was dropped off by her mom at school. Usually she rode the bus, but they were running late that morning. As soon as this teenager got into her wheelchair with her Tobii turned on, she immediately navigated to her Picture WordPowerTM and went to the "People" page and selected "brother" and automatically returned to the Main page. She then selected "Toys and Games" and repeatedly selected "Lego." Her teacher and paraprofessional acknowledged what she said by saying, "I know Matthew likes his Lego." At the end of the day when the teenager's mom was picking her up from school, her paraprofessional told her mom that she was selecting "Matthew and Lego" on her Tobii in the morning. Her Mom then told the story about what happened on the way to school. Her younger brother dropped his Lego creation, which fell apart, and some of the pieces went under this girl's automatic seat that lifts her in and out of the van. As a result, her brother had a "meltdown" about his Lego and her mom worried that the Lego pieces were going to break the motor on her seat. It turned out to be quite the morning drive to school! The teenager was sharing this experience with her teacher and paraprofessional using her Tobii and it was completely accurate and in context of the drama that had taken place that morning. Amazing and incredible communication moments happen with girls and women who are using eye gaze technology when you least expect them.

It is very important for a girl to have access to her eye gaze system across as many natural settings as possible. This represents her "voice" and there should not be restrictions on when she can use her voice to communicate. Quite often this translates into having two different mounting systems to support her access across multiple settings. For example, for girls who can walk independently, a rolling floor stand can be used at home with another one or a table mount for use at school. Girls who need assistance to stand and walk often need a table stand so they can get up closer to tables and a wheelchair mount so they have access to their "voice" in the community, especially when they are shopping at the mall. Girls also need time to explore the vocabulary and pages that are on their device without demands or expectations. Often these opportunities can take place at home in natural settings, as shown in Image 19.

Image 19: Photo of 15-year-old teenage girl sitting on her bed and exploring the vocabulary and pages that are programmed into her Tobii C15 with CEye Module. The device is supported on an Ideas Rolling Floor Stand.

When girls and women are given independent and easy access to their "voice" with eye gaze technology, their personalities shine through. They engage in conversations and show us what they know and what they have learned. The possibilities are endless!

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RESOURCES

The Dynamic Communication Book
www.creativecommunicating.com

Email Judy (judy@assistivetech4all.com) a photo or screenshot of the receipt/confirmation Creative Communicating sends you and Judy will send content in her copyrighted eye gaze layout designed for individuals with Rett Syndrome to you electronically

Eye Gaze Trial Page Set in Tobii Communicator (for Individuals with Rett Syndrome) www.assistivetech4all.com

Eye Gaze Video Player for Children and Eye Gaze Video Player for Teens in Tobii Communicator www.assistivetech4all.com

Eye Gaze Music Player for Children and Eye Gaze Music Player Teens in Tobii Communicator www.assistivetech4all.com

From Eye Gaze Trials to Device – online course through Rett University http://www.rett-u.org/

Ideas Rolling Floor Stand http://ideasfil.com/

Picture WordPowerTM www.inmaninnovations.com

Accent 1200 with NuEyeTM Tracking System and NuVoiceTM 2.0 www.prentrom.com

Tobii I-series, Tobii EyeMobile, Tobii Gaze Viewer www.tobiiati.com ■

Application and Independent Study in Reading Comprehension

for Two Students with Sensory Challenges

ABSTRACT

Literacy is a necessary outcome of education. However, what is literacy in the 21st century and how long do we wait with children who have additional challenges to alter our traditional methods of teaching it? This paper begins with traditional and more current definitions of literacy and then investigates the reading comprehension of two students with sensory challenges. Using Parette, Peterson-Korlan, Wojcik, and Bardi (2007) guidelines, data will be presented to demonstrate the efficacy of alternate approaches to their reading.

Keywords: literacy, comprehension

APPLICATION AND INDEPENDENT STUDY IN LITERACY OUTCOMES FOR TWO STUDENTS WITH SENSORY CHALLENGES

In order to investigate literacy, one must have a definition of the concept. According to the National Assessment of Adult Literacy (White, 2005), there are two parts: "Task-based or conceptual: … the ability to use printed and written information to function in society, to achieve one's goals and to develop one's knowledge and potential." and "Skills-based or operational: … word-level reading skills and higher level literacy skills, i.e. competence or knowledge in a specific area." However, the most interesting definition found is that put forth by the National Council of Teachers of English (2013), who purport that there needs to be a 21st century revision to the definition and offer the following on their website:

Literacy has always been a collection of cultural and communicative practices shared among members of particular groups. As society and technology change, so does literacy. Because technology has increased the intensity and complexity of literate environments, the 21st century demands that a literate person possess a wide range of abilities and competencies, or, many, literacies. These literacies are multiple, dynamic and malleable. As in the past, they are inextricably linked with particular histories, life possibilities and social trajectories of individuals and groups. Active, successful participants in this 21st century global society must be able to: 1) Develop proficiency and fluency with the tools of technology; 2) Build intentional cross-cultural connections and relationships with others so to pose and solve problems collaboratively and strengthen independent thought; 3) Design and share information for global communities to meet a variety of purposes; 4) Manage, analyze and synthesize multiple streams of simultaneous information; 5) Create, critique, analyze and evaluate multimedia texts; and 6) Attend to the ethical responsibilities required by these complex environments.

So, interestingly, the "21st century" definition of literacy has less to do with traditional reading and writing than with the processing of information. Educators have been taught to consider decoding and encoding important. However, those skills may have less to do with the future than being able to utilize different platforms of computers. The improvements seen in text-to-speech and speech-to-text software over the last decade have made traditional reading and writing curricula almost obsolete. One says "almost" because, of course, there are still some things for which one needs decoding and encoding skills, or at least the ability to identify a logo (such as a STOP sign or a sign for a hospital or a favorite restaurant). However, there are very few instances in which one's lack of traditional literacy skills cannot be overcome using technology. That being said, what then is literacy? Probably points 4 and 5 listed above, i.e. "Manage, analyze and synthesize multiple streams of simultaneous information;" and "Create, critique,

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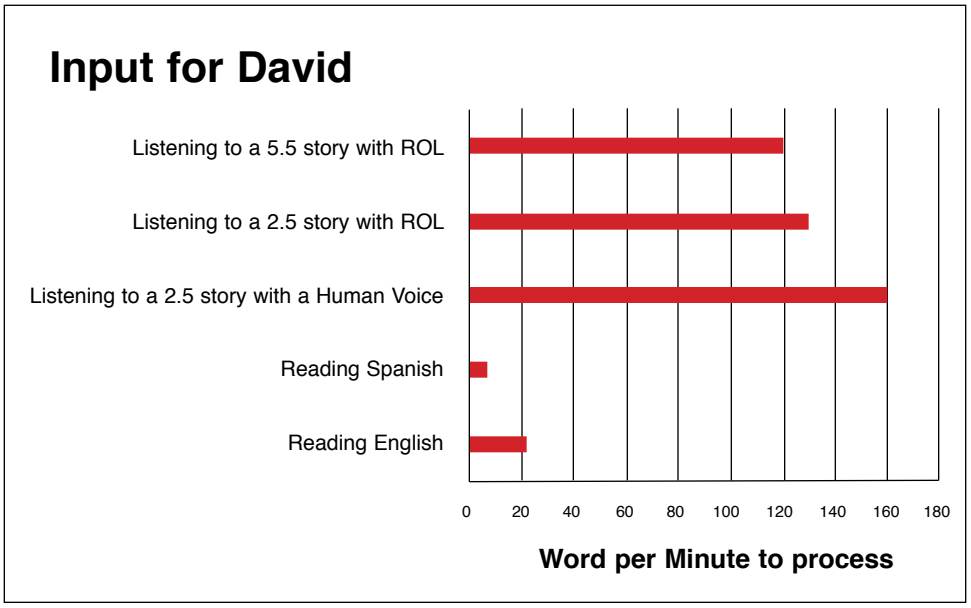
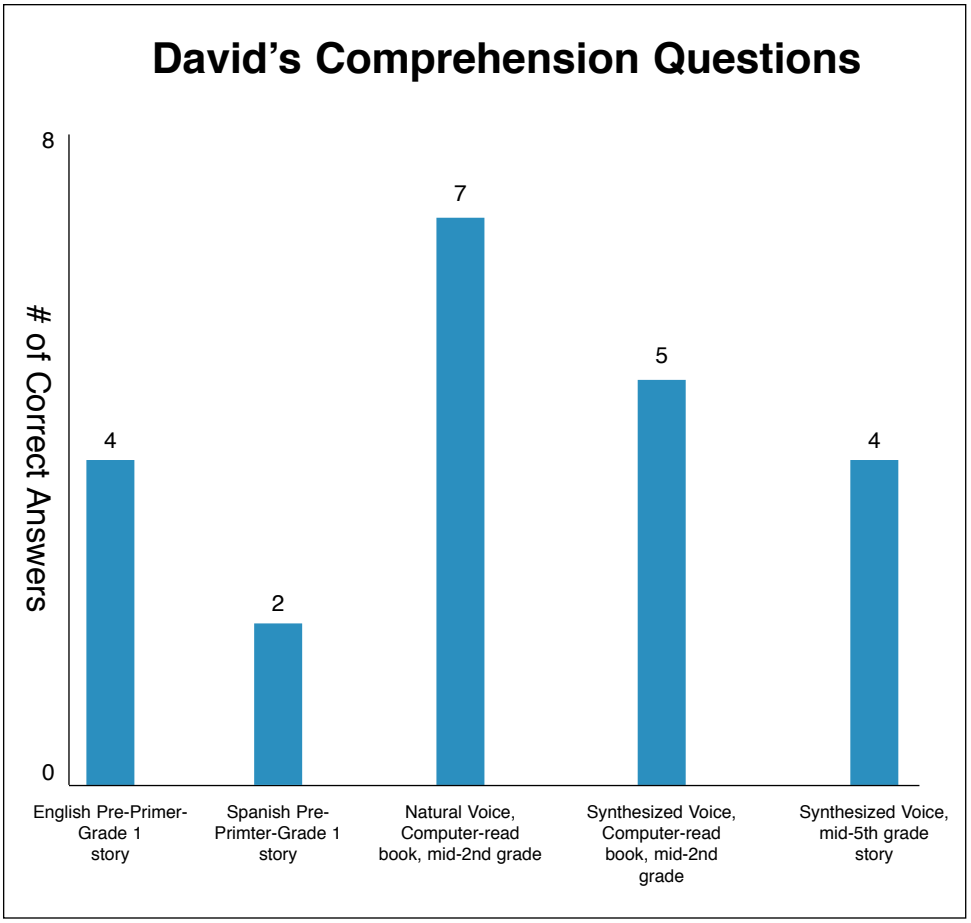
analyze and evaluate multimedia texts." (NCTE, 2013) In other words, comprehension and creation form its basis. If one cannot formulate comprehensible thought and cannot comprehend the language put before them, they cannot and will not be considered literate. In order to affect that outcome, the language must be presented in a format that the user can actually manipulate. Thus, in this study, which centered around two children with sensory losses, an analysis was made to determine the best method currently available for them to take in information.

The first student to be discussed will be an almost 12-year-old bilingual young man, David, who has significant visual impairment as a result of tumor surgery in 2007. The other student is an almost 10-year-old bilingual girl, Alana, who has a sensorineural hearing loss of unknown origin. Both students were seen five times with similar material presented five different ways to determine which mode boosted their comprehension. The environments stayed the same, although different technology was used in an attempt to boost attention and comprehension. When within the student's reading level, stories were used from Dr. DeCoste's PAR reading survey (2012). When not, the stories were created using Dolch words selected from the student's reported reading level. Spanish translations were done by www.translategoogle.com with modification by native speakers.

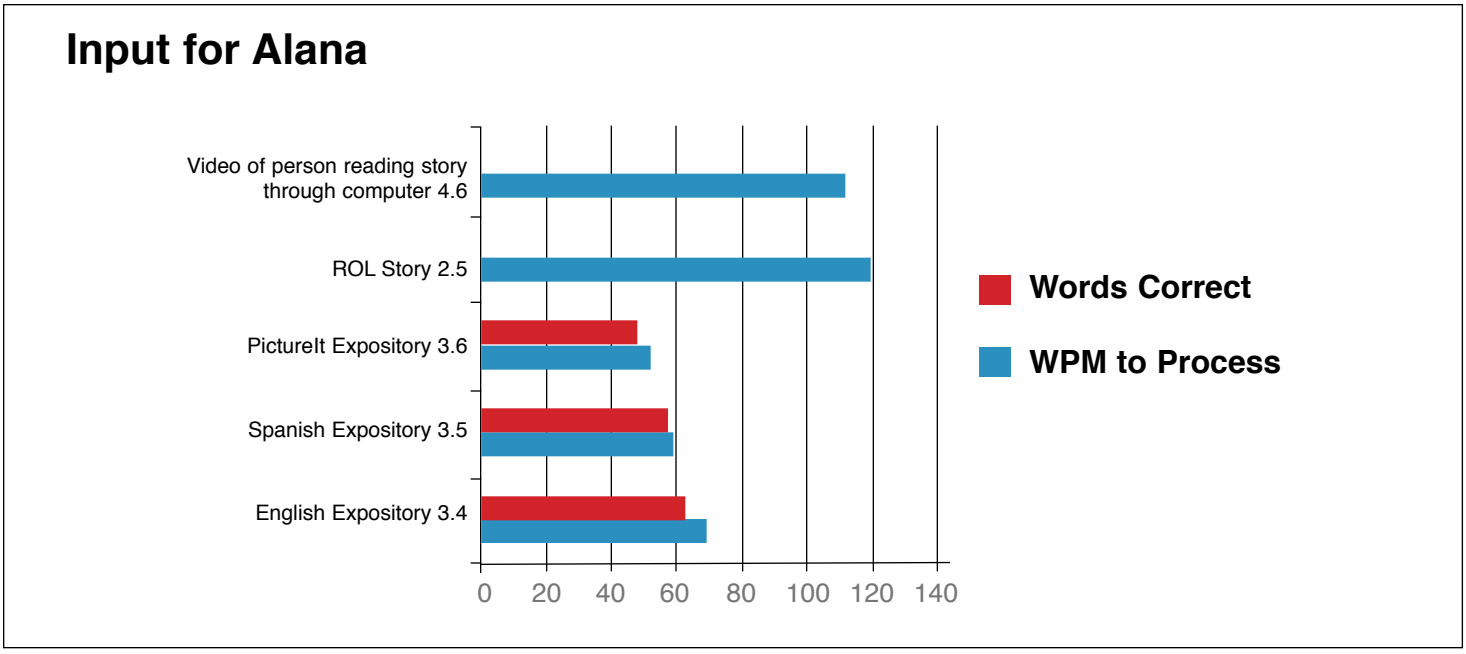


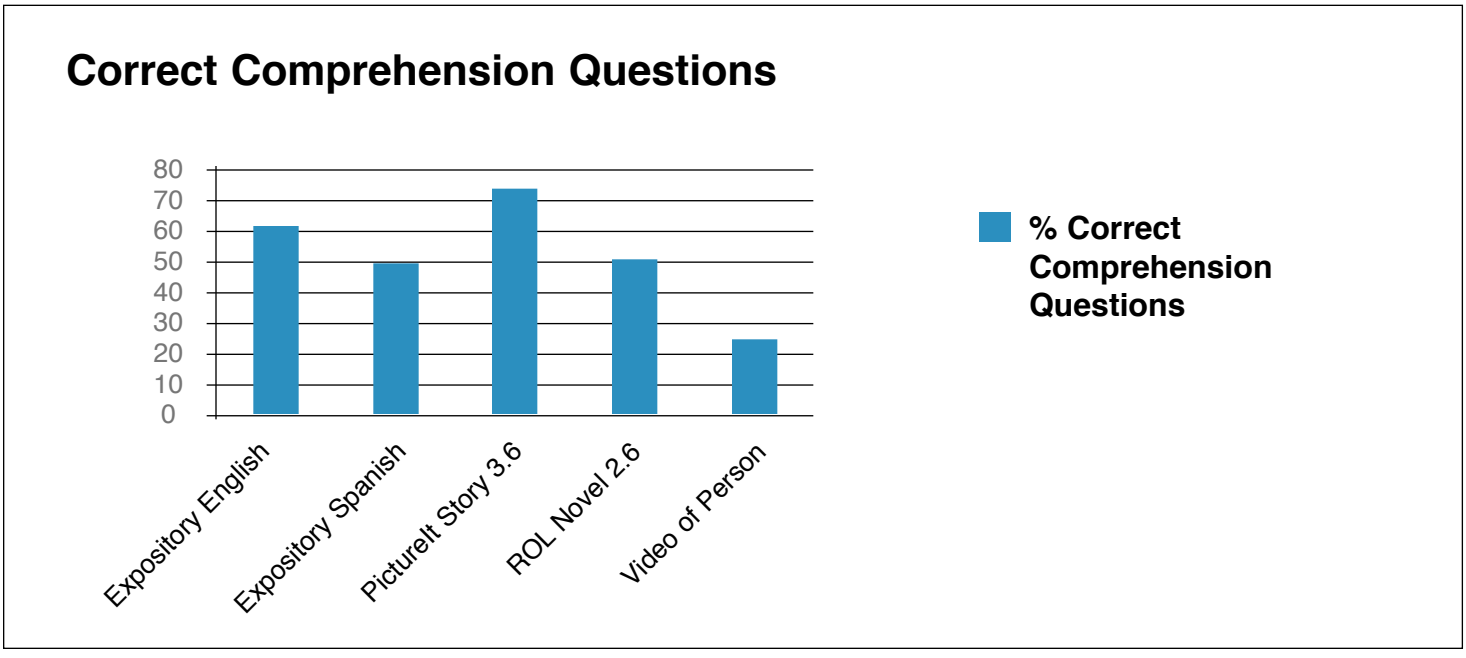


DISCUSSION

Even with his closed circuit television (CCTV), David cannot read independently at a Pre-Primer level in English or Spanish, although his IEP documented him as reading 1st Grade words. However, he speaks intelligibly and intelligently in both languages. The stories he was asked to read were composed of Pre-Primer, Primer and 1st Grade Dolch words. He read 22 words per minute (wpm) in English and missed 16 of 49 different words, or 32 percent. The missed words were at all three reading levels. He got a score of 50 percent on the comprehension quiz, showing that he could hold onto information from the decoded story and answer some abstract questions. It needs to be said, however, that for him to see the print with his glasses, the words had to be blown up to a size 125 font, not very practical in today's world. Reading Spanish with the CCTV was worse as he has never had any documented formal instruction in Spanish. He read seven wpm, and missed 39 of 41 different words, or 95 percent. He could only answer 25 percent of similarly designed comprehension questions, indicating that he spent more time on decoding the Spanish than processing the story. He did describe the story as "hard," although the level was no different from that of the English story he had been asked to read. It should be noted that it was during this session that his positioning at the table was addressed as, with his low tone, consistent physical support was needed to free his mind and energy for the task of reading.

The next step for David was an analysis of different modes of print input in order to justify his use of technology for age-ap-





propriate comprehension tasks. Thus, after his trials with the CCTV, David was allowed to choose his own Gold Start-to-Finish book (2nd and 3rd grade novels by Don Johnston). He chose a Lexile level 470 or Reading Level L, approximately mid-2nd grade text. During the session where he encountered the first chapter, he was also introduced to an FM system and now he could hear only the computer and not the noise of the classroom in which he was sitting. The second chapter was scanned into the computer and read by Read OutLoud (ROL), a well-respected text reader also manufactured by Don Johnston. A series of eight comprehension questions modeled on those in Dr. DeCoste's PAR screening (2012) were asked at the end of each session. In both instances, his comprehension exceeded that demonstrated after reading using his CCTV.

David's highest score was on the first chapter of the Start-to-Finish Book. This series of books is read by actors, and the subsequent computer product is extremely clear. David also had had a seating adjustment by that time and was using an FM system hooked into the computer, allowing him to concentrate more fully on the text. Although he clearly couldn't see the words, he followed the highlighting closely and never lost focus. It was necessary to have the ROL chapter read on Halloween, with all the distractions that came from the holiday festivities, so it could be deduced that he would have done better on a different day. Even so, he still scored much higher in his comprehension than he had when reading text himself. The last trial was to have a mid-5th grade PAR story read by Read OutLoud. The thesis was to prove that he could comprehend grade level material if it were presented in a suitable format. The story he chose was "Cruising in a Convertible" but it became clear he had no idea what a convertible was. A photo, therefore, was downloaded

from the Internet and enlarged under his CCTV. Then there was a discussion of what it would feel like to be riding in a car with no top. Living in Leadville, CO at 10,200 feet above sea level, he had never ridden in a car without a roof. The downside of the photo was that it made such an impression on him that he kept referring to its detail (beach, movie star, etc.) rather than paying attention to the particulars of the story. In retrospect, having a photo of a horseless carriage for comparison and basis of discussion would have been helpful.

Although there was only one sampling of each type of material, it was clear that the computerized presentation of the story allowed David to concentrate on comprehending what the story was saying as opposed to remembering how to decode each word. However, it should be reiterated that, early on in the investigation, some postural adjustments were made to David's seating that were then perfected and utilized during the computerized sessions. Since he no longer had to consciously or unconsciously adjust his position, he had more energy available to concentrate on the material before him. As seen from the English Pre-Primer to 1st Grade stories, David can decode, but since he is more than five years behind his peers in this skill, it is entirely questionable if decoding is the best use of his time at this point in his education.

Alana, the other student to participate in this study, was also bilingual, able to articulate in both languages and to decode reasonably well in both, but broken hearing aids and infrequent use of them have left her with poor vocabulary and background knowledge. Her answers to the comprehension questions, both concrete and abstract, were reflective of an inability to associate the story text with the questions.

The graphs above demonstrate Alana's comprehension when presented differently leveled material in a variety of formats. She was in 4th grade, so choices of mid-3rd grade PAR stories were initially given to her. She read the one in English and got just over 60 percent of the comprehension questions correct, although only one of her answers came from the story text. She didn't know the word "routine," which was mentioned once in the story and three times in the questions. Even in the Spanish story, it was not her decoding, but her vocabulary that diminished her score. Her listening to a chapter from a lower level novel where she could follow the text visually was no more effective comprehension-wise than her reading Spanish. As predicted by her Teacher of the Deaf and Hard of Hearing (DHH), Alana's highest comprehension score came from the story that had been translated into PictureIt, where the latter had some graphic explanation of each word's meaning. Thus, when she didn't know the word clumsy, she could look back at the graphics for clarification. Of the 100 words in the story, she was unfamiliar with 6 percent. As she goes into 5th grade, this number will increase. Further evidence of her need for visual information beyond the printed word came when she listened to ROL read a chapter in a mid-2nd grade novel. Although Mexico was mentioned four times in the chapter, she insisted the story took place in Africa. The word temple was mentioned six times and she chose country as the place to which the bowl was taken. True, she did not have her FM system available during any of these sessions and so she might have done better, but at least the deficit was consistent. She was extremely busy with both before and after school programs, but it was clear that having or reading about different types of experiences and, therefore, expanding her vocabulary, was not part of her routine.

Three things stood out about Alana's reading sessions: she would often leave off the ending of a word, she is a speech reader and she is not ready to advocate for herself. The first two were further investigated; on November 6th she was given a simplified phonological processing test and, on November 13th, she listened to a 4th grade PAR story by watching a video of someone reading the story into the camera.

The first thing that was noticed about Alana's phonological processing was that she had no idea how to rhyme. This is not surprising, as it was during Kindergarten and 1st Grade that she was without hearing aids. She caught on quickly but still missed 36 percent of the items. Lack of background knowledge was again apparent as she did not know the words brook or fan, nor did she know the concept of hatching. When she was asked to put sounds together, she had trouble with 17 percent of the items, totally missing the word stamp. Her association with that word was to stamp her foot, not the noun, as perhaps she has never mailed a letter. Leaving the first syllable off a compound word was difficult and she missed 62 percent of the items although she said it would have been easier if she had had a paper and pencil. Vocabulary deficits were again present, as she didn't know goldfish, rope, dish, gate or stream. Combining sounds to make words was easier, but she still missed 28 percent because of her lack of familiarity with the words truck, top, stripes and crutch. The entire test was picture-based, so the scores were not related to her lack of hearing the stimulus.

The story that was read into the camera and which Alana watched was about owls. Since Alana relies so much on her vision to understand what people are saying, it seemed logical that her comprehension would improve if she could watch someone read a story. Although positioning herself only inches from the computer, changing her seat when she was distracted by background noise, starting and stopping the story several times for clarity and having access to pencil and paper, she still missed important facts and, at least once, relied upon her background knowledge and not the story for her answers to the comprehension questions. She did not know the meaning of the words spooked, ancient, prey, culture, fascinated or ghost, all of which contributed to her 25 percent comprehension score. She said that the story was read "too fast," but, looking at the graph, it was read more slowly than the text reader Read OutLoud. As she also has the same complaint about her English teacher, it may be demonstrative of the difficulty she has in processing that language or not using her hearing as well as she could in those instances.

One of the interesting things about working with a student one-on-one is that they will eventually confide in you. Through Alana, I learned that her Spanish teacher is from Spain and, therefore, she doesn't always understand him and that her English teacher speaks too fast. When she was asked why she couldn't tell her English teacher to slow down, she shrugged. It is often easier to pretend everything is all right than to ask an authority figure to speak more slowly or to repeat information. As she uses an FM system in both classes, the receivers for which hook directly onto her hearing aids, she should be

able to hear her teachers well, even if she cannot always see their faces.

Alana, obviously, is a more complicated student than David. He can comprehend a grade level story being read through a computer as well as when he reads a Pre-Primer story himself. Visuals under his CCTV do give him better background knowledge to help him make connections and support the learning embedded in the story. The best options for Alana appear to be LACE, a program devoted to helping her discriminate among sounds for meaningful words, or use of an FM full-time so that she can get information from television and videos and/or graphic representations of unknown vocabulary, either through PictureIt or Internet images placed around the classroom. Alana would also benefit from curriculum organized into units so that several teachers would be supporting the same vocabulary. (Tovani, 2000)

CONCLUSIONS AND FUTURE STUDY

Students with sensory and environmental deficits suffer in similar ways to those with physical challenges. Their parents and others often expect less of them and, therefore, they end up with less background knowledge and vocabulary than their peers. Particularly in these poorer mountain areas, extra consideration must be given to extraordinary pieces of the curriculum which are outside the normal experience of these youngsters. Add the bilingual factor, and the students' experiences are either enhanced or further restricted. However, as Chris Tovani explains in her book, I Read It, but I Don't Get It, students often have background knowledge of which they are unaware (2000). When David put the photo of the convertible under his CCTV, he suddenly remembered that he had once seen a convertible during the summer. He could then visualize (Tovani, 2000) what it would be like to ride in a convertible, how he might need to dress, etc., enhancing his ability to comprehend Dr. DeCoste's mid-5th grade story, "Cruising in a Convertible" (2012). Alana often used her background knowledge instead of the story's facts to answer her comprehension questions.

PictureIt is a computer program that can easily add graphics to written material for Alana. Words that she knows can have the graphics eliminated and photos can be brought in for more curriculum-specific words. This program is available to Alana's DHH teacher and, once she is comfortable with it, could be taught to the general education teachers. Alana's DHH teacher has also requested the audiologist to do a FLA (Functional Listening Assessment) to see if Alana is a candidate for LACE, as this intensive listening program would help train the latter to eliminate background noise as a distraction when she does not have access to her FM system. Her performance, after going through the LACE training, would help determine her possible need for possession of a full-time FM system. The receivers that attach to her hearing aids are extremely small and expensive and, therefore, a lot of responsibility for a 10-year-old. At this time, Alana leaves them in her classroom at the end of the school day.

If one were to extend this study, it would be to investigate the writing capabilities of these two youngsters and how technology could help them better express their thoughts in print. As both of them have clear pronunciation, speech-to-text would definitely be an option.

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The Importance of Making AAC Accessible

Nearly three-quarters of the world's population has access to mobile technology, and over 30 billion mobile applications were downloaded worldwide in 2011 (McNaughton & Light, 2013). Developments in mobile technology have created unique tools for communication, and as personal tablet computers have become a staple for individuals of all ages and abilities, the potential benefit of these technologies for people with complex communication needs are significant. In just the past few years, tablet computers have become an inexpensive, mainstreamed and convenient hardware option for many of the individuals who use high-tech augmentative and alternative communication (AAC) to support their interactions. Moreover, when used with the appropriate AAC app, many have found success with personal computer tablets as a viable option for improved communication.

NavBar Pageset available on DynaVox Compass

As manufacturers of AAC technologies, we need to understand that our consumers have become savvier in their knowledge of what makes a good app. We must realize that it's no longer a "one app fits all" kind of world. Communication apps need to have the depth and range to support the individual needs of people who use AAC tools for communication. Additionally, we must consider the issues that make tablet technology use successful, such as providing multiple communication options across system platforms while securing a structure that allows for improved accessibility between download and hardware. As manufacturers, it's important for us to understand and take on the challenge to build accessible mobile technologies while educating people on how to use it.

USING RESEARCH TO BUILD ACCESSIBLE AAC

Incorporating research and clinical feedback into the development process allows companies to better understand how users will interact with AAC devices. For example, DynaVox Compass software provides research-based solutions for individuals of all ages and abilities who struggle to communicate due to conditions such as autism, ALS, stroke, cerebral palsy, Down syndrome, general speech loss or traumatic brain injury. The Compass App is built by a team of leading clinicians to give users a reliable pathway to communication success and further build their confidence in communicating with others. The app allows individuals who use

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AAC to download all the same tools, pre-programmed messages, symbols, core word strategies and behavior supports found on a dedicated device directly to a personal tablet. It truly is powerful communication for an increasingly mobile world.

The introduction of accessible tools, like the DynaVox Compass App, means that users can now have a complete version of leading AAC software on their iPad, giving them an efficient and affordable way to implement a quality communication therapy strategy on their platform of choice.

PROVIDING OPTIONS FOR COMMUNICATION SUCCESS

Each communicator has unique needs, specific strengths and personalized goals. Because of this, AAC apps must provide features that make it a true tool for communication success. Keeping the individual user in mind should drive content and feature development for AAC software and apps. Given the spectrum of individual communication needs and strengths, DynaVox Compass offers seven basic communication Pagesets to provide a "best fit" for individuals who use AAC devices. These Pagesets allow users to further personalize their communication through fast and powerful editing tools. Following are a description of four of these Pagesets and how they can be used to meet the specific communication needs of individuals who use AAC to communicate.

NAVBAR PAGESET

For those individuals who experience communication challenges, while still having the ability to recall visual images easily, the NavBar pageset presents a unique design to allow access to any Topic and context-specific language without navigating through multiple pages. Communication Tools remain visible and accessible from any Topic, providing organized, structured and consistent visual representations throughout its language structure.

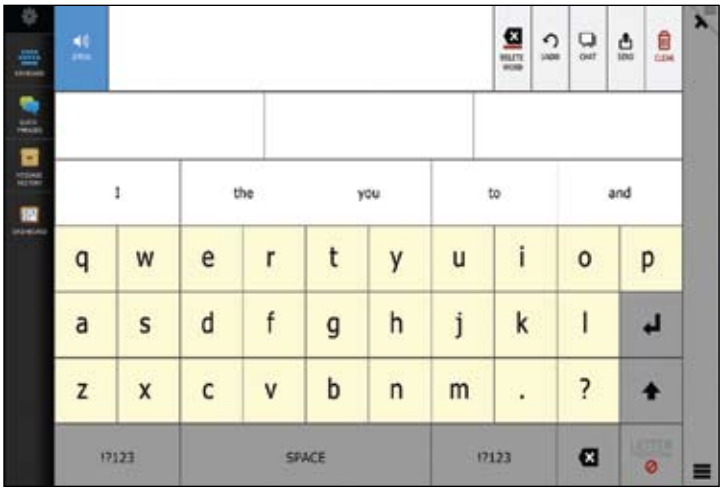
ALL ACCESS PAGESET

Universal design and accessibility need to remain a key focus when creating AAC tools. Communication for all must remain our top priority. This is especially true for those individuals who require an alternative access method when communicating with their AAC device. Specific features and language tools need to be considered, such as the options found in the All Access Pageset. Quick access to important system controls and language supports remain a priority, along with features, such as quick retrieval and editing of messages previously spoken. The All Access Pageset helps individuals who use alternative access methods, such as scanning or a head mouse, to communicate more efficiently and effectively.

NAVIGATOR PAGESET

A keyboard is a useful communication tool for those who are literate but may not be able to verbally express their everyday thoughts and needs. Pagesets designed for those who use a keyboard to communicate should consider additional supports to increase communication options. By providing a structure to store topic-specific messages, while enabling users to efficiently access and edit previously spoken messages, may create opportunities for increased communication efficiency and precision. The Navigator Pageset uses a series of levels to introduce new communication tools and other features in a way that promotes easier and more successful learning.

All Access Pageset



Navigator Pageset

Stroke and Brain Injury Persona Pageset

STROKE AND BRAIN INJURY PERSONA PAGESET

Individuals who use AAC devices to overcome their speech challenges due to stroke or traumatic brain injury require a powerful, yet intuitively simple, solution to enhance participation in everyday activities. To support the unique needs and strengths of individuals with aphasia, the Stroke & Brain Injury Persona Pageset offers integrated communication tools and contextually rich digital images. These tools include Scripts to support turn-taking routines in conversations, as well as prompting interaction with natural speech. Whiteboards, Rating Scales, Keyboards, and in-context communication options are also available as dynamic communication supports.

CREATING A PERSONALIZED COMMUNICATION EXPERIENCE

When developing an AAC solution, the link to accessibility can often be forgotten, as developers need to provide technology that allows seamless integration between software and hardware platforms. It's important to create systems where educators, therapists and family members can successfully implement technology that will enable them to all "speak" to each other. AAC apps should create an efficient environment where users can access teaching and therapy supports and share content among family members, therapists, fellow users, as well as other members of their support team. These apps must serve as a complete, integrated communication solution where everyone can manage, store, share and learn together. Accessible AAC apps, like DynaVox Compass, bring all of these important features together to provide a support experience unlike any other in one app.

DYNAVOX COMPASS APP

The DynaVox Compass App is available for a one-time purchase of $179.99, but can also be purchased as a subscription for $19.99 a month for those who may require a short-term communication solution. For more information or to arrange a trial of the new DynaVox Compass App, visit www.mydynavox.com/DynaVox-Compassapp.

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AAC Groups: How to Build Social Competencies

When helping individuals who have complex communication needs (CCN) build social competencies, we can and should be guided by literature in the AAC field. Examples of literature we can look to include The Participation Model, first introduced by David Beukelman and Pat Mirenda in 1998, Social Networks (Blackstone & Hunt-Berg), the four areas of communicative competence (Light, 1989) and AAC blogs (i.e., praacticalaac.org).

We are Speech-Language Pathologists who work in an augmentative and alternative communication (AAC) private practice in Colorado. In our practice, we find that, when supported, individuals who have CCN and rely on AAC technology to communicate and participate, do communicate and do participate. However, when not supported, many do not communicate and do not participate. In our practice, we see this across ages, across abilities and disabilities and across all levels of communicators.

Within Social Networks, it states that "individuals who use AAC are often passive, rarely initiate interactions, express a limited number of speech acts, use restricted linguistic forms, and have limited opportunities to interact with others. Speaking partners tend to dominate interactions, ask mostly yes/no questions, take the majority of conversational turns, provide few opportunities for people who use AAC to respond, often interrupt, focus on technology or techniques rather than messages spoken or the person and don't always confirm the content of messages communicated by people who use AAC." (Social Networks, 2012, Attainment Company)

Most individuals who have CCN and use AAC have multiple disabilities, disordered language, deficits in pragmatics and rely on others when communicating. In our practice, we see this with our clients across ages, across abilities and disabilities and across all levels of communicators.

Social competencies include, but are not limited to, looking to your communication partner, being an active listener, commenting and questioning, learning how to be part of a group and maintaining relationships. All of these are needed to be able to communicate with others and to be an active participant in activities and interactions.

We decided to start social groups to target social competencies, to assist our clients with generalizing goals and skills and to provide opportunities for the children, teens and young adults we work with to be with peers who also talk with AAC technology.

The focus of our social groups is for participants to use vocabulary in their AAC systems to communicate and to participate. During groups, participants have opportunities to be with individuals like themselves, to have natural and frequent opportunities to express preferences, take turns, express and share opin-




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Top row, left to right: Jill Tullman, Sarah Shields; Bottow ros, left to right: Barbara Myers, Jenny Kitchen

ions, form friendships, learn from one another and help one another.

Currently, we have multiple social groups at our offices. We have preschool/early elementary school-aged groups, elementary school-aged groups, upper elementary/middle school-aged groups and high school and young adult groups. Participants are grouped by age, and in all of our groups, participants have a variety of abilities and disabilities, communicate using a variety of AAC technology and use a variety of access methods (i.e., some use AAC applications on iDevices, some use speech generating devices, some communicate using direct selection with their hands, some rely on eyegaze, some use auditory scanning with switches).

Criteria for participation in groups are that individuals can sit, attend, participate, wait, not be disruptive and have a voice output AAC system.

Groups have shown us the importance of individuals having not only single word core vocabulary, but also having prestored questions and phrases in their AAC systems. This type of vocabulary has allowed and enabled individuals to participate more independently in peer interactions.

Goals for groups are similar across ages. During all group sessions, use of technology is integrated and literacy skills are targeted whenever possible.

For our preschool/early elementary school-aged groups, examples of goals include noticing one another, learning to interact with one another, turn taking, learning to participate in and tolerate nonpreferred activities and using vocabulary in their AAC systems in a group setting.

Language functions targeted include directing, requesting, expressing preferences, commenting, protesting, using each other's names and asking and answering questions.

For our youngest participants, a predictable routine is provided, and these group sessions are more structured than other groups. A typical session includes beginning and ending each session with greetings and then having a variety of activity choices to request from.

We have found that by modeling and practicing using greetings at the beginning and end of each session, these young participants are now coming in to group saying "good morning" to each other and ending each session with communicating goodbyes. They are using language in meaningful ways, and they are provided with frequent opportunities to practice using language in their AAC systems in natural settings. Typical activities may include tea parties, celebrations, instrument play, music and dancing and interactive applications on iPads. Goals and early language functions are targeted, and vocabulary use is supported, practiced and incorporated within activities.

Image 1: Charlie is using Cora's switch to make a selection during play with an interactive application that is scanning on an iPad.

Social competencies they are learning include looking to one another when communicating, greeting each other, turn taking, responding to one another, asking questions and negotiating and forming friendships.

We are seeing spontaneous use of vocabulary across sessions and across activities with these children. They are watching and learning from one another. Participants without physical disabilities readily and naturally help peers who have physical disabilities. It is both encouraging and interesting that all individuals in our youngest group, who are all new to using AAC systems, are all initiating communication!

We are learning the critical importance of early introduction of social competencies for individuals who have CCN and what vocabulary young children want and need to be able to interact with each other and to negotiate friendships. We are seeing use of early language functions emerge as young children use vocabulary in their AAC systems to protest, greet, request, direct, comment and initiate communication.

Unexpected outcomes we have found with this group are that social competencies naturally emerge when they are provided with authentic opportunities to interact and communicate with one another. These young children are also forming true friendships, as are their parents, who are becoming and serving as supports and resources to and for one another.

The current makeup of participants in our school-aged groups varies from 7 to12 years of age.

Examples of goals targeted include talking to one another, participating and interacting with one another, waiting, making relevant comments, staying engaged in activities and structured conversations, asking and answering questions, expressing preferences and opinions and initiating communication.

Vocabulary targeted varies depending on activities. For example, at the start of each school year, we target personal information and news, as this vocabulary is needed at the beginning of each school year. In the fall and winter months, holiday and seasonal vocabulary may be targeted. Participants are supported and encouraged to share news, greet one another, comment and ask and answer questions during activities and structured conversations. Specific vocabulary and generation of novel utterances may also be targeted (i.e., use of verbs, adverbs, adjectives).

These groups typically begin by checking in, as this is a natural way for them to practice greeting one another and using each others' names. Opportunities are

provided at the beginning of sessions to talk about relevant news and events (i.e., new month, upcoming events/holidays). We typically make a schedule for the day, vote on activities or the order of activities and wrap up each group by sharing a "word" that describes that day's group. See image 2.

As image 3 depicts, voting may become an activity in and of itself. During this particular group, participants were asked to provide the first letter in their names when voting for an activity, and then votes were tallied.

Typical activities include playing games, taking pictures and adding captions using iDevices, completing recipes (i.e., making school houses out of graham crackers), participating in literacy activities, commenting on posts of themselves on Facebook, celebrations and occasional outings.

Social competencies participants in our school-aged groups are learning include how to communicate and interact with one another and how to actively participate in activities and structured conversations. They are learning how to be active participants and active listeners and how and when to use vocabulary in their AAC systems to interact with one another.

Participants need assistance with social competencies similar to the social competencies we target and address with our younger groups, including looking to one another when communicating, turn taking, greeting, asking questions and commenting. They need to know when and how to use social etiquette and how and when to share information. They help one another and are learning to negotiate friendships.

We are learning how naturally motivated they are by each other and by group. We are also learning that children who have CCN and communicate using AAC technology need ongoing opportunities to interact socially with their peers and to take turns, and that they need to have age appropriate vocabulary to do this. If we expect them to be active participants in activities and interactions, they need ongoing practice to be able to do this.

The current makeup of participants in our high school and young adult groups are individuals who vary in age between 15 and 31.

Goals for these groups are similar to goals for our younger groups and still include participating and interacting with each other by looking to your communication partner when communicating, greeting, using social etiquette, making relevant comments, maintaining topic and asking and answering questions.

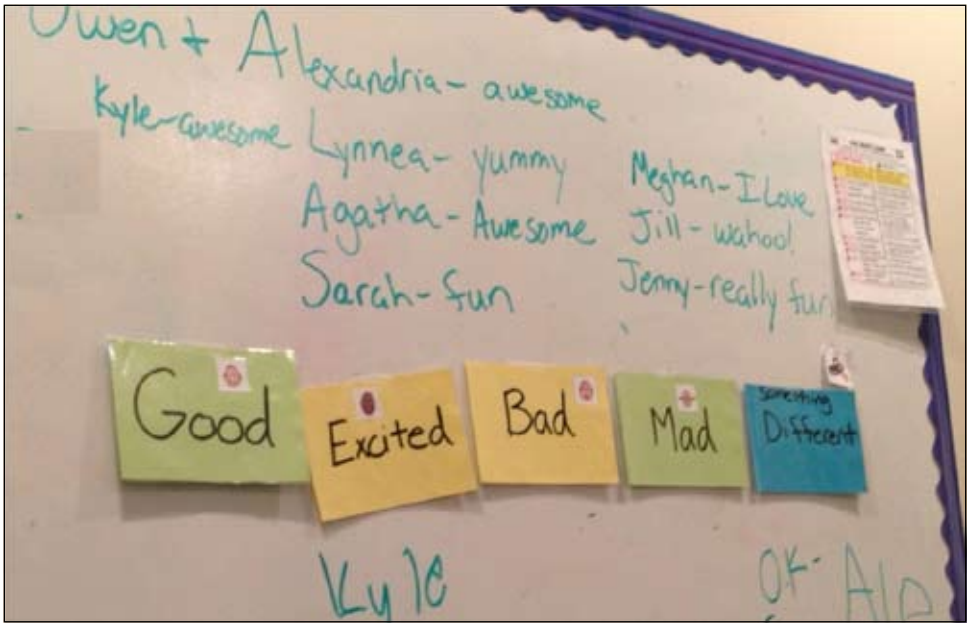

Image 2: Participants and therapists provide their word of the day.

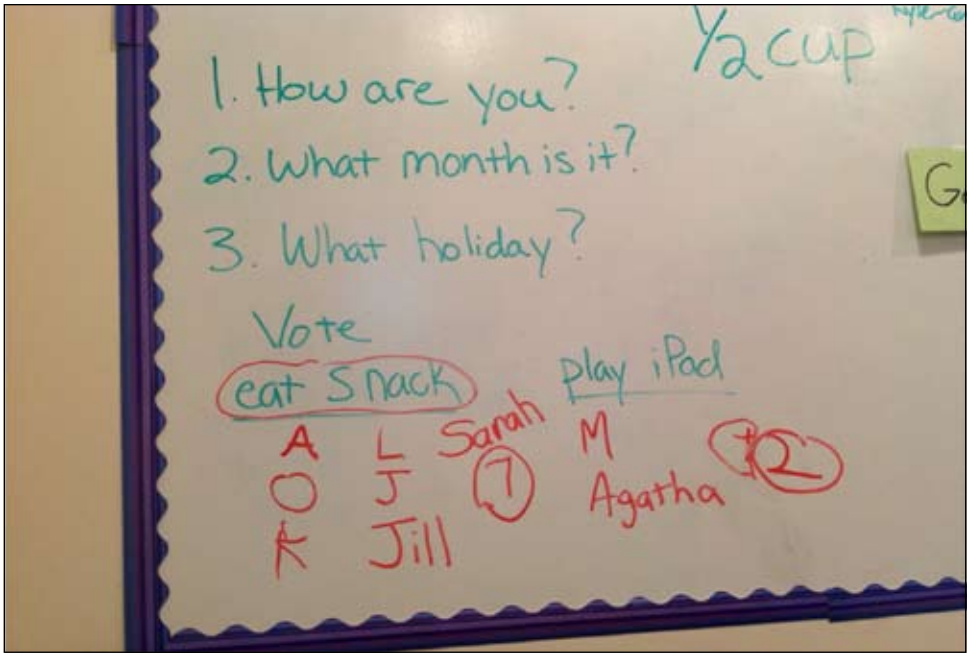

Image 3: During this particular group, participants were asked to provide the first letter in their names when voting for an activity, and then votes were tallied.

Specific vocabulary targeted includes messages needed for asking questions, commenting and for clarifying. This age group particularly enjoys "stealing" vocabulary from one another. For example, most have messages in their devices to request that a message a peer has in his/her system be programmed in their devices. They also want and need to use vocabulary related to self-advocacy and to direct their care and their caregivers.

The structure of these older groups is the least formal and the least structured, compared to other groups, because of participants' ages. During sessions, participants engage in structured conversations with one another as they share news with one another, comment and ask and

answer questions. They use technology, apps on iDevices and social media.

We also teach and encourage them to use built-in features of their iDevices, how to post to Facebook, take pictures, add captions, find pictures online and email one another. For example, Facebook is a common activity during group sessions, where those who have Facebook pages share their posts, and they all contribute to posting pictures from group sessions to our Facebook page, Jill Tullman & Associates.

It is noteworthy that many participants in our older groups are no longer in school, and many no longer participate in individual speech-language therapy sessions so they need to be supported to advocate for themselves and/or learn how to update vocabulary in their AAC devices and how to obtain new AAC technology, when needed. Some use their AAC systems minimally outside of group. Many continue to rely heavily on those who know them best to interpret and/or expand their communication. Passive individuals remain passive. All participants need ongoing support to be active participants. They are highly motivated and clearly enjoy interacting with one another.

Social competencies they are learning include the importance of looking to your communication partner, being able to maintain conversations and interactions with others, being able to self-advocate and having the vocabulary they want and need in their AAC systems.

We are learning that for this age group, our goals are to support them and help them be confident and comfortable when communicating in social environments. When targeting specific language functions or skills, we may need to provide direct instruction prior to expecting them to be able to do things (i.e., asking partner-focused questions). We also have a much better understanding of what being and "needing" to be supported really means and looks like.

In summary, in our AAC practice, we find that all participants benefit from group sessions with similar age peers who communicate using AAC technology. Regardless of age, abilities/disabilities and levels of communicators, individuals are highly motivated by peers and benefit from natural opportunities to communicate and participate with one another.

To build and foster social competencies, individuals with CCN must be provided with ongoing natural opportunities to interact with one another. Our youngest participants initiate communication much more than their older and much older peers. ■

Image 4: Megin is helping Brian put his flower in his pot.

Image 5: Max and Emily always have fun!

Speech Recognition and Mobile Computers

INTRODUCTION

Speech recognition (SR) has become a "mainstream" option for interacting with mobile computers, such as smartphones and tablets. As is well known in the assistive technology (AT) field, SR is also a viable way for people with motor, vision or other disabilities to access a computer. SR on mobile computers is a rapidly evolving part of the field, and this article will outline some ways for people with disabilities to interact successfully with a mobile computer.

SR offers access to a device that has largely been designed for use with a touchscreen. These devices can be readily accessible (some estimate there will be 2 billion smartphones in the world in 2015) and relatively low in complexity and expense when compared with a standard computer. "Normalization" of a smartphone or tablet for a person with motor, vision or other disabilities is also an important factor. That person may prefer to use a device that is "cool" or attractive to peers, over a standard PC that may isolate them.

IPhones were released in 2007, and Android was released in 2008. This article will largely focus on these options. Windows and Mac software is available in a tablet-size device, but is much more expensive, as well as significantly more complex. There are also other operating systems, such as Blackberry, Windows Phone and WebOS, but their adoption has been limited. For purposes of this article, we will focus on Android and iOS (operating system for iPhone and iPad) software running on phones and tablets.

ALTERNATIVES TO TABLET COMPUTERS AND TOUCHSCREENS

Computers should not be neglected as an AT option. A client with low vision may still benefit from a large screen or monitor (although there are some Android tablets upwards of 20 inches). Clients with motor deficits may be able to better utilize physical keyboards or an alternative mouse (vs. the touch screen that is ubiquitous on tablet computers), Alternative mice may include options for head control or eye control.

Some Bluetooth keyboards are available for Android and iOS. Size and selection is limited. Android does offer an additional option that allows for a cable connection to a USB keyboard and/or mouse (usually with the addition of a small adapter cable). This allows Android to accept a variety of adaptive mice or keyboards, such as a head-activated mouse or large-key keyboards. Additionally, Bluetooth mouse and keyboard combinations can be used with Android 4.0 and up. For clients who are unable to access a touchscreen, these options may be valuable. It should be noted that a full computer maintains more flexibility and options for use of add-on hardware and software.

While this article will be addressing use of SR for access to tablet computers, it is important to recognize that there are presently minimal and occasionally unreliable options to allow a tablet computer to be operated solely by speech. There are drawbacks to devices that are voice activated ("OK Google" or "Hey Siri" on Android and iOS devices), as well as limited functions that can be controlled by voice. A client with some access via direct selection to the touchscreen or other methods will be far more functional with these devices.

EVALUATION

The client's goals vs. the capabilities of the device will benefit from careful feature matching. Most devices are capable of offering communication through voice/video over IP (such as FaceTime or Skype), and access to social networks (Facebook, Google+), messaging and email. Phones obviously also offer phone calling and SMS service. The devices are capable of some computer access options, including word processing, Internet browsing and access to spreadsheets and presentation

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programs through apps. Additionally, clients may use them for access to movies, books, music and the like.

Evaluation with a client should include (as for any client considering AT), abilities and deficits in vision, cognition and motor areas. "Technology Tolerance" is important to address; determine the client's ability to deal with technology malfunctions or unexpected behaviors.

The client's ability to use SR should be considered. Dictation and speech for successful access to a SR app or program is not a natural skill. While most tablet computers are increasingly developed to recognize "natural speech," the devices still perform better if a client is able to speak clearly and fluently (like a newscaster). Using punctuation while you are speaking and understanding when a SR app can recognize a novel word or not are important considerations. While marketing for these devices will have you believe that SR is just as easy as talking to your family member, this is often not the case. The Automobile Association of America carried out a study to determine the most distracting activities behind the wheel involving smartphones and found that a voice activated email required more cognitive attention than many other common activities. It is important to consider that SR is often more difficult than marketing would have it look.

However, cognitive issues may be addressed using a smartphone and SR as well. While fluently expressing a statement such as "Remind me to preheat the oven when I get home" is not an inconsiderable task, it may be easier to accomplish than opening a reminder app, starting a new task, typing the task, typing the location (or time) and saving it. Setting calendar appointments, reminders, searching the Web ("What is today's weather") and finding local information or navigation ("where is the nearest pharmacy") can often involve fewer steps than typing into a smartphone or using a standard computer.

Consideration should be given to the actual device. As previously discussed, this presentation will focus on Android and iOS. Both systems offer phones and tablets in a variety of sizes; however, Android offers a greater variety. iOS does currently require that the user activate the home button to access Siri, the voice activation system. Android allows for hands-free activation via "OK Google" when the screen is on. Certain phones are also able to be activated when the screen is off. iOS will require a data or Wi-Fi connection for voice recognition to work, whereas Android does allow for offline SR in more recent models.

This tablet mount is available from www.ModularHose.com

MOUNTING AND ACTIVATION

The device may benefit from being mounted for the client to access the screen by touch, as well as for reading and monitoring accuracy of the SR. An alternative to this: if the device offers text-to-speech feedback, then the client may be able to access functions (without seeing the device) using SR, utilizing text-to-speech feedback to confirm accuracy and receive feedback.

Many devices are able to be turned on using a "smart cover," which will turn on the screen when the cover is opened. Building up the cover with an exposed tab can allow for a client with limited hand function to turn on the device without need-

ing to access the power button.

Many covers will also double as a tablet or phone stand to allow the device to be viewed at an angle. Commercially available options can often be adapted to a wheelchair, such as bicycle or automotive mounts. Many vendors in the AT world also offer effective mounting solutions such as the RAM Mount, Modular Hose or RJ Cooper Tablet Mount.

Device touchscreens are intended to be accessed by fingertip, but many of our clients are unable to isolate finger control to do this. A mouth stick or typing splint can be used to access a device. The most reliable system for this will run a wire or other conductive material between the clients' bare skin and the capacitive stylus, thus transmitting necessary electrical activity from the clients' body to the capacitive touchscreen. Not every touchscreen device and stylus combination will require conductive material, but a short wire will work well (while being cost effective and commonly available) if it is not registering stylus touch. Styli do tend to wear out, so buying several is often helpful.

Devices may also be activated through the standard home or power buttons using a variety of build-ups. This writer often uses scrap thermo plastic material to do so. A pencil eraser or other build-up to a power button is also a quick and easy way for some clients to turn on a device. A device with a back- or front-mounted power or home button is often easier to modify than a device with a side mounted power button.

DIRECT SELECTION OPTIONS

As discussed, it beneficial to allow for direct selection of some sort to a tablet computer. There are options with each system to allow for enhanced access to relevant icons and apps within the program.

iOS allows for movement of icons from screen to screen to allow for easier access to more commonly used icons. Folders can also be utilized for the same purpose. Less commonly used icons can be placed farther away from relevant ones.

Android allows for a variety of options for customization of the home screen. The home screens can be filled with only relevant icons, and non-relevant ones can actually be removed from the screen. More extensive modification can involve enlarging icons to allow for easier targeting (using apps such as Giganticon and Desktop Visualizer). Native Android allows for removal of the lock screen altogether, removing the need to "swipe" the screen to unlock the device. The home screen can be reduced to 1 to allow for removal of unintentional scrolling to additional screens that is common for some clients with decreased fine motor ability. Alternative launchers, such as Nova and Apex, can allow for locking of home screen to prevent unintentional movement or adjustment when an icon is "long pressed." BIG launcher allows for very large icons with no options for scrolling or movement of icons.

This platform was fashioned from spare orthoplast (thermoplastic material). The tab is placed over the home button and a client with gross arm placement but no isolated finger function can push on the top part of the screen, thereby levering the home button into the tab and turning on the phone.

Some clients with good head control can utilize a Bluetooth Earpiece with a build-up against their headrest to turn on SR features, as described below. An additional option is to leave the screen on the device "On" at all times, but this can use battery life at a rapid clip.

A better option may be to utilize alternative switch activation or magnet activation using an SAJE EasyBlue or No Hands Button respectively. The EasyBlue allows for activation of SR using an ability switch, while the No Hands button requires that you bring the earpiece within range of a magnet mounted by the head.

Complete voice activation is available through Android using Dragon Mobile Assistant, but this can also have a negative impact on battery life as the device is always "listening" for the activation keyword. iOS (Version 8 released in Sept 2014) has a setting for "Hey Siri" to activate the device, but requires that the device be plugged in for the feature to be active. Motorola makes the Moto X phone with a dedicated low power chip always listening for "OK Google," which allows for a lesser impact on battery life.

These options continue to benefit from access to the touchscreen as the actual ability to completely control the device remains limited. If the client is unable to activate the SR on a device, then it will not be of benefit, so the preceding information is important to consider.

SPEECH COMMANDS

This section will compare and contrast Google Now (default SR app for Android), Siri (default SR app for iOS) and Dragon Mobile Assistant (DMA), a frequently recommended app available on Android. It should be noted that the below are confirmed capabilities at the time of this writing (October 2014). The field and app capabilities often evolve rapidly, so this list is not meant to be inclusive, nor is there any guarantee that these commands will be available or limited to the description below. It is strongly recommended that you trial these options with the client on the definitive phone, as this writer is frequently surprised by changes in the technology and capability from phone to phone.

Once the SR has been activated, then the device can be used for a variety of options. A phone can be used to "Call my Wife", "Call John Smith", or "Call 312 123 4567". A messaging service can be used to say "Text my wife I will be home at 530." It is important to recognize that these commands must be given in a fluent and continuous pattern. It is possible to say the command in shorter patterns, i.e. "Call"... "My Wife". Or "Text"... "My Wife"... "I will be home at 530." However, the body of the text message must be given in one fluent statement, which can be a difficult skill for some to learn, and usually requires some practice and forethought.

Email can be accomplished through Siri, Google Now or DMA. The user can activate SR and command: "Email". Siri and DMA will allow you to add a subject, whereas Google Now will only send the email message in the body, not the subject line. Again, the body of the message must be provided in one fluent statement with no pauses, making this option impractical for anything longer than a couple of lines.

Each SR app can be used to play some variation of music from music players, either by song, artist or play list, depending on the app. But it should be noted that you have minimal control over the music player and other features, such as volume.

The above options can be activated and utilized hands free (following activation of SR app). While SR, such as Dragon NaturallySpeaking, on a PC does not require one to ever touch a keyboard or a mouse, assuming one knows the appropriate commands, SR apps are far more limited on iOS, Android or other tablet computers. Clients may use SR to launch an app, such as "Start Safari" or "Open cnn.com". Direct selection will then be needed to interact with the device to refine the information, select options or scroll on the screen. Thus, it is beneficial for a client to have some method of direct selecting on a tablet using aforementioned techniques, such as a stylus. This allows for more efficient access to various tasks, using SR to complement direct selection on the device.

DICTATION

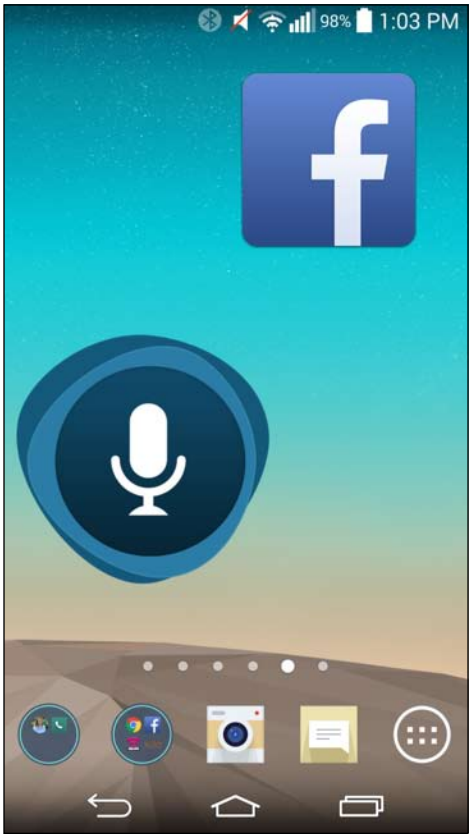
Siri and Google offer a microphone key on the standard system keyboard that allows a client to dictate text into a text field that has been bought up through direct selection. It is a cliché in the speech recognition field to say that this text has been written using speech recognition. To keep up this tradition, this section was drafted using Google dictation.

Text can be dictated using the microphone button anywhere text can be typed, while using an onscreen keyboard. Unlike the PC, dictation cannot be verbally or directly corrected, which can make it difficult to utilize proper names or unusual vocabulary. But this may allow efficient production of longer sections of text (for a client with slowed but intact direct selection), while requiring direct selection on the device to open a document or other text field, as well as interacting with the text after dictation, e.g. to send the email, edit or correct text, change formatting etc. On a PC, using more robust SR options, this can be executed hands free, but on a mobile computer using dictation, some method of access other than speech will be required.

CONCLUSION

Speech recognition has always been an effective strategy for some people with motor, vision or other disabilities to access technology. Emergence and evolution of SR options in the mobile computing field has been as rapid as the field itself. It is sometimes difficult for this writer to remember that the iPhone was only introduced in 2007, followed by rapid evolution in the field!

As with all AT strategies, it is important to rely on SR as one of many tools. Features and capabilities of a mobile computer and SR will match up to certain goals and abilities of our clients, but not all. Careful monitoring of continued changes in the field can sometimes be difficult, given the rapid changes, but will also allow AT professionals to assist our clients to reach their fullest potential using technology. SR in tablet computers can add a valuable tool to our "toolbox." ■



Caption: This android home screen offers only two enlarged icons, one to activate voice recognition, the other to activate the Facebook app.