Breakthroughs in speech output technology have opened doors to communication for people around the world. Today, a wide range of voice output communication aids (VOCAs) offer both synthesized and digitalized technology to users of augmentative and alternative communication (AAC) devices.

Synthesized speech devices have been available since the late 1970s. To generate synthesized speech, the user must type letters or select words or symbols from a display. The computer then translates the input into machine-generated speech. Early synthesized speech devices were not very intelligible and had robotic, male-sounding voices. When the Digital Equipment Company (DEC) began licensing their high quality DECtalk synthesizer as an affordable software product to AAC manufacturers in the early 1990s, it enabled AAC companies to put high quality text-to-speech synthesis in AAC devices and communication software products. This gave AAC users nine intelligible voice options. New synthesizers are becoming available that also offer intelligible speech.

In 1988, AAC manufacturers introduced a new family of VOCAs that generate digitized speech. The user, family member or clinician record sounds, words (cont. on page 2)
Augmentative Communication News

Although she tried several VOCAs over the years, she did not like them. They were "too big and required too much memorization."

Tiffany has cerebral palsy and uses an electric wheelchair. Last year, she tried the LightWriter with DECTalk (Beautiful Betty voice) and liked it. She says it is small, easy to carry on her lap, and she can use it in a way that is similar to her alphabet board.

Tiffany says speech output has made some very important differences in her life. First, it makes her feel safe and, thus, more independent. For example, when she is in a mall, she now feels comfortable shopping by herself, because she knows that if she needs help, she can get it. Second, it enables her to have private conversations on the telephone with her boyfriend. She also likes how speech output allows her to: (a) get people's attention, (b) communicate with friends who do not read or cannot see, and (c) stop and chat when she is driving her electric wheelchair.

Tiffany Renae Adams, 17232 Foley Drive, Yorba Linda, CA 92886. Email: TifRenae@aol.com

Work and Play. Kevin Smith works as a part-time augmentative speech aide for a school district. When Kevin graduated from high school in 1988, he had no plans. He also had no VOCA, despite the fact that he had been evaluated three times and each time an AAC device was recommended.

A multi-agency team conducted a fourth evaluation and decided to write grants and raise money for a device. In 1992, Kevin was able to purchase a Touch Talker. Training time was donated by a speech-language pathologist on the team.

Today, Kevin uses a Liberator with Words Strategy. In addition to his job for the school district, Kevin leads an active social life, has lots of friends and enjoys casinos and church. (There's a combination!) He says speech out-

For Consumers (cont. from page 1)
put allowed him to get his job and is useful in his work with children. In addition, it gives him the option to do public speaking and work as a counselor in a summer camp, and is useful for advocacy work.

Kevin Smith, 3600 Missile St.,
Prichard, AL 36612.
Phone: (334) 457-8734

Lecturing and Advocacy: Michael B. Williams is widely known for his public speaking abilities. In 1996, he was honored as the ISAA CWords + Distinguished Consumer Lecturer and currently serves on the ISAAC executive committee in the Sentient Systems Consumer Leadership Chair. Michael is the author of Alternatively Speaking. I asked him how he goes about preparing an effective speech using his Liberator with Words Strategy.

"I always begin work on a speech by thinking about it. Writing an effective speech requires both, creative and technical skills. My Words + lecture took six weeks to do. This included thinking about the speech, researching personal history; writing three or four drafts on a word processor, downloading the speech to my Liberator, and massaging and tweaking it until it sounded right."

His wife, Carole, adds, "Michael spends days ruminating about a speech before touching the keyboard. The tweaking he refers to means listening in a silent room to each sentence, some sentences many times before they sound right."

Michael says that he uses his special technical knowledge of the Liberator’s hidden DECtalk abilities to make his speeches more interesting and effective. For example, he:

- judiciously uses the different voices of the VOCA. This adds interest and spice to his talks and often surprises the audience by catching it off guard.
- constructs hard-to-understand words out of phonemes rather than using standard text-to-speech methods.
- gives certain words more stress than others.
- puts slight pauses between some words in the middle of a sentence to heighten the dramatic effect.

Michael says: "The way to do this technical magic is often not contained in the user manuals, and, as I discovered while helping a fellow augmented communicator, these tricks vary from device to device."

In response to a query about how he programs his speeches for delivery, Michael replied, "I program my VOCA so I can deliver the speech sentence by sentence. This gives me precise control over the timing of delivery; something that is absolutely critical to giving an effective talk."

Finally, I asked Michael and Carole to share other things they feel have made Michael a better speaker, Carole said, "Michael reads voraciously, so the sound of good writing is always being freshly layered on his brain. Writing for speech is not the same as writing for print, Michael also listens to a lot of music and has read a lot of poetry. He thinks about the sound of words."

Michael said many things have influenced him including: "Watching my minister grandfather sweat over the preparation of his sermons as a kid, reading great speeches of the past; being old enough to appreciate Martin Luther King and John F. Kennedy at the height of their speaking powers; seeing Mark Twain Tonight with Hal Holbrook multiple times; and going to see Richard Pryor as often as I could when he was at the top of his game." He added, "Holbrook and Pryor really taught me how to tell and pace a story."

Michael B. Williams, Alternatively Speaking, 1 Surf Way, #237, Monterey, CA 93940.
Email: mbwill@well.com

Temporary access. Ruth Leff described a man who is employed as an actor and singer. A year or so ago, he was diagnosed with vocal nodules and had to have them surgically removed. After the surgery, his doctor ordered him not to speak for two weeks, i.e., vocal rest. During the period when he was nonspeaking, he used a Crespeaker, a simple text-to-speech device, to communicate with his family. He and his family said that having speech output made it easier for everyone.

Ruth Leff, Crestwood, PO Box 6624, N. Sidney Place, Milwaukee, WI 53209. Phone: (414) 352-5678

Voice for a blind child. Hope is a twelve-year-old girl who is blind and has a severe speech impairment. She is ambulatory and uses some manual signs; however, many people she wants to communicate with do not sign. Hope attends a special classroom for children with visual impairment on a regular school campus. Although she is beginning to develop an interest in reading, her literacy skills are quite limited.

(continued on page 10)
Four clinical programs

Speech output devices have different impacts on different people, at different ages, in different environments. Projecting across distances (whether it be a room or a continent) is a universal benefit of speech output. However, other applications are more specific to individuals or situations. For example, Schaeffler suggests that speech output teaches young children the power of communication when they are first gaining an understanding of the use of AAC. It also gives children a way to communicate with their peers, and allows adolescents and adults to communicate with unfamiliar partners. VOCAs support independence, employment, friendships and intimacy. They also give adult AAC users a way to communicate with children and others who cannot read communication displays.

Many feel that speech output also strengthens instruction and learning. For example, speech output devices offer a way to "self-practice" and "self-monitor." Expert AAC users often practice for hours upon hours to develop automaticity using their device. Speech output also may assist an AAC user to spell, learn grammar, and attach meaning to graphic symbols. This section gives four examples of how master clinicians use speech output to enhance daily communication and learning among their AAC clients.

1. Community integration

John Costello, a speech-language pathologist in Boston, has worked for years with group home staff. He developed this strategy to support people with severe mental retardation to successfully communicate in the community and establish social relationships beyond their support staff and family. "Success (in the program) is wanting vanilla ice cream and getting it," he says.

Desired Outcomes. (1) Effortless and successful communication of a single message in the community. (2) Increased independence and interaction during routine community activities. (3) No need for instruction or guidance. (4) Recognized by community workers as a viable and competent communication partner.

Settings. Community restaurants, library, theaters, shops.

Target population. Adults with severe mental retardation who can use a single spoken message in the community. Diagnoses include cerebral palsy, tuberous sclerosis, Angelman, Noonan and Down syndromes.

Support required: Group home staff in consultation with a speech-language pathologist who is knowledgeable about AAC.

Technology. Easy-to-use digitized speech devices that are portable, allow single messages and have a volume control. Costello uses the Big Mac switch (AbleNet), the One Step Switch (AbleNet), or a Voice Recording Picture frame (Radio Shack). He prefers the One Step Switch because of its size, portability and low profile and because it is most often accepted by staff. For individuals who can handle more than one message and/or have difficulty accessing these devices, alternative choices are made.

Description of the intervention. Table I summarizes the steps to using a single message in the community. Staff preprogram a message for use on a regular community outing. Examples are:

- Library: "May I borrow this book, please?"
- Restaurant: "I need a receipt, please," or "I'd like the sunshine breakfast #2 and black coffee."
- Movie: "Could I have two adult tickets, please?"

During regular outings, the augmented communicator uses the device. Staff make every effort to go to the same place around the same time of day in order to provide a consistent learning environment and support developing relationships with consistent communication partners. Community workers become good partners through repeated exposure.

Results. Data collected by group home staff seem to show that even
limited use of speech output in the community:

- promotes increased social contact.
- increases opportunities for social integration.
- creates incidental learning opportunities for adults with severe communication problems.
- educates people in the community about disability issues.
- promotes increased expectations of competence by communication partners in group homes and community.
- increases the number of people who become familiar with the communication/speech patterns of these individuals.

The strategy is not without difficulties, of course. Costello shared the following problems:

- Environmental. When the context is noisy and community personnel are busy, trying to implement the program is a mistake. It is important to choose times and contexts where things are quiet and relaxed.
- Staff. Staff are responsible for providing access to the device and support for using it appropriately. When staff don't support the program, it will fail. This barrier is difficult to overcome.
- Consumer/AAC user. Some consumers are shy and reluctant to participate; others may refuse. Still others may continually activate the device in need to make individual accommodations to ensure success.
- Technology. The biggest problem with technology has been messages being incidentally erased because of the proximity of the record and play buttons. Another problem occurs when the VOCA does not have a volume adjustment.

Edie Thayer, Tracy Bombara and Sallie Bartner developed Project AICEs (Augmentative Intervention in Community Events and Situations) for the Vineland New Jersey school district. The three-year-old project teaches volunteer student tutors to support children and adolescents who use AAC in the school and community. Three years ago, eight high school students volunteered to be tutors. This year, 60 peer tutors volunteers are participating. This has led the Vineland school board to consider offering a five credit high school course. Assistive Technology for Persons with Disabilities, in September 1998.

Desired Outcomes. For students who use AAC: (1) Friendships and communication with peers. (2) Competence in using AAC techniques. (3) Success in the community. (4) Enhanced participation in classes. (5) Success in academic areas. (6) Independence and advocacy skills. For tutors: (1) Understanding of disability issues and assistive technology. (2) Friendships with students who have disabilities. (3) Skills in supporting students who use AAC. (4) Advocacy skills.

Settings. School and community.

Target Populations. All district students with AAC needs.

Support required. Administrative support to set up the program, faculty/staff advisor for AICEs club to provide ongoing training to volunteers. Daily support of AAC users is provided by volunteer tutors.

Technology. VOCAs currently used are: Dynavox 2C, DynaMyte, AlphaTalker, Liberator, DeltaTalker, IntroTalker, Touch Talker.

Description. School. Some tutors meet daily during homeroom. The AICEs Club meets once a week after school. Tutors currently support four high school students, one elementary student and one preschool child. Peer tutors learn to: (a) program devices, including tweaking the speech in VOCAs to make it more intelligible and interesting; (b) help AAC users select vocabulary; (c) make sure devices are operating; (d) encourage students to use devices appropriately and independently; and (e) "trouble shoot" technology problems.

Urban Summer Camp. For two weeks AICEs tutors and students who use AAC invite guest speakers (e.g., the Fire Chief, a neurologist, local business managers) to talk to the group. Prior to the visit, students prepare questions, program AAC devices and practice using them. After the talk, speakers and students participate in lively discussions.

The Urban Camp also involves community outings. These are planned by the students and require lots of communication. They also make everyone more aware of access barriers in their local community. Students have learned advocacy skills and now routinely ask, "Is your restaurant accessible to..." (cont. on page 6)
Table II. Reported il-n--c~tut'.he AICEs Prc-j ectun students nhu use AAC and their pl'eer tutors

| AAC users  | More mature as a result of interactions with peers who teach them what is aud is not age appropriate. Enhanced self esteem-tutors 'accept them,' improved school performance and increased independence. |
| Parents | Very pleased with the progress their children have made in all areas. |
| Community leaders | Appreciate and are impressed with the students. 'Something wonderful happens when AAC users and peers are together.' |
| Peer tutors | Enjoy learning about AAC devices and being involved with AAC users. Demonstrate creativity, technology skills, sensitivity, acceptance and warmth. |
| Teachers | Have stopped worrying about needing to spend extra time because the students take care of everything. Are free to focus on the child's abilities. Several have expressed amazement at the children's test scores. Enjoy the tutors way of communicating and enjoy seeing the spontaneous interactions. |

Clinical News. (Cont from page 5)

people who use wheelchairs?"
"Do you hire persons with disabilities?"

Results. Anecdotal evidence suggests that Project AICEs results in a number of positive outcomes. (See Table II for examples.) In addition to the results, as perceived by those involved, Thayer and Bombara note that the service delivery model within the school district has shifted from an expert-based to a school- and community-based model, because peer tutors have the expertise needed to support the use of AAC devices and techniques. Also, they indicate that they did not expect to see such rapid rates of change in teacher attitudes, student self-esteem, student independence and community involvement.

Finally, the students involved in Project AICEs have presented at international and national conferences, as well as to local and state groups. Peer tutors assume responsibility for making sure everyone's technology works during these events. The students also helping a school district in Florida replicate the project by communicating with their peer tutors over e-mail.

3. Voice Output in the ICU

At Children's Hospital in Boston, John Costello works in an 18 bed, multidisciplinary pediatric intensive care unit (ICU). He and his colleagues from Nursing and Child Life have developed a protocol for patients who are temporarily unable to speak following surgery:

Desired outcomes. (a) Ability for patients to communicate with staff and family immediately after surgery. (b) Ability for patients to go to surgery with an increased sense of comfort regarding post-surgical communication issues.

Setting. Pediatric ICU. (Also relevant to adult ICUs.)

Target Populations. Individuals who are unable to speak after surgery: ages 2 years and older, both English and non-English speakers. Patients are referred by: Otolaryngology (airway management issues, tracheal reconstruction, stenosis, tracheostomy); Cranio-facial/orofacial construction/construction; Oncology: (tumors of oral, facial and cerebral nature); Muscular Dystrophy clinic; Cystic Fibrosis clinic; Heart and Lung Transplant teams; Most patients regain their speech. Approximately five percent of the children are nonspeaking pre-operatively.

Technology. Digitized speech devices (e.g., MessageMate 40, CheapTalk 4 and 8, IntroTalker); Synthesized speech devices (Dynamyte); Peripherals (e.g., Switch Module, Jelly bean Switch, TASH Microswitch, AbleNet Universal Mount, BoardMaker software for PCS); Non-electronic communication displays (alphabet boards, miniboards, eye-gaze boards, listener assisted auditory scanning arrays).

Support Personnel Required. A speech-language pathologist with expertise in AAC sets up the program, conducts initial training and monitors the use of AAC in the ICU.

Description of Intervention. Step 1. Pre-operative Instruction. A week or so before surgery, the speech-language pathologist meets with the patient and family to: (a) Talk about their perceptions, fears and expectations; (b) Assess the patient's motor, sensory and literacy skills and ascertain which symbols and access techniques to use for communication. Note: Access decisions are based on the patient's pre-operative skills as well as any likely post-operative complications (i.e., eyes swollen shut, limited mobility of arms, halo traction); (c) Select vocabulary. (The patient chooses vocabulary with guidance from the clinician. Efforts are made to reflect the patient's personality through vocabulary selection); (d) Record or program the vocabulary (The patient often records his or
I

patient to use AAC strategies and her own voice); and (e) Teach the devices to communicate. Table III summarizes the benefits of pre/posterative AAC instruction.

Costello reports that frequently requested vocabulary items are:

Personal needs: "Bathroom; ice; wet cloth; mouth brush; pee; please brush my teeth; can I ?; I am thirsty; I am really, really thirsty; put on my glasses; wipe my nose."

Psychosocial needs: Emotional - "I am scared, mad, OK, not stupid, tired, lonely, confused."

Control- "Leave me alone; Wait five minutes; I don't want that; I want privacy; Hold me; No chest PT; Just do it quick, please; I don't want you back."

Social - "Thank you; I'm sorry; I appreciate it; What is your name; I love you; I love you too; How is ?; Thank you for your help; I want to see ; Did you feed the dogs?; Is everyone okay?"

Medical needs: "I need to throw up, cough, be suctioned, sleep, I am in pain; I want medicine, to sit in the chair, to go to bed, a pillow behind my head, more pillows; I don't want medicine; I have a headache; I am hot, cold, itchy; My ___ hurts; Bed up/down; Turn me over; Put a towel ___; Move my ___ ."

Step 2. Bed-side Intervention. During the ICU admission, the speech-language pathologist:

- monitors the individual's cognitive and physical status.
- re-introduces strategies for commUnication.
- makes sure the individual can access communication at all times. Mourn- and/or carefully positions equipment.
- provides staff and family with support and instruction, if needed.

Heard. Step 3. Discharge Interview. At discharge, the speech-language pathologist conducts interviews with the patient and family and solicits feedback from staff.

Results. AAC is an important service in the ICU environment at Children's Hospital. To date, Costello has used the protocol with more than 70 individuals, ages two to 40 years. Staff, family and patients, summarize the benefits in Table IV.

Costello feels that digitized VOCAs are useful for non-English speakers because they allow any language to be recorded. He suggests three ways to program a VOCA depending upon who will use it. For example:

- If a patient uses a VOCA with patient and family who speak English, then messages are stored in English and symbols are in the patient's native language.
- If a patient uses a VOCA with staff and family who do not speak English, then half of the messages are stored in English and the other half in the patient's native language. Symbols on the display are in the patient's native language.
- Sometimes staff also use a VOCA with patients, and families who do not speak English. All messages are stored in the patient's native language. English symbols are placed on the display so staff can ask questions and give information.

Desired outcomes. (a) Systematic provision of a reading curriculum with students who use AAC devices or computers with speaking word processors. (b) Improvement in students' reading, writing and oral language through a full range of literacy activities. (c) Improvement in phonemic awareness and related skills. (d) Increase in participation and spontaneous activity (cont. on page 14).
In the Boston Tea Party of 1773, the American colonists took direct action against a tax imposed by their British governors by throwing the tea into the harbor. Some 225 years later, a group of Americans equally intent on creating change came together in Boston to initiate Medicare Action. The goal this time? The taxes that support Medicare should ultimately pay for all AAC devices. The first steps are to: (1) help families and individual speech-language pathologists pursue the Medicare claims appeals and denials that will eventually get Medicare's attention, and then, (2) persuade Medicare to review and change its AAC funding policy. The idea to launch a Medicare initiative originated with Lewis Golinker, Esq., an AAC advocate and lawyer who has fought for (and won) funding for people who use AAC. His work has overturned policy barriers that denied access to AAC devices and services. Initial supporters of this initiative are: Advocacy, Inc. (Texas P & A), Assistive Technology, Inc., Communication Independence for the Neurologically Impaired, Mayer-Johnson Co., Prentke Romich Co., Sentient Systems, Inc., United Cerebral Palsy Assoc., and the Universities of Nebraska and North Carolina. Individual supporters are David Beukelman, Sarah Blackstone, John Costello, Garth Corbett, Esq., Lewis Golinker, Marta Kazandjian, Pam Mathy, Pat Oursland, Howard Shane, Peter Strugatz, and David Yoder.

**Background**

Medicare is the largest health-care funding program in the U.S. It serves adults over 65 and many adults with disabilities, both developmental and acquired. Thousands of Medicare recipients are in need of AAC intervention.

Medicare is a "cost reimbursement program," meaning that it provides payment for a Medicare recipient receives a particular form of treatment, or a needed device is delivered. Medicare eligibility is based on age and/or health, disability status, not income level. In reality, few Medicare recipients with an expressive communication disability have sufficient resources to buy a needed AAC device unless they are certain that they will get reimbursed. But does reimbursement occur?

Medicare's "guidance" related to AAC devices is internally inconsistent, making it possible for some people to get devices with relative ease, while others face a daunting challenge. Medicare recipients seem to fall into three groups:

- People needing an artificial larynx or trach speaking valve. For them, Medicare works and reimbursement is available.
- People who need other types of AAC devices who have the private resources to acquire them. This includes individuals whose speech impairments are caused by conditions and/or disease processes that affect the neuromuscular system. Examples are amyotrophic lateral sclerosis, multiple sclerosis, traumatic brain injury, brain stem strokes, aphasia, cerebral palsy, mental retardation and many others. Reimbursement is available as long as the person continues to appeal the negative Medicare decision through to the level of the administrative law judge (ALJ) hearing. This requires considerable resources including time, information and support.
- People who are unable to find the resources necessary to acquire a device and/or to pursue an appeal. This group comprises the largest number of people. These people can not get access to devices. Efforts are being planned to help raise the funding necessary for them to purchase devices and then pursue Medicare appeals. Because these funds will not be able to accommodate everyone who needs a device, people in this group will be the ones who benefit most from the ultimate revision of the current Medicare policy.

The current Medicare guidance directs Medicare decision makers to deny reimbursement claims for all AAC devices other than the artificial larynx and trach speaking valve. Individualized review is not allowed, either at the initial decision or at the first two appeal decision levels. However, at the third level of appeal, which occurs before a federal administrative law judge (ALJ), an in-person hearing is held. The "guidance" to deny funding for all AAC devices except an artificial larynx or trach speaking valve is no longer binding at the ALJ level, so the judge is free to disregard it. It

---

*Note: This process is in clear contrast to Medicaid, which requires beneficiaries to seek prior approval before a device is obtained. Medicaid is a means-based program.*
is important to note that all Medicare recipients, who have needed an AAC device and who have continued to appeal up to the AU level of review have won.

Medicare AACtion

Delays in reimbursement caused by decision makers who are forced to apply the Medicare guidance are unnecessary at best. At worst, they impose significant hardships on many individuals and their families. For these reasons, Medicare AACtion has begun a campaign to revise this Medicare guidance, and with it, the reimbursement delays. The Boston gathering reached consensus on a strategy to: (a) remove Medicare funding barriers for AAC devices and (b) ensure that the ensuing decision-making criteria for AAC devices would be fair, as well as medically and scientifically appropriate. To implement the strategy, the group identified the need to gather:

- materials that clearly document the effectiveness of AAC devices with specific disabilities;
- evidence that irreparable harm can occur and tragically has occurred when AAC devices are not available to those who lack intelligible speech;
- funds to support the successful implementation of this initiative (estimated at $25,000 US).

The United States Society of Augmentative and Alternative Communication (USSAAC) pledged to enlist the support of its members to help raise funds and build a groundswell of support for this initiative.

If you have any information that might help, or questions about policy issues related to Medicare funding for AAC devices, call, write or e-mail Lewis Golinker, 202 The Commons, Suite 507, Ithaca, NY 14850. 607-277-7286 (phone), 607-277-5239 (fax), LGolinker@aol.com (Email).

International implications

While all nations develop health care reimbursement programs independently, some things about Medicare AACtion seem to resonate internationally. Strategies for changing funding of AAC devices and services in health benefits systems are based on a set of universal tenets, some of which are listed in Table V. It is important to make what is often obvious to us clear to policy makers, judges and administrators of funding agencies. To change a health-benefits system requires understanding how the system works. While countries differ in the details, we are often required to demonstrate a person’s right to AAC coverage and funding.

- Health benefits systems have some general eligibility rules: either a person is eligible or not. Advocates have to demonstrate that the client/intended user is a current participant in the benefits program, i.e., is eligible to claim benefits from whatever program they try to access.
- Health benefits systems have some menu of benefits that are stated to be covered. Advocates must show that the AAC device being sought fits within one or more of the benefits provided by that program.
- Health benefits systems may have special eligibility rules for one or more of those benefits. If so, advocates must present information that the client/intended user can meet the special eligibility or access criteria that AAC devices fall within.

Next Steps

Increasing access to funds for AAC devices and related services requires collaborative planning on the part of AAC stakeholders in each and every country. Somehow, we need to change health-care systems everywhere so people who need VOCAs (and the services that support their effective use) have access to them. From time to time, and in the U.S. at this moment, changing the system seems to require intentional action. As Golinker says, "we must rise up collectively to protest against constraints imposed by government programs and policies that are outdated and misguided."

If you wish to make a tax deductible donation toward the removal of AAC funding barriers in Medicare, send your check to USSAAC, P.O. Box 5271, Evansville, IN 47721 USA. Be sure to note 'Medicare AACtion' on your check.
For Consumers

A few years ago, Hope was introduced to a 32 location Macaw, a digitized speech device. Her speech-language pathologist, Mimi Deegan, placed fabric puff paint in the upper left hand corner of each square. Hope not only memorized where to find her vocabulary, but also learned to use all four levels, and was switching levels to combine words. Recently, she received a 128 location Great Green +2 Macaw.

Deegan transferred the 32 vocabulary items from each page on her 32 location Macaw on four quadrants to the first level of the Great Green Macaw. Currently, Hope is learning to use two additional pages that contain curriculum-based vocabulary. She also is learning some Braille, which may gradually replace the fabric puff paint.

Hope uses the speech output device in her classroom and in the community during orientation and mobility training. Her teacher is finding new ways for her to use it to interact with nondisabled students, and teachers in school. Deegan reports, “Hope always carries the device with her. Every week she finds a way to tell me what new vocabulary she wants in her device.”

Mimi Deegan, 604 Amador Street, Richmond, CA 94805.
Phone: (510) 233-8598

Voice for a hearing-impaired child. Kyle also is twelve-years old. He has Marshall-Smith syndrome, a rare genetic disorder that results in brittle bones. He has a tracheostomy and a progressive hearing loss (moderately impaired in his better ear). He wears a hearing aid. Kyle has had numerous surgeries, which have caused him to spend time in a "halo collar" and required some months of home schooling. He uses sign language, but his signs are not intelligible except to familiar partners. Kyle has Talking Screen on a laptop computer, which he uses at home, during school and with his large extended family. Speech output enables his communication partners to understand what he wants, needs and thinks.

Kyle is a very communicative child and a visual learner. Kelly Mollison, his speech-language pathologist, says the visual display seems to help him focus and overcome some of his learning difficulties. He currently uses almost 70 levels on Talking Screen and has figured out how to add and delete icons on his pages. Kyle's top page contains conversational categories (greetings, topics, closing statements, partings). He can sequences three words on a page. He also likes to read books, like Brown Bear, Brown Bear to his younger sister's classmates.

Kelly Mollison concludes that although Kyle is becoming increasingly deaf, speech output allows him to communicate with a broader audience and also helps him to focus on language. Kyle will use Mayer-Johnson's symbol set of manual signs, as soon as they are available.

Joshua is seven-years-old. He was born prematurely, has visual impairments (bubble vision/strabismus), and severe motor problems. A few years ago, Joshua began using a Baclofen pump to reduce spasticity. This has enabled him to use a communication device and electric wheelchair, and has increased his general level of comfort. Joshua attends school at the Rehabilitation Institute of Pittsburgh. Until two years ago, he communicated by yes/no responses, facial expressions and vocalizations. Now he also uses a Dynavox with a head switch and auditory scanning. He uses a pillow speaker to listen to his auditory scan and is trying out a speaker device that fits in his ear; so his partners don't hear the scan. Joshua has a master page, plus 60 to 70 pages that link together. His mom reports that he uses his vocabulary creatively.

Joshua's mom, Judy Greenwald, says that the Dynavox "gives Joshua control over his world." "After he began using it," she reports, "the school changed his placement from a functional skills curriculum to an academic curriculum. He has a page with the alphabet and has started to spell. He also is beginning to go to his local school one day a week. Another huge advantage of speech output," she concludes, "is that other people realize that Joshua is intelligent."

Judy Greenwald, 316 Dewey Avenue, Pittsburgh, PA 15218.
Email: greenwald@serviceware.com
Research

Efficacy of speech output

Research on the efficacy of speech output in AAC devices has focused primarily on the effects of machine-generated speech on communication partners. The first consideration of VOCAs is intelligibility. Unless speech is understandable and acceptable, other characteristics don't really matter.

Intelligibility of speech synthesizers

Many factors influence the intelligibility of digitized and synthesized speech. These include: (a) the technical sophistication of machine-generated speech; (b) how speech is programmed in the device; (c) the placement and size of the speakers; (d) characteristics of the individuals involved and (e) the environments in which the device is used.

Digitized speech

No one I spoke with knew of any studies that evaluated the intelligibility of digitized speech or its use in today's communication devices. While one might assume that the intelligibility of digitized speech in a VOCA would be similar to natural speech, anecdotal experience suggests otherwise. Differences exist in the quality of the digital-to-analog converters, playback mechanisms and speakers.

Digitization of speech

A number of studies have investigated the technical feasibility of synthesized speech which influence intelligibility. They are summarized below.

Technical Quality

High quality speech synthesizers are more intelligible than low quality synthesizers. No surprise! Early intelligibility studies demonstrated that DECTalk, a high quality speech synthesizer, was preferable and more understandable to able-bodied listeners (both children and adults) than a number of other speech synthesizers being used in AAC devices (e.g., Infovox, Votrax). However, DECTalk was expensive and originally available only as hardware. A breakthrough occurred when Digital Equipment, Inc. began to license DECTalk as software for use in AAC devices.

Recently, an intelligibility study compared five synthesized speech voices: (1) DECTalk's Perfect Paul and (2) Beautiful Betty, (3) MacinTalk, (4) MacinTalk's Pro Male, and (5) Pro Female voices. Results showed that the MacinTalk was significantly less intelligible than the four other voices. The DECTalk and MacinTalk Pro voices, however, were "roughly equivalent on intelligibility under optimal conditions." 1 AAC manufacturers might be interested to know whether MacinTalk Pro voices are acceptable to AAC users, as are DECTalk voices.

Reportedly, the most comfortable speech rates for adults listening to DECTalk voices are between 150 to 250 words per minute (wpm). The default setting for DECTalk is 180 wpm. Donald Fuller from the University of Arkansas, and his colleagues recently conducted two studies designed to investigate the influence of rate on the intelligibility of synthetic speech for reasons in various age groups. 13 They used the DECTalk voices Perfect Paul and Beautiful Betty programmed into a Liberator. Presenting stimuli at rates between 120 and 250 wpm in increments of 50 wpm, they set the "cutoff rate for acceptable intelligibility" at a level of 85 percent correct responses. At each of the tested rates, subjects answered simple questions, repeated words (e.g., ice cream, lighthouse) and followed commands. A total of 97 subjects participated, with eight males and females in each of the six age groups: (1) 5-6 year-olds, (2) 10-12 year-olds, (3) 14-16 year-olds, (4) 20-24 year-olds, (5) 35-50 year-olds and (6) 65-80 year-olds.

Results of the two studies showed that while gender did not affect performance age did. For all groups, the age of acceptable intelligibility rates varied. Acceptable rates for the Beautiful Betty voice, for example, ranged from 120 to at least 210 wpm across ages except for the youngest children, who tolerated rates.

11.
Admissible rates for Perfect Paul were slower. They ran ed fr 120 wpm to at least 180 wpm to people between 10 and 50 years of age. The youngest and oldest age groups rated rates from 120-160 wpm.

Fuller suggests that the default rate for DECtalk voices of 180 wpm may be too fast for some listeners. In fact, the default rate approached the upper end of the acceptable range of intelligibility for most of their subjects and exceeded the range for the youngest subjects in both studies, and for the oldest subjects in the Perfect Paul study. These researchers are continuing this line of research with other DECtalk voices.

Jeffrey Higginbotham and colleagues also investigated differences in optimal listening rates. They found that "less complex passages" were understood at faster rates (140 wpm). However, for complex material, intelligibility rates improved when DECtalk was used at very slow rates (5.5 words per minute, which approximates the typical rate of AAC users). Both rates are below the DECtalk default rate of 180 wpm.

Pauses. Pauses also influence rate. Higginbotham and colleagues investigated whether programming pauses in the message would influence the intelligibility of synthesized speech. They compared three methods:

1. Spersed between words, e.g., The + dog + is + ferocious.
2. Sentence method. Pauses interspersed between consecutive sentences, e.g., The dog is ferocious + The cat is cute.
3. Mixed method. Interspersing pauses between words and phonemes (intra- and inter-word pauses), e.g., The + dog + is + ferocious + The + cat + is + cute.

Their results showed that pausing between words was the most effective way to increase intelligibility. The mixed method was least effective.

Language skills and listeners. The language skills of communication partners have an impact on comprehension of synthesized speech. Non-native English speakers made significantly more errors transcribing English sentences produced with DECtalk than native speakers. In addition, listeners with language impairments and individuals with mild mental retardation have more difficulty understanding synthesized speech than non-disabled children.

Noise conditions. Loud environments almost always have a negative impact on a listener's understanding of speech. However, researchers have found that noise has a more deleterious effect on the intelligibility of DECtalk than on natural speech. Even when the signal-to-noise ratio is just +10dB, DECtalk voices become less intelligible.

EXQsure to synthetic speech. Communication partners seem to adjust to the accents of high quality speech listeners. Thus, repeated listening opportunities are likely to improve a listener's understanding of synthetic speech. David McNaughton and colleagues confirmed this for the Kit the Kid voice on DECtalk over five trials. However, they also reported that even after repeated listening experiences, the less sophisticated Echo synthesizer was not effective in classroom situations.

Summary

To summarize, most listeners are able to understand the high quality speech synthesizers of today's communication devices. This confirms the efficacy of using DECtalk and, perhaps, other high quality speech synthesizers in AAC devices for social communication. However, individuals with hearing impairments, non-native speakers of a language, persons with language impairments who have mental retardation, younger children and older adults have more difficulty understanding synthesized speech than natural speech, even in optimized conditions.

Current research clearly suggests that a number of strategies can improve the intelligibility of synthetic speech: (1) repeated listening opportunities; (2) placing pauses between words; (3) decreasing the rate of speech output, particularly for complex material; and (4) using additional amplification in noisy environments.
Beyond Intelligibility

Intelligibility, although crucial, is not the only feature of speech output technology. Voice characteristics such as gender, age, prosody, inflection and naturalness must be considered as well as access to different languages. An important research agenda is beginning to emerge. Some researchers are examining the impact that VOCAs have on the real lives of AAC users.

Today's claims that VOCAs enhance daily communication skills are based primarily on face validity, rather than on experimental research. We know, for example, that people who use VOCAs can give lectures, get jobs, be barmitzvahed, talk on the phone, participate in group discussions, sing, tell jokes and so on. Few studies, however, systematically examine the effects of using speech output devices on users' communication and life in different environments. Also, few studies have compared the use of VOCAs to other AAC methods. Some examples of this research on the functional use of VOCAs are briefly summarized below:

Buzolich showed that synthesized speech assisted individuals who use VOCAs to be more dominant as in control of conversations.

Iacono reported that a young child learned "words" more quickly when signs were accompanied by speech output.

Soto, Belfiore, Schlosser, & Haynes demonstrated that VOCAs positively affect the user's acquisition of request functions and preferences.

Romski & Sevcik's longitudinal research led them to hypothesize that speech output helped students with severe mental retardation to learn graphic symbols.

Schlosser, Belfiore, Nigam, Blischak & Hetzroni found that, in fact, use of a VOCA results in more efficient graphic symbol learning for some young adults with severe/profound mental retardation.

Schepis and Reid reported that the frequency of interactions between a young woman and support personnel increased when the woman used a VOCA to request desired items.

Schlosser, Blischak, Bartley and Barnett examined whether the use of speech output and orthographic feedback had an effect on spelling in a student with autism. Results showed that speech output was effective in combination with orthographic feedback and by itself. They concluded that speech output, while not essential, appeared to increase the efficiency of the child learning to spell familiar words.

The future

Today's VOCAs can allow individuals who are unable to speak to be understood by most other people. They can also enhance daily communication under a variety of conditions and can make learning more efficient for some individuals. However, at this time, speech synthesis does not yet allow AAC users to express nuances of emotion, personality or individuality. Future advances in these areas await further research and development.

We can, however, conclude from the research that when purchasing a VOCA, consumers need to consider both the variety of their communication partners and the ways in which they plan to use speech output. It is necessary to demonstrate the advantages of speech output across contexts.

Administrators and funding agencies will soon be asking for proof that the time and money invested has a positive cost benefit. Researchers can help demonstrate the efficacy of VOCAs in specific contexts (as compared to other AAC approaches) and ways in which VOCAs increase participation, productivity, and quality of life in the community, at home, in school, and at work.
communication with teachers and peers within the learning environment. (e) Improvement in teachers' perceptions of the learning ability of students who use AAC. (f) Increase in teachers' feeling of competence when working with students who use VOCAs.

Setting. School, clinical settings.

Target Populations. Individuals who use AAC devices and are developing literacy skills.

Technology. Dynavox 2C, DynaMyte and other VOCAs with high-quality text-to-speech synthesis.

Description of Intervention. This program adapts student's VOCAs for use with an appropriate reading program. Civils and her colleagues are currently using Project Read: Phonology, a research-based, multi-sensory approach for students who have difficulty mastering the code of written English by traditional or whole language programs. However, they say that for students who already have phonological awareness and linguistic skills, any traditional or whole language reading program could be utilized.

Civils reports the case example of an eight-year-old boy with chromosomal anomalies, who is nonspeaking and developmentally delayed. He had minimal phonemic awareness and very limited literacy skills. Over a six month period, he has progressed. The special education teacher (Marie Williams) sees him for two, 30 minute sessions per week.

A speech-language pathologist (Carol Civils) provides consultation during one of the sessions, and sees the child for a third session to focus on interactive storybook activities that reinforce his literature-based program, which is supplemented with a structured presentation of skills using Project Read materials. In addition to his VOCA, which has a page for sound-symbol associations, he sometimes uses a computer for writing and reading and other multi-sensory methods, such as finger spelling and special signs.

He is currently on Unit 2 of Project Read: Phonology, and has learned the vowel phoneme (short /a/) and consonant phonemes (t,s,m,b,c,f,r,h,j,l,p,n) in the initial position of words. Civils set up the Dynavox keyboard so it contained all the letters he needed. When he presses a letter button, the device "says" the correct phoneme. If the child presses a sequence of letters, the device says the correct syllable, word, and so on. The Dynavox screen shows the correct grapheme(s). To hear the sound sequences, he presses the message bar. In addition, he uses a generic conversational pop-up page so that he can communicate everyday messages while they are working on Project Read materials. He uses a dictionary page to "search" for words. When the VOCA is connected to a printer, he prints his work in a font size and color that meet his preferences and need for visual clarity.

Civils reported that she uses additional pages so he can build phrases and sentences, as part of activities related to the short books he reads daily.

Results. Using a VOCA allows this child to hear and see the sound letter relationships his peers are learning in school. His special education teacher reports, "it is easy to teach students to read using a VOCA. It allows them to respond the same as any other student." Table VI documents some of the changes noted after six months of systematic literacy instruction supplemented by specific training in phonemic awareness. This child is eager to read and is beginning to use invented spelling. And yes, his phonemic awareness skills have improved dramatically.

Table VI. Using a VOCA to teach phonemic awareness: A case example

<table>
<thead>
<tr>
<th>Improved skills in reading and writing:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>can sequence three letters on VOCA and computer to produce words; sequencing 3+ letters to produce sentences.</td>
<td></td>
</tr>
<tr>
<td>Demonstrates comprehension by making appropriate comments, and using pop-up pages.</td>
<td></td>
</tr>
<tr>
<td>Enters class eagerly motivated to read and communicate; demonstrates pleasure at his successes.</td>
<td></td>
</tr>
<tr>
<td>Uses device appropriately to get from vocabulary pages to keyboard pages for spelling.</td>
<td></td>
</tr>
<tr>
<td>Uses invented spelling.</td>
<td></td>
</tr>
</tbody>
</table>

![Table VI](https://example.com/table.png)
REFERENCES


4. Edie Thayer and Tracy Bombara. (December, 1997). Personal communication.


9. Project Read - Phonology. Available through Language Circle Enterprises, P.O. Box 20631, Bloomington, MN 55420.


12. Donald Fuller, (December, 1997). Personal communication.


14. Donald Fuller, (December, 1997). Personal communication.


RESOURCES

Tracy Bombara, Easter Seals Rehabilitation Center, 630 West Division Street, East Dover, DE 19904. (Phone) 302-678-3353.

Carol Civils, Children's Developmental Center, United Way Agency and UCPA Affiliate, 4805 College Drive, Baton Rouge, LA 70808 (Phone) 504-923-3420. (Fax) 504-922-9316.

John Costello, Communication Enhancement Center, Children's Hospital, 300 Longwood Avenue, Boston, MA 02115 (Phone) 617-355-8392, (Fax) 617-355-6882. (Email) costello-j@al.tch.harvard.edu.

Donald Fuller, University of Arkansas-Little Rock, Audiology-Speech Department, 2801 South University Avenue, Little Rock, AR 72204. (Phone) 501-569-3155, (Fax) 501-569-3151, (email) dfuller@uair.edu.


Ralf Schlosser, Bloorview MacMillan Centre and University of Toronto, 350 Rumsey Road, Toronto, ON M4G IR8, Canada.

Edie Thayer, Vigeland Public School, 625 Plum Street, Vineland, NJ 08360. (Phone) 609-794-6767. (email) Thayer-eric@algosystems.com.

In addition to people mentioned above or in the issue, the following people responded to my requests for help. Thanks to you all:

List of AAC speech output devices mentioned by those interviewed in this issue

<table>
<thead>
<tr>
<th>Name of Devices</th>
<th>Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boardmaker</td>
<td>Mayer-Johnson Company</td>
</tr>
<tr>
<td>LightWriter, Macaw, Giant Green Macaw 2+</td>
<td>Zygo Industries</td>
</tr>
<tr>
<td>Dynavox 2C, Dynamyte</td>
<td>Sentient Systems Technology</td>
</tr>
<tr>
<td>Big, Mac; One Step, Jelly Bean Switch,</td>
<td>AbleNet, Inc.</td>
</tr>
<tr>
<td>Universal Switch Mount</td>
<td>Words+, Inc.</td>
</tr>
<tr>
<td>Message Mate, Talking Screen</td>
<td>TASH, Inc.</td>
</tr>
<tr>
<td>Microswitches</td>
<td>Prentke Romich Company</td>
</tr>
<tr>
<td>Liberator, Delta Talker, Alpha Talker,</td>
<td>Radio Shack</td>
</tr>
<tr>
<td>TouchTalker, IntroTalker</td>
<td>Toys for Special Children</td>
</tr>
<tr>
<td>Voice Recording Picture Frame</td>
<td></td>
</tr>
<tr>
<td>CheapTalk 4 and 8</td>
<td></td>
</tr>
</tbody>
</table>