

## Upfront



This issue is about **visual scene displays (VSDs)**. VSDs look different from our typical AAC displays and are meant to be used in slightly different ways to support the communication process. Before reading further, you might be well advised to browse through the illustrations on the various pages of this issue, to get a quick sense of what the displays we'll be discussing actually look like.

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Welcome back.

Visual scene displays (VSDs), like other types of AAC displays, may be used to enhance communication on either low-tech boards or high-tech devices. The VSDs described in this issue are meant primarily to address the needs of beginning communicators and individuals with significant cognitive and/or linguistic limitations. These groups are unserved or underserved by current AAC technologies.

VSDs are designed to provide a high level of contextual support and to enable communication partners to be active and supportive participants in the communication process. Take, for example, a VSD showing a photo of picnic tables and family members eating, drinking and having fun at a reunion. If used on a low-tech board, the photo provides a shared context for interactants to converse about topics related to the reunion. When used on an AAC device, spoken messages can be embedded under

related elements in the digitized photo. These are known as "hot spots." Someone with aphasia may use a VSD to converse with a friend by touching hot spots to access speech output, *e.g.*, "This is my brother Ben," or "Do you go to family reunions?" Or, a three-year-old child with cerebral palsy may tell how "Grandpa" ate "marshmallows" at the reunion by touching the related "hot spots" on her VSD.

My thanks to David Beukelman, Kathy Drager, Jeff Higginbotham, Janice Light and Howard Shane for their generous help in preparing this issue. These researchers are collaborators in the AAC-RERC (Rehabilitation Engineering Re-

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## Clinical News



### Visual scene displays

Decades ago, people who were unable to speak (or write) had to rely solely on their impaired speech and other natural methods of communication. This led to frustration for both the individuals and their communication partners. During the 1970s and 1980s, the disability rights movement, new laws and new public policies brought children with severe physical, communication and cognitive disabilities into their neighborhood schools and gave adults who had been sequestered at home or living in institutions the means to move out into their communities.

Concurrently, teachers, therapists, family members and advocates found ways for individuals with limited

speech and language skills to communicate, by providing a growing range of AAC techniques and strategies, such as manual signs, gestures, pictures and graphic symbols. By the mid 1980s, the field of AAC had been firmly launched.

Today we have machines that "talk" and a growing cadre of professionals and advocates working to provide functional communication to people with complex communication needs. The AAC community has helped pave the roads to education, employment and community participation. AAC techniques,

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strategies and technologies have enabled some people with severe communication impairments to fulfill the same social roles as their nondisabled peers and to pursue their personal goals and dreams. However, many people who have complex communication needs are still not benefitting from AAC technologies.

### Current AAC technologies

Simple AAC devices enable users to express a small number of messages. While useful, the messages are typically restricted to a few preprogrammed phrases. Other devices are more complex and have dictionaries of symbols to represent language, an ability to store and

retrieve thousands of messages, colorful displays, intelligible voice output with male and female voices, multiple access options, environmental controls, Internet access and rate enhancing strategies.

A common complaint about complex AAC devices, however, is they are difficult to use and time consuming to learn. Research and clinical experience suggest that AAC technologies often place enormous cognitive demands on the individuals who use them. For example, current AAC devices that are available to

Traditional grid display



Visual scene display



Figure 1. Contrasting types of AAC displays

beginning communicators and individuals with cognitive and linguistic limitations are comprised of isolated symbols, whose meaning must be learned. These symbols are typically arranged in rows and columns. Users must navigate through pages and pages of symbols to retrieve phrases or words to construct meaning, or they must learn to use coding strategies (abbreviation expansion, semantic compaction, Morse code). The cognitive demands of these approaches make learning time-consuming. Some people manage to master these systems, but many do not.

### Visual scene displays

Advances in mainstream technologies (e.g., miniaturization, multi-functionality, storage capacities, processing speed, video, photo and voice capabilities, locator functions) offer options that may better address the requirements of people with complex communication needs who have, until now, been unserved or underserved by AAC technologies. One approach researchers are currently investigating—visual scene displays (VSDs)—may be particularly helpful to beginning communicators and individuals with cognitive and linguistic limitations. VSDs offer a way to (1) capture events in the individual's life, (2) offer interactants a greater degree of contextual information to support interaction

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search Center on Communication Enhancement). [[www.aac-rerc.com](http://www.aac-rerc.com).] They are committed to improving the design of AAC technologies so devices become more intuitive, user friendly and (bottom line) easier for people with complex communication needs to learn and to use.

**Clinical News** briefly explores why visual scene displays (VSDs) may be particularly useful to young children and individuals with cognitive and linguistic limitations. In addition, this section defines VSDs, their features and potential applications. **Beginning Communicators** summarizes completed research projects at Pennsylvania State University documenting the difficulties children with typical development have using AAC technologies. It also describes a current Penn State project that features VSDs to support the language and communication development in young children with severe communication impairments. **Adults with Aphasia** summarizes

work underway at the University of Nebraska and describes ways in which VSDs support the social conversations of individuals with severe aphasia. **Other Applications of VSDs: Beyond Conversation** discusses ways VSDs can support learning, offer prompts and provide information. It highlights a research project underway at Children's Hospital Boston that is exploring ways to use VSDs with children on the autism spectrum.

Most of the technologies discussed in this issue are still prototypes. Even so, the ideas and approaches described herein can already be creatively put to use.

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and (3) enable communication partners to participate more actively in the communication process.

Visual scene displays (VSDs) portray events, people, actions, objects and activities against the backgrounds within which they occur or exist. These scenes are used as an interface to language and communication. A VSD may represent

- a generic context (*e.g.*, a drawing of a house with a yard, an office with workers or a school room with a teacher and students.) [See Figures 10 to 13.]
- a personalized context (*e.g.*, a digital photo of a child playing in his bedroom or a picture of the family on a beach while on vacation.) [See Figures 3 to 9.]

Note: A VSD may also have animated elements (*i.e.*, intelligent agents) that can move around a scene. [See Figure 13.]

### Differences between VSDs and grid displays

Figure 1 illustrates and Table I contrasts some of the variables that differentiate traditional AAC grid displays from visual scene displays: (a) primary types of representation used (*e.g.*, photos, symbols, letters); (b) extent to which the representations are personalized (*e.g.*, involve the individual in the scene, are familiar or generic); (c) how much context is provided in the representation (*e.g.*, low=isolated concepts; high=concepts provided in a personal photo); (d) type of layout (*e.g.*, grid, full scene, partial scene, combination grid and scene); (e) how displays are managed (*e.g.*, menu pages, navigation bars); (f) how concepts are retrieved (*e.g.*, by selecting a grid space, pop ups, hot spots, speech keys) and (g) primary uses of the display (*e.g.*, communication of wants/needs, information ex-

Variables	Traditional grid displays	Visual scene displays
Type of representation	Symbols Traditional orthography Line drawings	Digital photos Line drawings
Personalization	Limited	Involve individual Personalized Generic
Amount of context	Low	High
Layout	Grid	Full or partial Scene Combo (scene & grid)
Management of dynamic display	Menu pages (symbols represent pages)	Menu pages (scenes represent pages) Navigation bars
Retrieval of concepts	Select grid space Pop ups	Hotspots Select grid space Speech keys
Functional uses (primary)	Communication (Wants/needs, Information exchange)	Conversational support Shared activity Social interaction Learning environment Communication (Information exchange, social closeness, wants/needs)

change, conversational support, social interaction, social closeness).

Both VSDs and grid displays can be used on low- and high-tech devices. Traditional AAC displays are configured in grids, most often in rows and columns, with elements comprised of individual graphic symbols, text and/or pictures arranged on the display according to specific organizational strategies (*i.e.*, by category, by activity, alphabetically, or idiosyncratically). The elements on a grid display are decontextualized so that users can construct desired messages on numerous topics using the same symbols.

In contrast, the elements of a VSD are components of a personalized or generic scene, *i.e.*, pictured events, persons, objects and related actions, organized in a coherent manner. As such, the display provides a specific communication environment and a shared context within which individuals can tell stories, converse about a topic, engage in shared activities and so on. VSDs also enable communication partners to assume a supportive role, if needed, to make interaction easier for beginning communicators and individuals with cognitive and linguistic limitations.

Contributors to this issue (Beukelman, Light and Drager, Shane) currently are investigating various features of VSDs to determine which can best meet the needs of different population groups, including young children with complex communication needs, children with autism and adults with aphasia.

**Current applications of VSDs**  
Depending upon the age and cognitive and linguistic needs of the individual using the display, VSDs can be configured to serve several purposes.

**1. Stimulate conversation between interactants.** Adults with aphasia and very young children often find it difficult to have conversations because of their limited language skills. Yet, within a shared context and with a skilled communication partner, conversations can occur. For example, a man with severe aphasia, still has much to share with his friends. Using a VSD with digitized photos of his trips and family activities, he can set topics, converse and navigate between topics when a friend comes to visit. [See Figure 7.]

**2. Support play, share experiences and tell stories.** Bill wants to play with his toy farm, so his Mom finds the page on his AAC system that has a large photo of them playing with the farm. Bill touches the part of the photo that has the bucket of feed that the farmer is carrying. Bill's touch retrieves the speech output "feed." His Mom gets the farmer and waits. Bill then touches the cow in the photo to retrieve the speech output "cow". His Mom touches the farmer, the feed and the cow in sequence and then says, "Oh, the farmer's going to feed the cow," and acts it out. [See Figure 3.]

**3. Facilitate the active participation of interactants during shared activities.** In this application, the activity is "in" the VSD. For example, Joe and his mom read the scanned pages from *Brown Bear, Brown Bear*, or sing "Old MacDonald had a farm" using a picture of a farm with various stanzas of the song. [See Figure 4.]

**4. Provide instruction, specific information or prompts.** Many

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children with autism are drawn to electronic screen media (e.g., videos, DVDs, TV) and, therefore, may find VSDs engaging. An animated character, known as an intelligent agent, may be useful in teaching language concepts or prompting the use of speech to label objects, activities and attributes. [See Figure 13.]

## Potential benefits of VSDs


VSDs are personalized, create a shared context, provide language in context and enable partners to assume more responsibility during interactions. They also shift the focus away from the expression of wants and needs toward social interaction and the exchange of ideas and information. VSDs can be highly personalized, which is important for young children learning language and can be helpful for others as well (e.g., individuals with aphasia, autism, Down syndrome, etc.) VSDs may reduce cognitive demands, make learning easier and offer beginning communicators and individuals with limited cognitive and linguistic skills immediate success. Researchers report that very young children and individuals with aphasia and autism have required minimal, if any, instruction before using devices configured with VSDs to communicate.

Persons who rely on conventional AAC technology may also benefit from VSD support of their conversational interactions in much the same ways that typical speakers use photo albums to support their communication. For example,

Tom relies on AAC technology because his speech is largely unintelligible as a result of amyotrophic lateral sclerosis. When he takes a trip or goes to an event, his family takes digital photographs and develops a simple slide show. When meeting with friends, the family runs the slide show in the background on a portable computer. His guests often take a couple of moments to view the show before talking with Tom. If his AAC technology contained

VSD capability in addition to spelling, word prediction and message retrieval, he would probably interact more easily and effectively.

AAC-RERC researchers are striving to inform the field about the ways in which VSDs and hybrid (combination of grid and VSD) displays are effective with specific populations. They are observing the impact of VSDs on early language/concept development and on social

interaction. Neither the current nor the potential value of ongoing VSD research and development should be underestimated. By continuing to explore the many unanswered questions about VSDs, their configurations and their uses, these pioneering researchers are opening new windows of communication opportunities for individuals we don't yet serve very well. 

## Beginning Communicators



### Penn State projects

For all children, early childhood represents a crucial development period. Very young children at risk for severe communication impairment especially need the earliest possible access to AAC strategies and tools to support their language and communication development during a critical period of growth. The need for this support, while widely accepted, is exceptionally difficult to achieve.

### Difficulties with current AAC technologies

A research team at Pennsylvania State University (PSU), led by Janice Light and Kathy Drager, has been investigating techniques (1) to increase the appeal of AAC technologies for young children and (2) to decrease the learning demands on young children who can benefit from AAC technologies. The results are summarized below.

Increasing the appeal of AAC technologies. Researchers and clinicians have noted that young children without disabilities do not find current AAC devices particularly appealing. To investigate these observations, researchers at PSU asked groups of children to design

an AAC device for a hypothetical younger sibling who was unable to speak. The designs of typically developing children (ages 7-10) did not

resemble the box-like, black/gray design of current AAC technologies. The devices these children developed were colorful, multifunctional and easily embedded into play activities.

Decreasing the learning demands of AAC technologies. The PSU research team also investigated ways to reduce the learning demands of AAC technologies by redesigning the representations of language concepts, their organization and their layout.

Representation. Researchers hypothesized that popular AAC symbol sets are not meaningful to very young children because the symbols are based on adult conceptual models. Results confirmed the hypothesis. When asked to draw pictures of words representing nouns, verbs, interrogatives, etc., typically developing four- and five-year-old children (independent of cultural and language group) did not draw parts of objects or events as is common in AAC symbol sets. Rather, they drew personalized scenes that involved themselves and other people engaged in meaningful activities. For example, most chil-

dren drew “who” by showing two figures together (a parent and child) in the foreground and the figure of a stranger in the background. This representation is very different from any of the symbols typically used on AAC displays to mean “who.”

**Organization.** Researchers hypothesized that AAC device displays are not organized in ways that reflect how young children think. Findings confirmed the hypothesis. Young children without disabilities do not group symbols in pages by category, by activity, alphanumerically or idiosyncratically, although these are the organizational strategies currently used on AAC devices and low-tech displays.

When typical children were asked to organize a set of 40 AAC symbols by grouping them, they sorted the symbols into pairs or small groups, not into large groups or pages. Also, more than 80 percent of the time, they sorted according to an activity-based (schematic) organization (*i.e.*, grouping together the people, actions, objects and descriptors associated with bedtime, mealtime or shopping). They rarely grouped symbols based on taxonomic categories (*i.e.*, food, people, toys or actions). Today’s AAC displays typically organize symbols on multiple pages, often in taxonomic categories.

**Learning to use AAC devices.** PSU researchers hypothesized that the cognitive demands of current AAC devices are well beyond what most young children without disabilities can handle. They investigated the extent to which 140 typically developing children grouped by age two years (N=30), three years (N=30), four years (N=40) and five years (N=40) could learn to use AAC devices to communicate during a familiar play activity (a birthday party theme). Each child

received 1.5 to 2.5 hours of instruction over four sessions: three training sessions and a generalization session. All participating children had normal cognitive, language and sensory motor abilities.

Researchers investigated the effects of different display organizations and layouts on learning. The AAC devices used in the study were configured with four types of displays. The systems under investigation necessarily differed in relation to the types of representations used as well. The taxonomic grid and schematic grid conditions used DynaSyms™. The iconic encoding technique represented language concepts using standard icon sequences from Condensed Unity™ software. The visual scene display condition used scenes representing a birthday party. [See Figure 2.] The conditions were:

1. **Taxonomic grid display.** Target vocabulary items were organized on four pages (5 x 4 grid with approximately 12 to 20 symbols per page). The Dynavox™ with Dynasyms™ was used. Items were grouped taxonomically so each page represented a category: people, actions, things, social expressions. A total of 60 symbols were available. There was a menu page to allow the children to select one of the four pages.
2. **Schematic grid display.** Targeted vocabulary items were organized on four pages (5 x 4 grid with approximately 12 to 20 symbols per page). The Dynavox™ with Dynasyms™ was used. Items were grouped according to event schema associated with the

birthday party (arriving at the party, eating cake, opening presents, playing games). A total of 60 symbols were available. There was a menu page to allow the children to select one of the four pages.

3. **Visual scene display (VSD).** Targeted vocabulary was organized on four pages of the Freestyle™ system using Companion™ software. Each page represented events related to a birthday party that occur within different scenes in a house: (1) arriving at a birthday party in the living room, (2) playing games in the play room, (3) eating cake in the kitchen and (4) opening presents in the family room. Scenes were drawn by a student in graphic design and were generic rather than personalized. Sixty vocabulary items were preprogrammed under “hot spots” in the scenes. There was a menu page to allow the children to select one of the four scenes.

4. **Iconic encoding.** The Condensed Unity™ software on the Liberator™ was used. A total of 60 vocabulary items were stored in two icon sequences. Forty-nine symbols were organized on a single page.

[Note: All four conditions required the children to make two selections to retrieve target vocabulary.]

During four intervention sessions, an effort was made to teach each child to use between 12 (two-year-old group) and 30 (five-year-old group) symbols out of the 60 available vocabulary items. Thirty concrete concepts and 30 abstract concepts were included in the corpus. Ten children from each age group participated in each of the conditions. Children ages two and three participated in three conditions. Children ages four and five participated in four conditions.

## Results

Findings across the studies confirmed that all children learn concrete symbols more readily than abstract symbols. Even so, no group performed well during the initial session, suggesting that current

### Figure 2. Device used for each condition

- 1 and 2. Dynavox™ device with DynaSyms™ (taxonomic and schematic grid conditions)
3. Companion Software™ on the Freestyle System™ (visual scene display condition)
4. Liberator™ with Condensed Unity Software™ (iconic encoding condition)

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technologies are not transparent to young children under the age of six. The studies confirmed that typical children experience significant difficulties learning to use AAC devices as they are currently designed and configured.

**Two year olds** performed poorly across all learning sessions, showed limited progress across all conditions and demonstrated no generalization. However, they did significantly better locating the 12 vocabulary items taught in the VSD condition than they did in the taxonomic or schematic grid conditions. [Note: They did not participate in the iconic encoding condition.]

**Three year olds** performed somewhat better than the two year olds after the initial learning session. Overall, they made limited progress learning to use the 18 targeted symbols. Similar to the two year olds, they did better using VSDs than the grid layouts. A few showed some evidence of generalization to new vocabulary. [Note: They did not participate in the iconic encoding condition.]

**Four- and five- year-old children** learned a greater number of symbols in the dynamic display conditions (grids and VSDs) than they did in the iconic encoding condition, and they generalized to novel vocabulary items except in the iconic encoding condition. By the final learning session, four-year-old children were performing with a mean of 67% accuracy (16 of 24 items correct) in the taxonomic grid condition; 62% accuracy (14.8 of 24 items correct) in the schematic grid condition; 66% accuracy (15.8 of 24 items correct) in the VSD condition; and 14% accuracy (3.4 of 24 items correct) in the iconic encoding condition. Five-year-old children were performing with a mean of 80% accuracy (24.1 of 30 items correct) in the taxonomic grid condition; 79% accuracy (23.8 of 30 items correct) in the schematic grid condition; 71% accuracy (21.4 of 30 items correct) in the VSD condition and 27% accuracy (8.1 of 30 items correct) in the iconic encoding condition.



Figure 3a. Visual scene display: A Fisher Price® farm toy.

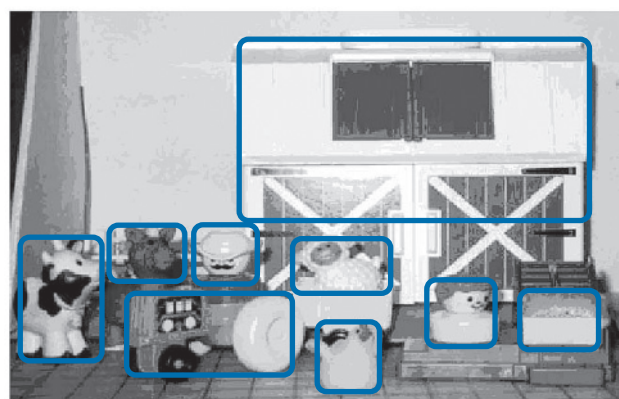


Figure 3b. Shows hot spots where language is embedded.



In summary, while typical four- and five-year-old children learned to use AAC devices to communicate, they did so quite slowly. Two- and three-year-old children were not successful and really struggled. The younger children performed significantly better using VSDs than either grid display but did not perform well. The researchers hypothesized that the VSDs might have been more effective if they were personalized to each child's experiences. No child in the study under six performed well using iconic encoding. During the generalization session, most of the children did not choose to use devices despite being prompted to do so. Researchers concluded that typical children under the age of six have difficulty learning to use current AAC technologies. Thus, it is essential that researchers and

developers design devices for beginning communicators that (1) children find appealing and (2) support, rather than overcomplicate, the use of AAC technologies. Devices for young children must present and organize language in developmentally appropriate ways.

### Designing new AAC technologies

Janice Light, Kathy Drager and other members of the PSU research team are now conducting a longitudinal research project to design features of AAC technologies for children that will reduce learning demands and create

new opportunities for language learning and communication success. The team has incorporated findings from their previous research and are using personalized VSDs in conjunction with instructional strategies tailored to meet the needs of each participant in their research.

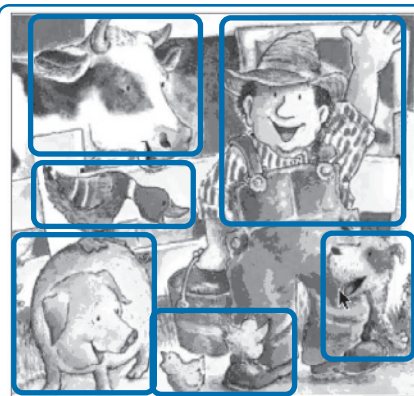


Figure 4. "Old Macdonald had a Farm." Shows hot spots where language is embedded.





Study #1 focuses on children with developmental disabilities (ages one to three). A spin-off study targets older children with autism spectrum disorder. These studies are underway.

Study #2 targets older children or adolescents with significant cognitive impairments. This study has not yet begun.

The device prototype for the VSDs is Speaking Dynamically Pro™ on the Gemini® and Mercury® devices. Researchers are measuring a number of variables at baseline (*i.e.*, rate of vocabulary acquisition, frequency of communicative turns and range and type of communicative functions expressed) and then periodically documenting the children's progress in these areas over time.

Figures 3, 4, 5 and 6 show examples of personalized VSDs. [Note: The digital photos that comprise the VSDs typically have the child and family members in them. However, because of privacy issues, these particular scenes do not.]

Figures 3a and 3b show the VSD of a child's favorite Fisher Price® toy. Figure 3a shows what the child sees and Figure 3b shows where language is embedded under "hot spots." The scene is designed to support play and language development, *i.e.*, the use of single words and/or two or three word combinations.

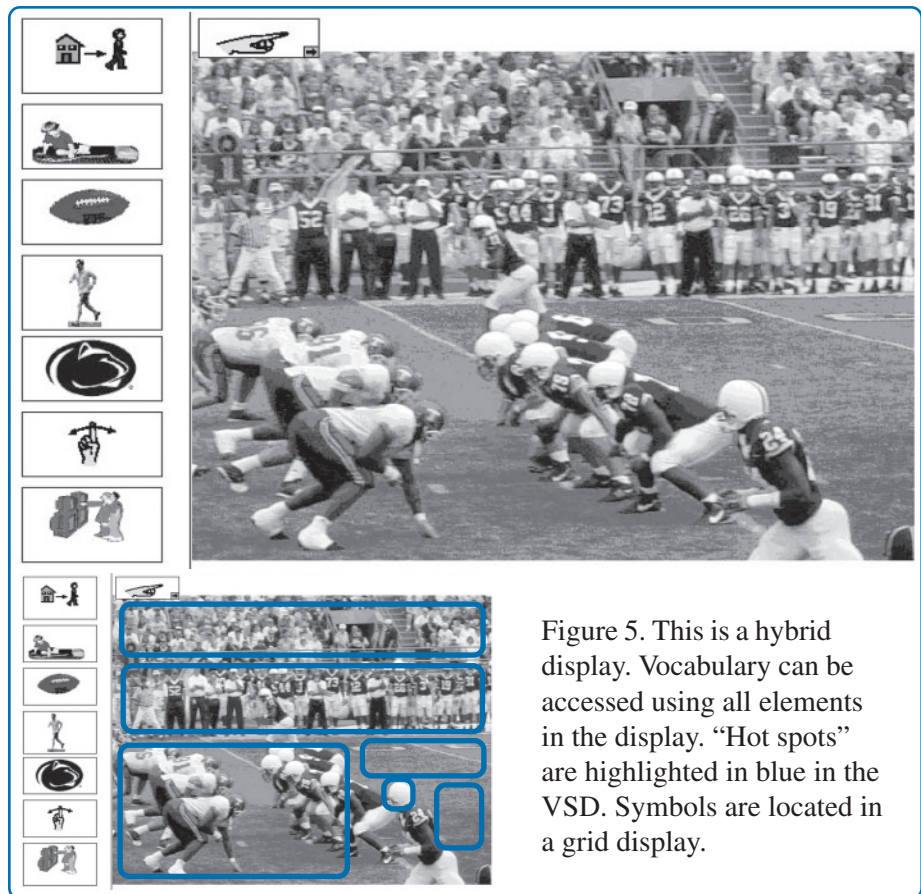


Figure 5. This is a hybrid display. Vocabulary can be accessed using all elements in the display. "Hot spots" are highlighted in blue in the VSD. Symbols are located in a grid display.

The child touches the cow on the VSD to retrieve speech output "cow." The clinician might then say, "Where do you want the cow to go?" and pause. If the child does not respond, the clinician might touch the barn and the device would say, "barn." Then the clinician could select cow and barn and say, "the cow walks in the barn," and walk it into the barn.

Songs and stories can build joint attention, an important component of language development. In Figure 4 the VSD represents the song, "Old Macdonald had a farm."

The parent touches the farmer and the device sings the refrain "Old Macdonald had a farm E I E I O." The parent might then sing, "On his farm he had some . . ." and pause. The child touches the pig and the device sings "Pigs. E I E I O. With an oink, oink here and an oink, oink there..." Through modeling and expectant pauses, the parent and child have fun participating in this shared activity, using language.

In Figure 5, the scene is a digital photo of a college football game. The child accompanies her parents to the PSU games and has become quite a fan.

The child touches the "hot spot" where the fans are sitting, which starts the cheer, "We are Penn State!"

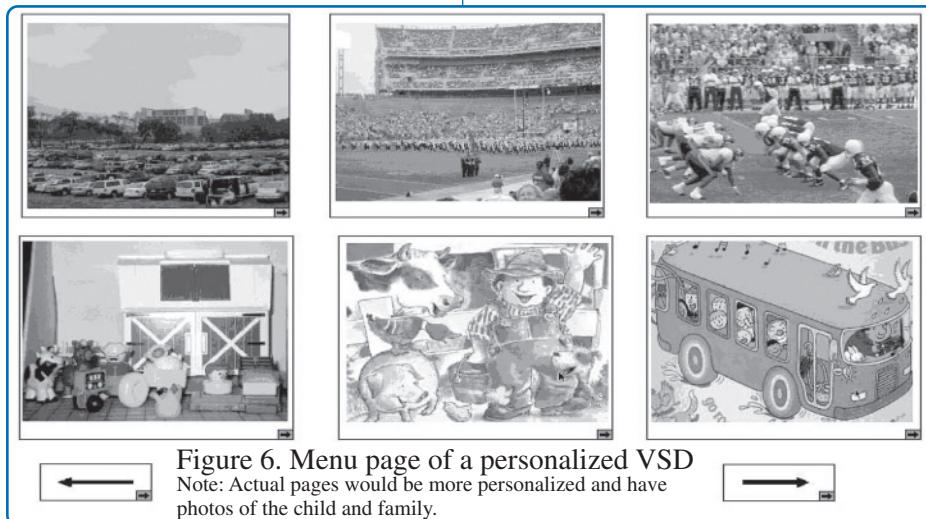


Figure 6. Menu page of a personalized VSD  
Note: Actual pages would be more personalized and have photos of the child and family.

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Along the left side, additional symbols enable the child to ask questions or make comments, *e.g.*, “What’s that?” “Touchdown!” These additional symbols introduce the use of grid displays, while continuing to offer important contextual support.

Figure 5 shows a menu page, which enables a clinician, family member and ultimately the child to navigate through a child’s system.

### **Instructional strategies**

Longitudinal data are presently being collected on eight young children. According to Janice Light, “None of the eight children with severe disabilities enrolled in the study uses an AAC device only.” Researchers encourage the use of multi-modalities (*e.g.*, gestures/signs, eye pointing, facial expression, low tech, high tech and speech) and are designing systems to support language learning and concept development. Light said, “Children are not being asked to ‘show me’ or ‘tell me’ and are not tested.” Instead, clinicians are modeling the use of low-tech and high-tech VSDs to support interactions during play and shared activities. Light reported that the children regularly use their VSDs during solitary play, as well as when they are communicating with others.

### **Preliminary data**

While preliminary, these longitudinal data are very encouraging. Two examples follow:

**Child #1 at baseline.** Prior to intervention, a 25-month-old boy with severe cerebral palsy, a tracheostomy and a feeding tube had no vocalizations or speech approximations and used no signs or gestures. However, his mother had created approximately 25 digital photos of toys he liked, which he used to request objects when offered a choice between two toys.

During the baseline session, he expressed one concept or less per 5 minutes of interaction, requesting objects only.

**Child #1 at followup.** After 12 weeks of intervention (1 hour per week), the child had acquired more than 400 words/concepts. He started by using VSDs, but has also learned to use grid displays as well. Data show he is increasing his vocabulary by four or five words per day.

He expressed more than 12 concepts during five minutes of interaction, ten times more than he did during the baseline session. In addition, he spontaneously combined concepts using two- and three-word utterances and expressed a variety of semantic relations (agent, action, object, locative, quantifier, descriptors, questions). He requested objects and actions, initiated and sustained social interaction with adults and was beginning to share activities with peers and to comment and share information.


**Child #2 at baseline.** Prior to intervention, this 29-month-old boy with Down syndrome used fewer than ten spoken word approximations and had fewer than ten signs. He expressed less than one concept per minute during the initial session and less than 20 words or concepts during a 25 minute baseline period. Mostly, he used nouns.

**Child #2 at followup.** After seven months of intervention (one hour per week), this 36-month-old boy was using 1,210 words via speech, signs, light-tech and high-tech AAC. His vocabulary had increased by more than five words per day. He used VSDs initially and, later, grid displays. He also relied on signs, gestures and speech to express more than 10 words per minute and more than 250 words in 25 minutes. This was ten times his baseline rate.

In addition, he was using a variety of semantic relations: agent, action, object, locative, demonstrative, possessor, quantifier, instrumental and asking questions.

### **Comment**

To date, the PSU research team reports that all children in the study have been able to use VSDs on initial introduction and they continue to be engaged, active, interested and motivated to use their AAC systems. Also, interactions last longer and involve social routines and commenting, not just requesting. The children are using their systems independently during play and learning activities.

Light cautioned, “Preparing existing devices to use VSDs requires programming that is very time consuming and means the coordination of a lot of hardware and software.” She also pointed out that because of the children’s rapid rates of vocabulary acquisition, it is critical that new vocabulary be regularly added to the systems. As a result, clinical support is intense. Identifying vocabulary needs and designing pages is done in collaboration with the family, with the clinical support managed through a collaborative effort with parents, clinicians, PSU students and volunteers. 

This research reflects the dedicated work of Penn State students: Katherine Bercaw, Brianne Burki, Jennifer Curran, Karen D’Silva, Allison Haley, Carol Hammer, Rebecca Hartnett, Elizabeth Hayes, Lisa Kirchgessner, Line Kristiansen, Heather Larson, John McCarthy, Suzanne Mellott, Jessie Nemser, Rebecca Page, Elizabeth Panek, Elizabeth Parkin, Craig Parrish, Arielle Parsons, Sarah Pendergast, Stacy Rhoads, Laura Pitkin, Maricka Ward, Michelle Welliver and Smita Worah.



## Adults with Aphasia



device that will increase the ability of adults with aphasia to engage in conversations and maintain their social roles.

### Nebraska project

A research team at the University of Nebraska, led by David Beukelman, Susan Fager, Karen Hux and Jamie Carlton, has studied the acceptance of AAC technologies by people with acquired disabilities, including those with aphasia. The team has found that people with aphasia, their communication partners and clinicians who provide aphasia therapy are underwhelmed by AAC devices. In part, this reflects the cognitive and linguistic demands of current AAC technologies, which can magnify the difficulties people with severe aphasia have generating language.

When adults with aphasia use AAC technologies, they typically do something very specific, such as make a phone call or request assistance. While using the telephone, stating one's needs and asking for something are important communication functions, they do not begin to address the reasons most adults want to communicate. Engaging in "small talk," telling stories, sharing ideas and information, discussing current events and gossiping about family and friends are the fodder for adult interaction. When someone cannot participate in this kind of communication, their social circles begin to shrink, and they are at risk for increasing isolation. Thus, to meet the needs of this population an AAC device must have built-in ways to support these important conversational functions.

This article describes the ongoing effort of researchers at the University of Nebraska to create an AAC

### Goal and rationale

The goal of the project is to develop a prototype device that (1) uses digital images (scenes) to represent meaning, (2) enables people with aphasia to navigate from scene to scene during a conversation and (3) reduces the cognitive and linguistic load of using AAC technologies. The research team hypothesized that adults with aphasia would be able to communicate more effectively using visual scene displays (VSDs).

The Nebraska prototype device is being developed in collaboration with a corporate partner, Dynavox Systems LLC. In designing features for the prototype device, the research team considered ways to help people with aphasia represent meaning by capitalizing on their strengths while finding ways to compensate for their difficulties with language. As a result, the prototype uses visual scene displays (VSD) that are rich in context and that enable communication partners to be active participants in the conversation.

Beukelman recounts some early observations that underlie the team's rationale for selecting specific design features.

#### Use of personalized photos.

There is power in personal photographs; and they quite naturally provide a shared context within which to have a conversation. Beukelman noted this when his mother was moving into an assisted living facility.

*I found myself curious about the decisions she made about what to take with her, espe-*

*cially her photographs. She selected photos to be displayed in her room at the assisted living facility. These were of large family groupings, scenes of the farm where she and my father lived for many years, a few historical favorites, individual pictures of the great grandchildren and a picture of my father standing beside their favorite car, a 1948 model.*

*Later, I also noticed that a number of my mother's new friends, who share her new home, also had photo collections that supported their conversations.*

The research team decided to design a prototype device that used personal digital photos in ways that could both engage others and support the formulation of personal stories.

**The use of context to support meaning.** At the AAC-RERC State of the Science Conference in 2001, Janice Light and her colleagues described the contextual nature of the "symbols" that young children draw to represent meaning.

*"Mother" was represented by a woman with a young child. "Who" was represented by drawing a relatively small person in the distance who was approaching an adult and a young child. "Big" was presented in the context of something or someone small or little. "Food" was drawn as a meal on the table, not by a single piece of fruit. Young children maintained context when they represented meaning.*

The Nebraska team hypothesized that adults with aphasia would also benefit from contextual supports

*Continued on page 10*

*Adults with Aphasia, Continued from page 9*

when attempting to construct meaning. They decided to use digital photos to capture important activities and events in the lives of individuals with aphasia and organize them on prototype devices in ways that could provide rich contextual support.

### **Capitalizing on residual strengths of adults with aphasia.**

Being able to tap into the residual visual-spatial skills of people with severe aphasia was key to designing the prototype device. Beukelman explains the team's thinking.

*Jon Lyon, a well-known aphasiologist, has described a drawing strategy that he teaches to persons with aphasia in order to support and augment their residual speech. Many of these drawings are relatively rich in context, even though they are usually drawn with the non-dominant hand.*

*Mr. Johnson, a man with expressive aphasia, taught Kathy Garrett and me a lot about communication. The first time I met him, he took out a bulging billfold and began to spread race-track forms, pictures from the newspaper, pictures of his family and articles from the paper on the table between us. Whenever, he did this, I knew that we were going to have a "conversation."*

The research team decided that the prototype AAC systems should incorporate strategies like maps, diagrams, one-to-ten opinion scales and photos, because they currently work for people with aphasia, and then should organize these strategies in ways that provide ready access to language.

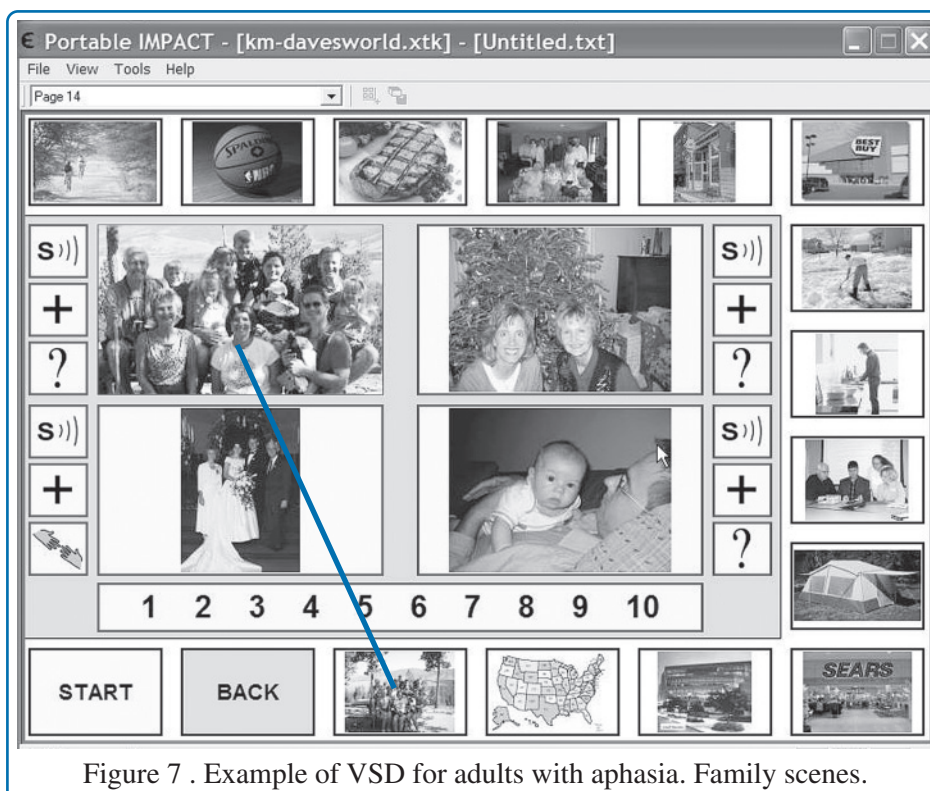


Figure 7 . Example of VSD for adults with aphasia. Family scenes.

### **Description**

The prototype device, which is currently under development, primarily uses digital images. The visual scenes are accompanied by text and symbols to (1) support specific content (e.g., names, places), (2) cue communication partners about questions or topics that are supported by displays and/or (3) support navigation features. The digital images are used to (1) represent meaning, (2) provide content and (3) support page navigation.

Unlike the VSDs discussed in the previous article, the prototype device does not use "hot spots" in the images. Thus, nothing happens to an image when it is touched. This means that the scenes can be touched many times by both interactants as they co-construct meaning, ask and answer questions and tell related stories. This enables persons with aphasia to use images in much the same way they would use a photo album.

Speech, questions and navigation buttons are placed around the image as shown in Figures 7, 8 and 9. These elements allow both interactants to speak messages, ask questions or move to related images. The figures show the available themes on one person's system. These are represented by digital images located around the edge of the display, e.g., family, vacations, shopping, recreational activities, home and neighborhood, hobbies, exercise, favorite food and places to eat, life story, former employment and geography.

Figure 7 highlights the family theme and provides a way to talk about family-related issues. For example, the "theme" scene of the family on vacation has mountains in the background and babies in backpacks, providing lots of information with which to represent meaning and build a conversation. To expand the conversation to other family-related topics, the individual can go deeper into the family theme (by pushing the [+] symbol) and get to



additional photos (Christmas tree, wedding, new baby). The blue line on Figure 7 shows that the theme photo also appears in the left hand corner. Figure 8 illustrates what happens when the person goes deeper into the family theme. For example, if talking about a new grandchild, the person can touch the [+] symbol near the photo with the baby and retrieve more pictures related to the arrival of the new addition to the family.

Figure 9 shows a shift to a shopping-related topic. The scene represents various stores the person frequents. To access these displays, the person simply selects the store to retrieve more information.

Figures 7, 8 and 9 also illustrate elements around the perimeter that have specific functions.

- s))) symbol specifies synthesized speech messages that describe the picture or individuals within the picture.

- ? symbol gives a way to ask one's communication partner a

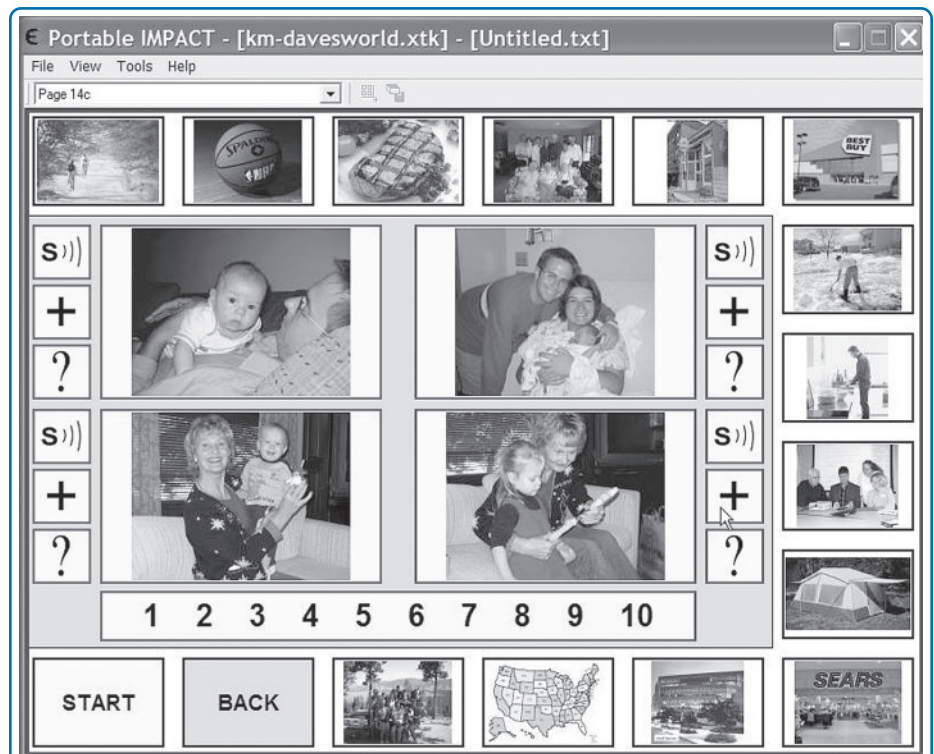


Figure 8. Example of VSD that shows more scenes on the family.

question (e.g., Where do you like to go for vacations?).

- + symbol means there is more information about the theme available.

- two hands icon stands for “I need help” or “I’m lost here, give me a hand.”

## Using the displays

For the past year, the research team has collaborated with two individuals with severe aphasia in an effort to develop design features and investigate the uses of VSDs.

1. Pat has expressive aphasia and is able to say very little, other than stereotypic utterances and some jargon. Before she began to use the prototype device, she was using a low-tech communication book containing drawings, photos of some items (buildings and people) and some words. While the low-tech book successfully represented meaning for her, she was unable to navigate through it easily. She usually engaged in a linear search, beginning at the first page, until she found the item or the page that she was looking for. In an effort to support her, family members often

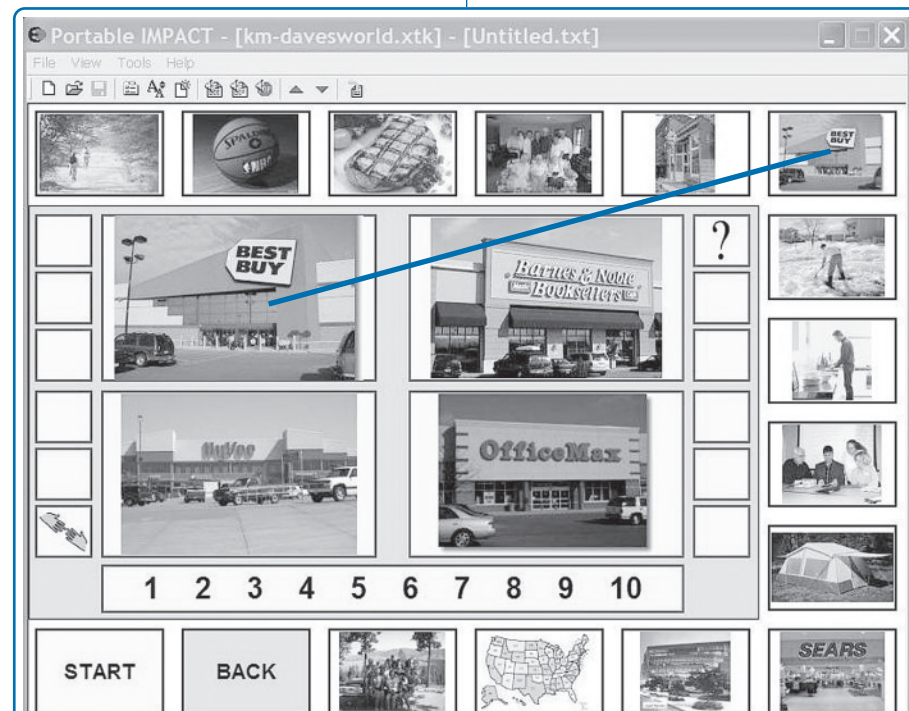


Figure 9 . Example of shopping scenes.

Continued on page 12



*Adults with Aphasia, Continued from page 11*

located a page beforehand, asking her a question she could answer using the page.

When first presented with the VSD prototype device, Pat did not engage in a linear search. Rather, she went directly to the scene she wanted. Researchers noted that she used the photos to support her conversation by relating the story that was illustrated. She also was observed using gestures, vocalizations and items in the photos to communicate something quite different from the illustrated meaning. Beukelman recounts,

*Pat had selected a large number of digital photos to talk about a trip she and her husband had taken to Hawaii before her stroke. Her favorite scene was an autographed picture of them with the entertainer Don Ho. She loved to tell us about the concert and the visit with Don afterward.*

*Another series of photographs illustrated a bus trip in the mountains to see the sun rise over the ocean. It was during that side trip that her camera was lost. When asked how it was lost, she navigated back to the Don Ho scene, pointed to her husband, pointed to the side of her head and twirled her finger in a circle, exhaled loudly and began to laugh. No one needed to translate for her.*

2. Ron is another collaborator. He has severe aphasia secondary to a stroke which has limited his verbal interaction. He produces stereotypic utterances and uses many generic words, but is unable to retrieve the content words that enable him to convey messages. Prior to the

stroke, he was a semi-professional photographer, so he brings the research team gorgeous photographs to include in his AAC device. As part of the research protocol, Ron was videotaped conversing with Dave Beukelman about a trip he took to the Rio Grande after his stroke. Beukelman reported,

*Ron wanted to tell me about rock formations, the light on the rocks in the morning and the evening, the location of the park on several different maps, the direction that the canoe took, the new wheelchair access for persons in wheelchairs and much more. The digital photos, digital images of maps and photographs from the Internet that were on his VSDs supported our conversation.*

When the research team looked at the tape of the session, they commented that the video “looks like two old guys who like to talk too much.” Beukelman adds,

*As I watched the video, I began to understand. We were interrupting each other, talking over the top of each other and holding up our hands to indicate that the other person should be quiet for a minute. And, over 20 minutes of conversation, he apologized only once for not being able to talk very well, something that filled most of his prior communication efforts. It looked and felt like a conversation of equals sharing information and control.*


## Comment

The Nebraska research is revealing that pictures appearing early in a theme are more effective if they are rich in context and

contain a good deal of information. Thus, the first page of each theme in the prototype system is designed to support at least five conversational turns. Subsequent pages may contain elements with more detail to clarify the content of the early photo, e.g., names of family members, where they live, how old they are and so on.

Researchers are using highly personalized photos early in the theme content. Then, as an individual progresses further into a theme, more generic pictures may be used to represent a doctor, hospital, grocery store and so on.

The team finds that people with severe aphasia can use the various navigation strategies provided on the prototype AAC device. They are impressed by the visual-spatial abilities of persons with severe aphasia when the language representation and categorization tasks are minimized.

To summarize, it appears that VSDs allow individuals with aphasia to make use of their strengths with images, to navigate through pages of content and to communicate in ways that cannot be accomplished using low-tech communication book applications and current AAC technologies. 

## Other Applications of VSDs: Beyond Conversation



### Children's Hospital Boston projects

This section provides examples of additional applications of visual scene displays (VSDs). The examples illustrate the use of generic scenes designed to facilitate organization, cueing and instruction, as well as communication.

#### Communication

Figure 10 shows two scenes from *Companion*®, a program designed by Howard Shane in 1995 for Assistive Technology, Inc. Until a few years ago, it was available on their Gemini® and Mercury® AAC devices. The intent of *Companion*® was to create a program using common everyday locations, such as a home, school, playground or farm that could support interaction. For example, the scene in Figure 10 shows a house with several rooms. When a person touches the bedroom, the scene changes and shows a bedroom with a dresser, bed, lamp and so on. There can be 20 hot spots with linguistic elements in the scene. Touching the dresser drawers, for example, can retrieve the speech

output, "I'd like some help getting dressed."

Shane has talked about these scenes as "graphical metaphors,"

because they stand for real places, actions and objects. He says they were designed primarily to enable persons on the autism spectrum to indicate what they wanted by making requests.

a ch cue, *i.e.*, a partial cue. The program features three types of cues: (1) a complete visual cue (chair), (2) a partial visual cue (ch) and (3) a spoken cue. Individuals with aphasia have demonstrated an ability to navigate through this environment and select intended objects.

#### Organization

Figure 12 on page 14 shows *Comet*, which stands for the Control



Figure 11.  
Example of  
VSD with  
partial cue.  
Hot spot is  
highlighted.

#### Cueing

The *Companion*® program also was used to give visual and auditory cues to persons with anomia to help them recall the names of familiar items. Figure 11 shows a living room and illustrates what would happen when someone clicked on the chair to retrieve the word "chair." You see

*Of Many Everyday Things*. Shane also developed this VSD for Assistive Technology, Inc. Different functions occur when hot spots are selected.

Calendar. Touch the calendar and the date is spoken. This is set to the computer's calendar.

Clock. Touch the clock and the time is spoken. This is set to the system clock of the computer.

TV. Touching the T.V. launches the remote control.

Two figures. Touching the figures launches the built-in communication program.

Computer. Touching the computer launches an Internet connection.

Cabinet. Touching the cabinet launches a menu of computer games.

Calculator. Touching the calculator launches the calculator program.

Persons with ALS have found

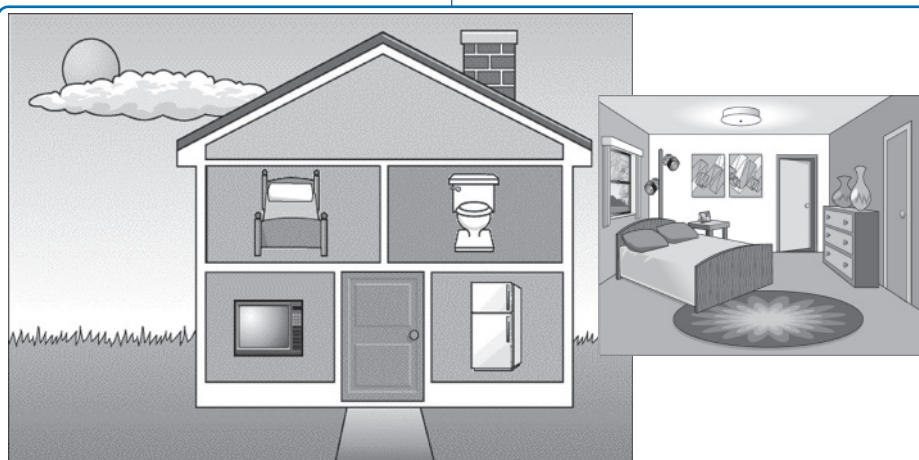


Figure 10. VSD for communication using *Companion*® program.

Continued on page 14

*Other Applications, Continued from page 13*

COMET to be a helpful computer interface.

### **Auditory training**

The next application is not pictured. *Sense of Sound* is a program that provides an interactive auditory experience for persons who are hard of hearing and includes a variety of familiar environmental sounds. When an object is selected, the sound associated with that object is presented. The program is thought to be a useful component for a cochlear implant auditory training program.

### **Puddington place**

Figure 13 illustrates *Puddington Place*, a program that uses VSDs as an interface for multiple functions. Shane reports that the photo-realistic scenes seem to have meaning for children with pervasive developmental disabilities and autism. These children immediately see the relationship of the scene to the real world and also understand the navigation inherent in *Puddington Place*. They can go into the house, enter rooms and make things talk and make sounds. For example, one child immediately started using the program. When his interactant mentioned items, he would hunt for and find things embedded in different scenes. Children enjoy interacting with the program.

Puddington Place serves as the background for the intelligent agent (IA) known as Champ. Champ is an animated character who can be programmed to give instructions, ask questions and demonstrate actions, such as dressing. For instance, by activating hot spots, Champ can demonstrate the sequences and actions involved in getting dressed.

Shane is currently studying the use of IAs as a way to engage individuals on the autism spectrum.



Figure 12.  
Example of  
VSD for  
organization  
the *Sense  
of Sound*  
program

If a child accepts input from an IA, then perhaps the IA can be used to teach language concepts, support the development of speech, regulate behaviors and so on.

- Phase I of the project asks parents of children with autism to identify the features of electronic screen media, such as videos, that their child prefers. Data are currently being collected and will be analyzed in ways that provide information about the reported nature of the children's preferences and the extent of interactions individuals on the spectrum currently have with electronic screen media. Researchers will compare these data to information about the siblings of these

children and to the results of available national studies.

- Phase II will investigate how VSDs can support comprehension and expression and help regulate the behaviors of children on the autism spectrum using an intelligent agent and generic visual scene displays.

### **Comment**


The use of visual scenes can extend well beyond supporting conversation and social interaction to offer a wide range of applications to individuals on the autism spectrum, as well as to children and adults with and without disabilities. 



Figure 13.  
Example of VSD  
for multiple  
functions  
*Puddington  
Place*




## Prototype to Market

This issue mentions several types of visual scene displays (VSDs). Some are completed products; most are prototypes and under development. This type of technical development often entails close communication, collaboration and/or partnership with an equipment manufacturer. These relationships involve information sharing about capabilities of existing technology, the addition of features to support the researchers' development activities and perhaps more.

The Penn State VSD project has received valuable technical support from Mayer Johnson, Inc., for their use of Speaking Dynamically Pro®. In addition, the research team has used AAC technologies produced by Assistive Technologies, Inc., DynaVox Systems LLC and the Prentke Romich Company in their research.

The Nebraska prototype device is being developed in collaboration with a corporate partner, DynaVox Systems LLC. The prototype is based on Enkidu's Impact software. DynaVox has played an important technical role in redesigning Impact's user interface and programming the system to accommodate large numbers of digital images.

The Children's Hospital Boston has supported the ongoing development of Puddington Place and will seek a distributor. Dr. Shane developed the other programs mentioned in collaboration with Assistive Technology, Inc.

A variety of relationships are possible among researchers, developers and manufacturers. The AAC-RERC continuously seeks to foster collaborations, cooperation and partnerships with members of the manufacturing community to help insure that products, which research suggests will benefit individuals with complex communication needs, become available to them at reasonable cost. 

For additional information about the AAC-RERC and its projects and activities, go to <http://www.aac-rerc.com>

## Resources

- David R. Beukelman, Department of Special Education and Communication Disorders, University of Nebraska, 202 Barkley Memorial Center, Lincoln, NE 68583. [dbeukelman@unl.edu](mailto:dbeukelman@unl.edu)
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- Jeff Higginbotham, Department of Communicative Disorders and Sciences, University at Buffalo, 1226 Cary Hall, Buffalo, NY 14214. [cdsjeff@buffalo.edu](mailto:cdsjeff@buffalo.edu)
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- Howard Shane, Communication Enhancement Center, Children's Hospital Boston, Fegan Plaza, 300 Longwood Avenue, Boston, MA 02115. [howard.shane@childrens.harvard.edu](mailto:howard.shane@childrens.harvard.edu)

## Lingraphica

Lingraphica ([www.lingraphica.com](http://www.lingraphica.com)). A device for people with aphasia with synthesized speech, a large dictionary of images or icons (some animated) organized in groups and a way to create messages, access familiar phrases and develop personalized information. Uses generic scenes (hospital, town and home) with embedded messages. Has clinical exercises for practicing outside the therapy room.

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Select Articles & ..., Cont from page 15

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