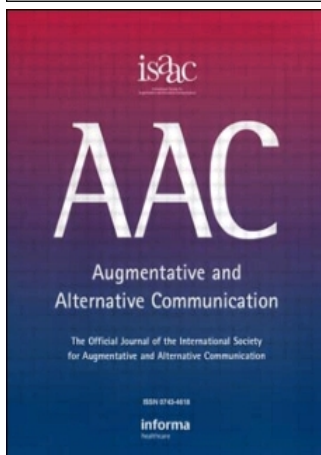


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AAC Technologies to Enhance Participation and Access to Meaningful Societal Roles for Adolescents and Adults with Developmental Disabilities who Require AAC

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In this paper we review published research describing the use of augmentative and alternative communication (AAC) to support societal participation by adolescents and adults with developmental disabilities who require AAC. We focus on three major participation domains: post-secondary education and training, the workplace, and community living and social interaction opportunities. Based on the findings of the review, we highlight five needed areas of research and development related to AAC technology: face to face communication; distance communication and interconnectivity; training and support for system use; adapted applications and cognitive tools; and supports for independent operation, development, and maintenance.

Keywords: Augmentative and Alternative Communication; Adult; Adolescent; Societal Role; Developmental Disability

INTRODUCTION

Individuals who use augmentative and alternative communication (AAC) and their families have new expectations for life after high school (Bryen & Moulton, 1998). In the past two decades, effective use of AAC technology has supported desired outcomes for individuals who use AAC in college and university settings (Atanasoff, McNaughton, Wolfe, & Light, 1998; Bryen, Slesaransky, & Baker, 1995; Chung, 2004); employment (Bryen, Potts, & Carey, 2007; Carey, Potts, Bryen, & Shankar, 2004; Isakson, Burgstahler, & Arnold, 2006; McNaughton, Light, & Arnold, 2002); and independent living (Davis, 2005). At the same time, we know that many individuals with developmental disabilities who require AAC lack appropriate communication systems and supports (Feinstein, Levine, & Lemanowicz, 2003; Hamm & Mirenda, 2006; Murphy, Marková, Collins, & Moodie, 1996). Their communication challenges severely restrict their participation in traditional adult roles as students, workers, friends, partners,

citizens, and parents (Bryen & Moulton, 1998; Light, 2003).

This paper is divided into two sections. The first deals with the societal roles desired by many adolescents and adults who use AAC, specifically active participation in postsecondary education, the workplace, and community living and social interaction opportunities. In the second section, we discuss future research and development for AAC technology to better support individuals who use AAC in assuming important societal roles in the adult world.

COMMUNICATION DOMAINS AND DEMANDS FOR ADOLESCENTS AND ADULTS WHO USE AAC

Adolescents and adults who use AAC are increasingly involved in three areas in society: post-secondary educational opportunities, the workplace, and community living. The setting demands of these domains provide special

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challenges for individuals who use AAC and their communication partners.

AAC and Postsecondary Education for Adolescents and Adults

Traditionally, postsecondary education assists individuals in acquiring vocational skills, establishing peer relationships, and supporting the transition to independent living (Neubert, Moon, & Grigal, 2001). At present, many of these benefits have not been realized by individuals who use AAC; individuals with severe and multiple disabilities are the least likely of any disability group to pursue postsecondary education (Wagner, Newman, Cameto, Garza, & Levine, 2005).

Reduced participation in post-secondary programs may have its roots in the high school experiences of individuals who use AAC. In a study of the concerns of 32 adolescents and young adults who use AAC, Light et al. (2007) reported that persons who were still in high school experienced serious challenges with workload management and inappropriate curricula (e.g., difficulties keeping up with coursework, strategies for managing academic demands), low levels of peer interaction (e.g., difficulty establishing and maintaining friendships), and low levels of support for appropriate use of AAC (e.g., lack of teachers with training in AAC, difficulties with educational assistants). Negative experiences in high school and poor support for the transition to post-secondary activities may prevent individuals who use AAC from experiencing the benefits of post-secondary education.

Despite these challenges, in recent years we have seen both survey and program evaluation research describing the participation of individuals who use AAC in both traditional college and university programs (Atanasoff et al., 1998) as well as specialized post-secondary programs focusing on the development of communication, empowerment, independent living, literacy, and employment skills for individuals who use AAC (Bryen et al., 1995; Bryen, Carey, & Cohen, 2004; Cohen, Bryen, & Carey, 2003).

Atanasoff et al. (1998) described the findings of a written survey research project designed to investigate the communication experiences of seven individuals who used AAC and attended college. These individuals described themselves as having strong literacy skills, and most reported participating in competitive general education high school programs. All participants had access to an AAC device, and described the need to fulfill many of the same communication demands as their non-disabled peers: to ask and answer

questions; to lead and contribute to discussions; and, in one case, to complete a final oral examination using face-to-face communication. The most commonly reported concern related to AAC was their slow rate of communication. The use of pre-programmed vocabulary, and increased reliance on written communication or email in place of face-to-face communication, were popular compensatory strategies. The academic demands of these postsecondary settings, however, clearly illustrate the importance of rigorous high school programs and the need for AAC technology and services to support interactive communication and access to a diverse vocabulary set.

Some individuals who use AAC wish to continue their education after high school, but either do not want to attend college, or have not yet developed the literacy skills to be successful in that environment. Specialized post-secondary programs targeting employment, literacy, and assistive technology skills have produced benefits for these individuals. Bryen et al. (1995) described the outcomes of the Augmentative Communication and Empowerment Supports (ACES), a program developed to provide adults with significant physical and speech disabilities with training in the use of AAC devices. Seventeen adults with significant physical and speech disabilities participated in the intensive ACES summer program over a 6-year period. Most of these individuals had received a device through their educational or vocational programs, but needed additional training in the operation of the device. After a 2-week immersion program and 1-year of follow-up training and support, most participants reported that learning to use an AAC device had substantially helped them in many major life activities, including communicating with unfamiliar people or in groups, maintaining a source of income, and acquiring new skills such as engaging in advocacy activities.

A follow-up program, ACETS (Augmentative Communication Employment Training and Supports), focused on the pursuit of employment (Cohen et al., 2003). Six individuals who required AAC attended 5 days of employment-related training, and then received 1 year of online job-coaching to assist them in identifying local and accessible transportation, housing, personal assistance services, and other job-related skills. In addition to the weeklong training, participants committed to treating their employment search as a full-time job for 1 year. They were given ongoing support and technical assistance throughout that year from ACETS staff, via e-coaching. Participants reported an increase in job-hunting skills, "managing disability and

work” skills, overall communication skills, and information technology skills. The number of participants who held part-time jobs increased from one to three; and four of the six participants reported increasing their monthly earned incomes. Common communication concerns expressed by participants included the need for access to highly specialized vocabulary, interconnectivity between AAC devices and other computer technology, and integrated cognitive tools (e.g., calendars) to support management of academic and vocational activities (see, for example, Bryen, Carey, & Potts, 2006). For those individuals who had only recently obtained their AAC technology, there was also a need for learning supports to assist them in making effective use of their AAC systems.

In addition to formal educational options targeting a broad range of skills, a small number of projects have investigated more focused interventions. The Mentor Project (Light et al., 2007) provided a two-phase investigation of the impact of partnering experienced mentors who used AAC with younger individuals who used AAC and who were navigating important transitions. In the first phase, older individuals who used AAC received web-based instruction in socio-relational skills and problem-solving strategies. All participants who received training achieved mastery of targeted skills, as demonstrated on case study probes that were scored for strategy use. These adults later acted as mentors via email to 32 younger individuals who used AAC, and assisted them in developing solutions to transition-related problems such as planning living arrangements and looking for a job. McCarthy, Light and McNaughton (2007) later extended these findings by documenting the successful provision of web-based instruction in social problem-solving skills to five young adults who used AAC.

Foley and Staples (2003) documented the impact of a literacy intervention provided in a unique setting. Reading and writing instruction was provided to five individuals with autism who used AAC at their supported employment site. All five made progress towards conventional literacy, and were viewed as more “communicatively competent” by center staff.

In another project supporting the development of new skills by individuals who use AAC, the Writer’s Brigade Project assists adults who use AAC in acquiring technical writing skills through a series of targeted writing assignments (Schwartz, 2004). All correspondence with the editor/instructor takes place via the Internet. The completed assignments are submitted for publication, thereby providing the individuals who use

AAC with information about the real life expectations for writers. The assignments also serve as introductions to the editors of a variety of publications.

The reading, writing, and communication demands of colleges, universities, and other post-secondary educational activities have been well documented (Schumaker & Deshler, 1990). Whether individuals who use AAC are participating in traditional postsecondary settings or special programs specific to their needs, there is a clear need for technology that can address three needed capabilities: (a) provide quick access to a wide range of vocabulary items; (b) easily handle multiple functions (e.g., face-to-face communication, support for written communication, access to email and internet functions); and (c) provide integrated cognitive tools (e.g., calendars).

AAC and Employment Activities

Individuals who use AAC report that employment provides both the income to act on important personal decisions as well as strong feelings of self-worth from contributing to society (McNaughton et al., 2002; McNaughton, Symons, Light, & Parsons, 2006; Odom & Upthegrove, 1997). At the same time, individuals with multiple disabilities, including those who use AAC, experience the lowest level of employment of any major disability group (Wagner et al., 2005). Recent survey and focus group research has contributed to our understanding of the employment activities of individuals who use AAC, and the technological supports needed for positive employment outcomes (McNaughton, Light, & Gulla, 2003).

Success in finding employment is dependent both upon having needed job skills as well as a strong and useful job contact network. Bryen et al. (2006) provide detailed information on the use of a variety of communication technologies, including landline telephone, email, and various forms of IM (Instant Messaging) by 38 adults who used AAC to build and maintain job related social networks. Key recommendations from this study for technology development included better interconnectivity between AAC devices and cell phones and other computer technology, better access methods (to support increased speed), improved speech synthesis, and improved (larger) screens.

Individuals with a broad range of disabilities, and of different ages and educational levels, use AAC to participate in a broad range of employment activities (Bryen et al., 2006). To date, employment for individuals with severe

physical disabilities who use AAC is often limited to those with strong literacy skills and an efficient method of text entry (McNaughton et al., 2002). Common workplace activities include professional writing, public speaking, computer programming, and providing technical support for AAC manufacturers (Light, Stoltz, & McNaughton, 1996). Employers frequently talk of the importance of identifying appropriate "low-input, high-output" jobs, whereby a relatively small amount of text input results in a high-value product (McNaughton et al., 2003).

For individuals who use AAC and who have only mild or moderate physical disabilities, employment opportunities are more varied (e.g., restaurant staff, parking lot attendants). For this group, literacy skills do not serve as a prerequisite for employment, however individuals involved in "service" jobs with low literacy requirements (e.g., maintenance workers) expressed lower levels of satisfaction with their jobs (Light et al., 1996).

Employers of individuals who use AAC typically report very positive employment experiences with these workers, noting significant benefits in the quality of work provided by the employee who uses AAC, as well a positive effect on other employees (McNaughton et al., 2003). Even for individuals who are highly competent in the use of AAC, however, communication in the workplace remains a challenge. Employers and individuals who use AAC note difficulty with respect to the increased time necessary for communicative exchanges, difficulty with unaided and low-tech communication, and the unreliability of equipment (Bryen et al., 2006; McNaughton et al., 2002). In addition, challenges with access to traditional offices tasks, such as private telephone conversations and access to workplace computers, as well as the integration of activities (e.g., being able to take notes and communicate at the same time), have been noted (McNaughton et al., 2003).

Common to the individuals who used AAC and their employers was an interest in durable, reliable, equipment that (a) provided quick access to specialized vocabulary; (b) connected easily with other workplace technologies (secure connections to mainframe computers); (c) contained integrated embedded technologies (e.g., cell phones) that could be used in a variety of environments (e.g., outdoors, in noisy situations); (d) maintained privacy; and (e) was capable of switching quickly between multiple functions, for example, face-to-face communication and taking notes (Bryen & Pecunas, 2004; Bryen et al., 2006; McNaughton et al., 2003).

AAC and Post-school Adult Living and Relationships

Many individuals who use AAC are clearly interested in making independent personal decisions about their post-school living arrangements and their participation in relationships (Bryen & Moulton, 1998; Schwartz, 2005). At present we have only a limited understanding of the communication challenges present in these situations. We know from longitudinal studies of individuals who use AAC that the perceived appropriateness of a living situation is a highly individualized decision. For example, Lund and Light (2007) reported that high levels of satisfaction were reported both by adults who used AAC living at home with parents, as well as by individuals who were pursuing greater levels of independence in their living arrangements.

It is important, however, that the individual who uses AAC has the self-determination and communication skills necessary to make and act on a personal decision, and that options are actually available. In a study of the experiences of nine adults who use AAC, Davis (2005) reported that four of the nine wanted to live in a more independent setting but lacked the resources to achieve this goal. The desire to live more independently was also a key goal identified by adolescents and young adults who participated in the Mentor Study (Light et al., 2007). These participants identified numerous barriers to independent living, including negative societal attitudes and difficulty in finding competent personal care assistants.

Critical to success in any living arrangement is the ability to clearly communicate personal needs in order to make decisions and manage personal care services. As Collier has commented, "no matter where someone lives, their quality of life depends to a great extent on the degree to which they can direct the services of persons who provide attendant care" (Blackstone, 2005, p. 3). Based on the results of an informal survey reported by Collier (Blackstone, 2005), individuals who use AAC may have to deal with as many as 15 different persons in managing their personal care; and few reported being prepared to be assertive and negotiate their own care, give feedback that is positive and constructive, and deal with conflicts and dangerous situations.

Hamm and Mirenda (2006) reported that there is good reason to be concerned about the communication supports and services available to young adults who use AAC. The authors observed a positive correlation between the quality of communication scores and the quality of life scores for the eight individuals in their

study who used AAC. They also noted, however, that a majority of the individuals who used AAC, and their caregivers, were very dissatisfied with the AAC services and supports available for young adults (aged 19–24).

The inability to direct the actions of others and to report inappropriate activity can have devastating consequences. A survey by Bryen, Carey, and Frantz (2003) of 40 adults who used AAC indicated that 45% of individuals had experienced crime or abuse; of these, 97% knew the perpetrators, 71% reported being victimized multiple times, and 66% had experienced multiple types of victimization. Long-term effects of the crimes included significant physical and emotional harm as well as loss of property or money. Only 28% of those who had been victimized reported their experiences to the police. While there are challenges above and beyond access to vocabulary in reporting crimes committed by caregivers or familiar individuals, obviously important in the development of an AAC system is the ability to clearly and confidentially communicate concerns about inappropriate behavior by others, and to have access to a vocabulary that supports reporting abuse and other criminal behaviors.

Of special importance to safe community living and participation is the development of social networks. Carey et al. (2004) reported that adults who used AAC had limited social networks, and that this may have had an adverse impact not only the number of potential communication partners for social interaction and friendship, but also access to important employment contacts. We know that forming friendships and developing social networks is a central concern of many adolescents and young adults who use AAC (Light et al., 2007; Smith, 2005). At the same time, these individuals may face difficulty in overcoming negative societal attitudes (McCarthy & Light, 2005), as well as substantial barriers in gaining access to traditional socialization activities, such as community recreation events, in an effort to establish friendships. In a focus group discussion on community recreation (Dattilo et al., in press), eight individuals who use AAC described key benefits, barriers, and supports to community participation. While participants enjoyed the opportunity to make social connections and educate society, their participation in some community activities was limited by negative societal attitudes and technological limitations of AAC devices (e.g., difficulty seeing computer screens on sunny days, and low volume levels of AAC devices).

In recent years, structured tools such as Social NetworksTM (Blackstone & Hunt Berg, 2003)

have provided educators and family members with strategies for making progress towards desired social interaction goals. At present, however, we have only a limited understanding of the factors that may affect attitudes towards an individual who uses AAC. Individuals with previous experience with individuals with disabilities appear to have more positive attitudes than individuals without experience (Beck & Dennis, 1996). However, AAC system features (e.g., use of computer technology) or the skills of the individual user (e.g., ability to produce longer messages) do not appear to be consistently influential as single factors. Instead, attitudes appear to be shaped by the interactions of many different factors (McCarthy & Light, 2005).

Part of the challenge of achieving desired social interaction goals may be intertwined with the ongoing development of communication skills by the individual who uses AAC and the need for skilled communication partners. Lund and Light (2007) contacted seven young adults who had received ongoing AAC services from an early age. Of the seven, three were still dependent on the skills of the partner to sustain the interaction. While all interactions require skilled contributions from both partners, it may be challenging for the individual who uses AAC to meet new people and develop new friendships if the new and presumably inexperienced communication partner carries a large responsibility for the success of the communication (Tavares & Peixoto, 2003).

In summary, new opportunities for community living have increased the need for durable and reliable communication technology that can be easily maintained, with minimal training, by individuals who use AAC or personal care attendants. Greater independence also increases the need for confidential and verifiable communication, and communication tools to support financial management activities, such as using a credit card or a bank machine (Wagner et al., 2005).

AAC TECHNOLOGY AND SUPPORTS AND BARRIERS TO FULL PARTICIPATION IN SOCIETY

Changes in the experiences and desired roles of individuals who use AAC have lead to new expectations for AAC technology (Blackstone, Williams, & Wilkins, 2007). In this section we will discuss developments in AAC technology that are needed to better support individuals who use AAC in desired societal roles (see Table 1).

TABLE 1 Recommendations for Research and Development in AAC Technology.

Function	Desired feature
Face to face communication	<ul style="list-style-type: none"> • provide quick access to a wide range of vocabulary, including pre-stored phrases • offer improved speech intelligibility and volume control • provide multiple output options • be useable in a variety of seating positions • be useable in a variety of communication environments, including adverse conditions • ensure privacy • be appealing • be unobtrusive
Distance communication and interconnectivity	<ul style="list-style-type: none"> • support access to distance communication technologies (e.g., cell phone, email, instant messaging) • facilitate interconnectivity with other devices • provide verifiability of identity
Training and support for system use	<ul style="list-style-type: none"> • provide assistance for learning and using vocabulary • provide assistance for learning and using conversational skills • provide <i>introduction message</i> to communication partner
Adapted applications and cognitive tools	<ul style="list-style-type: none"> • provide adapted applications to support access to email and other internet functions • switch rapidly between functions (e.g., face-to-face communication and taking notes) • provide cognitive tools (e.g., calendars)
Independent operation, development, and maintenance	<ul style="list-style-type: none"> • feature durable and reliable technology • provide supports for acquiring, storing, and representing new vocabulary • provide support for maintenance • place minimal demands on support personnel (e.g., personal care attendants) • provide access systems that recognize a variety of skills • provide access systems that can adapt to an individual's needs and performance over time

Face-to-Face Interaction

Greater participation in society means that individuals who use AAC will be participating in a wide range of communication environments, and will be less likely to be communicating with or accompanied by individuals who are familiar with their communication systems. While recognizing that both sides contribute to the successful construction of a message (Blackstone et al., 2007), one likely implication of communication with naïve partners is that there will be increased expectations for individuals who use AAC and their communication systems (Tavares & Peixoto, 2003), including their ability to successfully introduce the use of their AAC system to the communication partner (Rackensperger, McNaughton, Krezman, Williams, & D'Silva, 2005). There is a clear need for systems that provide quick access to a wide range of vocabulary, offer improved speech intelligibility and a variety of output modes, are useable in adverse conditions and in a variety of seating positions, ensure privacy, and are seen as appealing both by

individuals who use AAC as well as communication partners.

Vocabulary and Representation

Participation in a wide range of environments brings new specialized communication demands and the need for access to a wide range of vocabulary, including specific terms for participation in the workplace (Balandin & Iacono, 1999), postsecondary education (Smith, 2005), and society (Bryen et al., 2003). While the use of traditional orthography provides one approach, other individuals may benefit from the use of other representational systems and pre-programmed vocabulary dealing with academic content, work, or relationships. Individuals need access not only to commonly used core vocabulary items but also to words that allow them to communicate their individual opinions and beliefs. The increased vocabulary demands also result in new challenges for encoding and retrieval systems (Clarke, McConachie, Price, & Wood, 2001; Smith, 2005).

Output

Individuals who use AAC report that despite clinical reports of improved intelligibility for synthesized speech (Reynolds, Isaacs-Duvall, & Haddox, 2002), their use of an AAC device often is not understood by naïve communication partners (Rackensperger et al., 2005). Future technical development should continue to address improved intelligibility and explore the development of contextually appropriate and, as needed, redundant output. For example, an AAC device with the availability of both a screen display viewable to the partner, or a small built-in printer, would support comprehensibility in noisy environments.

Environmental Challenges

Difficulties with speech output is just one example of how the “real world” places special demands on AAC systems. Other concerns identified by individuals who use AAC include the need for screens that can be seen under bright conditions, and devices that are sensitive to changing environmental conditions, such as noise levels (Rackensperger et al., 2005).

Access and Positioning

For the most part, current technology is designed to be used by individuals with relatively good fine motor control, and is typically so large that it needs to be mounted to an adapted wheelchair. While there are some smaller, more portable devices available, they typically either feature a very limited vocabulary and or require very fine motor control for access. The challenge will be to develop devices and access techniques so that AAC systems are usable in a wide variety of environments and positions, and can be used by individuals who are independently mobile, or while in bed, or while eating a meal (Murphy et al., 1996).

Privacy

The ability to have private conversations is important in a wide variety of contexts, such as establishing and maintaining social closeness (Smith, 2005), participating in an employment setting (McNaughton et al., 2003), or reporting inappropriate and illegal activity (Bryen et al., 2003). Individuals who use AAC not only need access to appropriate vocabulary, but also the ability to communicate privately and confidentially. Sadly, individuals who use AAC report that family members and caregivers are often responsible for abuse and neglect issues (Bryen

et al., 2003). We should view with great caution technology that records the communication of individuals who use AAC, and the possible chilling effect that this may have on their ability to report abuse by caregivers.

Appeal

Smith (2005) has noted that the look of an AAC device may play a key role in its acceptance and use by adolescents and young adults who use AAC. Individuals may be reluctant to use technology that they believe “looks stupid” or is “embarrassing” (Clarke et al., 2001, p. 111). While we know that young adults (ages 15–27) have preferences related to synthesized speech that are different from those of children (Mirenda, Eicher, & Beukelman, 1989), more research is needed to determine the factors viewed as desirable to adolescents and young adults.

Distance Communication and Interconnectivity

Individuals who use AAC have clearly spoken to their interest in the use of distance communication technologies, including cell phones, email, instant messaging, and access to the Internet. They also have expressed their interest in interconnectivity: the ability to use their AAC device to “communicate” with personal and mainframe computers as well as other devices.

Distance Communication

Individuals who use AAC report that distance communication technologies such as email, cell phones, and instant messaging play a critical role in developing and maintaining important social networks (Carey et al., 2004; Datillo et al., 2006; Rackensperger et al., 2005), and can assist in overcoming challenges associated with face-to-face communication (Atanasoff et al., 1998). At the same time, there are significant barriers to the integrated use of these technologies (DeRuyter, McNaughton, Caves, Bryen, & Williams, 2007).

Interconnectivity

Effective use of distance communication technology (e.g., cell phones, email) may require embedded technologies in the AAC device, or the ability of AAC devices to seamlessly connect with mainstream technologies (e.g., personal computers). While some AAC technologies provide integrated cell phone capabilities, there are both technical and policy barriers to overcome (see DeRuyter et al., 2007). The development of future generations of AAC devices should

consider not only supporting connections with other communication technologies (e.g., personal computers), but also a wide range of devices such as office equipment (McNaughton et al., 2002), household appliances, and entertainment devices (Schwartz, 2005). Indeed, as DeRuyter et al. (2007) suggest, we may need to think of AAC devices as a way to help an individual connect with an “intelligent environment” (Emiliani & Stephanidis, 2005), and as a means to support communication among multiple people and a variety of machines, rather than the traditional conceptualization of a single person connecting to a single device or communicating with a single communication partner.

Verifiability

As individuals who use AAC take on new roles in the community, they will increasingly be in situations (e.g., voting, using an ATM, accessing a mainframe computer in the workplace) in which they will need to be able to confirm their identity. Verifiability of communication will take on special importance for those individuals who live independently and want to manage their own finances (Wagner et al., 2005).

Training and Support for System Use

Successful communication requires skilled participation by both partners (Blackstone et al., 2007); however, there is a lack of trained professionals to provide needed training and support to individuals who use AAC and their communication partners (McNaughton et al., 2002; Simpson, Beukelman, & Bird, 1998). Individuals with severe disabilities are the most likely of any disability group to initially have low levels of computer confidence, the lack of which often translates into a reluctance to try new technology (Forrester Research, 2004). Early support and positive experiences play critical roles in adoption of new technology (Forrester Research, 2004; McNaughton et al., in press). Individuals who use AAC have expressed interest in the use of AAC devices to provide both training and ongoing support in learning AAC systems (Rackensperger et al., 2005).

Vocabulary

Individuals who use AAC that includes icon sequences have described the time and effort required to learn these sequences; similar and sometimes greater challenges have been described for learning traditional orthography (Rackensperger et al., 2005). Individuals who use AAC

have expressed an interest in the use of technology to support learning and practicing these codes prior to their use in an interaction.

Some have also suggested the further development of technologies to support learning codes within an ongoing interaction. For example, during a conversation, the Prentke-Romich Icon Tutor™ provides the individual who uses AAC with the Minspeak™ icon code for a typed word. The interaction continues without interruption; however, the AAC user is provided with a code that can be used during a future interaction.

Interaction

The use of a single mode (e.g., written output) or communication with a naïve partner places greater pressure on the text to convey nuances that may be communicated via other modes (e.g., facial expression, gesture) in face-to-face conversations with familiar partners. While the message is still, in a sense, co-constructed, there is often a greater need for syntactically correct text and appropriate vocabulary in order to support listener comprehension (Stevenson, 2001).

With respect to learning to make use of AAC within a conversation, use of computer-based video-instruction has been demonstrated to be a powerful technology for teaching needed skills for participation in community based interactions (Mechling & Cronin, 2006). Integration of this technology into the AAC device itself would support both independent practice, as well as functional use within the target environment. While computer-based video instruction typically shows the communication expectations of the target environment (e.g., a restaurant employee asking for an order), future research may explore the impact of video modeling and self-modeling of desired responses on communication exchanges.

Future research should also explore the impact of providing syntactical and vocabulary supports that are within the AAC device and that could be used during an ongoing conversation. One possible direction is the development of *computer based conversational scaffolding*, much like that provided by familiar partners (Tavares & Peixote, 2003), to assist individuals who use AAC in providing information in key areas of concerns, such as negotiating their care, giving feedback to caregivers that is positive and constructive, and dealing with difficult situations (Collier, McGhie-Richmond, Odette, & Pyne, 2006).

Partner Training

AAC devices could also play a greater role in introducing the use of AAC to a new

communication partner. Naïve communication partners typically will know little about AAC in general, and may be reluctant to acknowledge an individual's use of AAC techniques (Murphy et al., 1996).

Partner training will need to be individualized, as there will be wide variations in how individuals communicate. For example, Hunt-Berg (2005) described the communication techniques used by the 16 adolescents and young adults included in her study. All had received training on AAC technology, including speech-generating devices and non-electronic communication boards and books. However, all participants used a wide variety of individualized body-based modes of communication (e.g., facial expressions, body language, gestures, and vocalization), more frequently than AAC technology.

A brief introduction as to how an individual communicates can often have a powerful effect (Tavares & Peixoto, 2003). Light and Binger (1998) reported the positive impact of teaching an introduction strategy to adolescents and adults who used AAC. Many of today's AAC devices have the capability of providing short video presentations, and research is needed to investigate the impact of these introductions on the skills and attitudes of communication partners.

Adapted Applications and Cognitive Tools

A fourth area of future development for AAC technology is that of adapted applications and cognitive tools. The increased participation of individuals who use AAC in a wide variety of environments has heightened the need for AAC systems that can perform the following types of necessary academic and workplace functions: send and receive email; browse the Internet; access calendar, address book, and calculator functions; support group presentation activities; and taking notes (Bryen & Pecunas, 2004; Lasker, LaPointe, & Kodras, 2005).

Adapted Applications

While individuals who use AAC require access to the Internet, email, and many other applications, the effective and efficient use of commercially available software often provides significant technological and instructional barriers. Recent work (Sohlberg, Fickas, Ehlhardt, & Todis, 2005) has demonstrated the positive impact of adapting software applications so as to provide email access to individuals with significant cognitive impairments.

Another major area of concern is access to the World Wide Web. Williams (2005) describes

the many benefits of the web for youth and adults who rely on AAC, including web access to support social interaction, to obtain information, to engage in e-commerce, and to provide entertainment by downloading music, e-books, and photographs. Many of the current Internet browsers, however, feature requirements (e.g., ability to manipulate a mouse or an equivalent tracking feature) that pose significant barriers to individuals with physical disabilities (Bryen et al., 2006). Additional research is needed to insure that the individuals with severe disabilities are able to access and reap the benefits of the Internet (DeRuyter et al., 2007).

Ability to Switch between Multiple Functions

Individuals who use AAC devices and their communication partners want devices that can move quickly and easily between one communication function and another. For example, employers have commented that individuals who use AAC should, like any other participant at a business meeting, be able to rapidly move back and forth between presenting a prepared speech to a large group and answering questions, or between taking notes and contributing information to a business meeting (McNaughton et al., 2003). Smith (2005) has observed that personal story telling may form a key theme in conversations with adolescents; at the same time, rapid turns involving the communication of empathy, teasing, and negotiation, sometimes as many as seven per minute, are the norm.

One possible approach may be providing access to pre-stored phrases within the AAC device. Todman (2000) described the benefits of computer-based text storage and retrieval system for a 40-year-old woman with cerebral palsy. Use of the system in a conversation with a communication partner enabled her to contribute text at a faster rate and with shorter pause times between turns. These changes had a positive impact on the communication partner's perception of the user's communicative competence.

Cognitive Tools

The effectiveness of electronic organizers and computer-based cognitive supports has been clearly demonstrated for individuals with mental retardation (Carey, Friedman, & Bryen, 2005); however, this area has received only limited attention in AAC technology development. Future research should explore the impact of providing integrated, embedded cognitive support technologies within AAC devices, as well as the use of modified interfaces (e.g., simplified email

programs, calendars) to support effective use (McNaughton et al., 2003).

Independent Operation, Development and Maintenance by User

As individuals who use AAC explore new options for independence in school, work, and living situations, the need for durable and reliable technology that can be easily and independently operated, developed, and maintained by the users has become clear (Rackensperger et al., 2005).

Operation

Many individuals who use AAC continue to rely on their communication partners to assist them in setting up and accessing their AAC systems. Hunt-Berg (2005) reported that, of the 16 teenagers and adults who participated in her longitudinal study, all were dependent on their communication partners for the set-up, programming, and maintenance of their AAC device; and seven were dependent on their partners for assistance in using the device. Although this may not be viewed as a significant problem in a school environment, it is clearly an issue in independent living, working, and educational situations, where an individual is more likely to encounter unfamiliar partners (Rackensperger et al., 2005). More research is needed to provide features such as a hands-free "on-off" option (McNaughton et al., 2002), and to address the access needs of individuals who have difficulty with reliably and repeatedly performing the skills required to access the current generation of technology, and who are considered "hard to serve." At present, access systems that bypass direct selection (e.g., scanning) shift the physical challenge to a cognitive challenge (Light, 1993; McCarthy et al., 2006). Research is needed to better describe the physical skills of individuals who require AAC, and to develop access systems that recognize a wide variety of user skills and that can adapt to changes in an individual's needs and performance over time (e.g., can change as an individual fatigues).

One innovative approach is the development of systems that recognize the use of multiple modalities (Light et al., 2005). The current generation of access techniques typically relies on a single input modality (i.e., hand movement to control a keyboard or mouse). If the individual has a motor impairment, this input modality may be significantly restricted: range and accuracy of input may be very limited; rate of input is typically slow; and unintended movements (e.g., tremors or reflex patterns) may result in

numerous errors. Computer recognition of multiple modalities (e.g., hand movement, head movement, eye pointing, vocalizations and speech) would allow for a greater range of input. Speed and accuracy might be increased, as one mode (e.g., vocalization), could be used to confirm a selection made with another mode (e.g., eye gaze). The goal is that the device would learn to act as an "expert partner" that recognizes a wide range of behaviors, while learning to filter out and ignore unintended movements (e.g., reflex patterns).

Development and Maintenance

New approaches are needed to assist individuals who use AAC so they can to independently add vocabulary to and maintain their devices. Individuals who use AAC are interested in Internet-based documentation for their devices so they will not have to handle books or other materials (Rackensperger et al., 2005). The WebCrawler, a software application now under development, would search the Web for topic-related vocabulary, and has been proposed as a technology to support individuals who use AAC in obtaining needed words for their device (Higginbotham, 2007). Additional suggestions from individuals who use AAC include clear guidelines for the addition and representation of new vocabulary, and a "rewind" button to support troubleshooting when a device "freezes" (Rackensperger et al., 2005).

SUMMARY AND FUTURE RESEARCH

Today, we see adolescents and adults who rely on AAC occupying socially valued roles in communities across the nation and across the globe. Some are students in inclusive regular education classrooms; some are college students and college graduates; some are wives, husbands, life-long partners, and parents. More and more individuals who use AAC are choosing to live in their own homes and apartments with or without personal assistance. They are choosing to volunteer, work, vote, and participate in a variety of ways in their communities. They are citizens of the world, and a growing number communicate via instant messenger, cell phone, text messaging, and on listservs and in chat rooms.

At the same time, too many individuals who use AAC, especially adults, continue to be denied AAC services (Feinstein et al., 2003; Hamm & Mirenda, 2006; Murphy et al., 1996). While cost may be a barrier for some of these individuals, the more significant barrier appears to be the lack of

knowledge by support personnel that AAC interventions can lead to an improved quality of life for individuals with disabilities. For example, Feinstein et al. (2003) reported that approximately 30% of all individuals with intellectual disabilities served by the Office on Mental Retardation in Pennsylvania require the use of AAC, but that only 10% of the individuals with this need have access to an appropriate AAC system and to the needed supports for learning how to use it. Parents of individuals with severe cognitive difficulties report that they typically receive only limited information from professionals and are more likely to acquire information about AAC from friends and family members or by discovering it on their own (McNaughton et al., in press). Interventions with both practicing and pre-service AAC professionals are needed to ensure that they are aware of the need to (a) provide communication support to all and promote access to a range of AAC systems, and (b) meet the training needs of both those who use AAC as well as their communication partners (Bryen et al., 2005). As Smith (2005) has noted, advances in technology alone will be of little use without both a reduction in societal barriers to participation, and an increase in the provision of needed supports.

Individuals who use AAC expect to be full participants in our society (Blackstone et al., 2007). The AAC technologies of today and tomorrow must be more robust, reliable, and capable of connecting with a variety of mainstream technologies, so that individuals who use AAC can continue to expand their roles as self-determined adolescents and adults. Increased attention to the need for AAC technology that can support participation in face-to-face and distance communication, that assists in providing training and support for system use, that includes adapted applications and cognitive tools, and that can be independently operated and maintained, can play a key role in empowering individuals who use AAC to participate in meaningful societal roles.

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