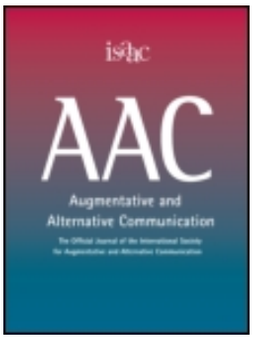

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FORUM NOTE

Putting People First: Re-Thinking the Role of Technology in Augmentative and Alternative Communication Intervention

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Abstract
Current technologies provide individuals with complex communication needs with a powerful array of communication, information, organization, and social networking options. However, there is the danger that the excitement over these new devices will result in a misplaced focus on the technology, to the neglect of what must be the central focus – the people with complex communication needs who require augmentative and alternative communication (AAC). In order to truly harness the power of technology, rehabilitation and educational professionals must ensure that AAC intervention is driven, not by the devices, but rather by the communication needs of the individual. Furthermore, those involved in AAC research and development activities must ensure that the design of AAC technologies is driven by an understanding of motor, sensory, cognitive, and linguistic processing, in order to minimize learning demands and maximize communication power for individuals with complex communication needs across the life span.

Keywords: *Augmentative and alternative communication (AAC); Technology; Intervention*

Introduction

Several years ago, we witnessed an interaction between a young university student and Michael Williams, a leader in the field of augmentative and alternative communication (AAC) and himself an expert user of AAC. The student enthusiastically posted on a listserv that she just loved AAC because of all the exciting technologies. In his wisdom, Michael gently chided her by reminding her that if she wanted to make a difference, she had better focus on the people, not the technology. Michael's words have stayed with us since his post.

Communication technology is ubiquitous in today's society; the impact of rapid technological developments is widespread and inescapable. Innovation in technology has spilled over into the AAC field as well, with the development of a wide array of speech-generating devices (SGDs) and, most recently, the explosion of iPads™ and other mobile technologies with AAC apps (Bradshaw, 2013; Lorah et al., 2013; McNaughton & Light, 2013; Shane, Blackstone, Vanderheiden, Williams, & DeRuyter, 2012).

The possible benefits of these technologies are innumerable. They offer the potential to support communication to meet needs and wants, develop social relationships, and exchange information faster and with greater reach than ever before (Hyatt, 2011; Rummel-Hudson, 2011). The availability of a wide array of portable, powerful, networked technologies has changed how we work, learn, meet our daily needs, spend our leisure time, and interact socially. However, as David Beukelman first noted in his discussion of the magic and the cost of AAC devices, this new communication technology revolution comes with a price as well (Beukelman, 1991). Perhaps the greatest danger is that the excitement over these new devices will result in our focusing on technology alone, to the neglect of what must be the central concern: Providing appropriate and comprehensive services for people who have complex communication needs. Have we lost our way amidst all of the technological advancements? Has our excitement with the new technologies caused us to lose focus on the essence of the field, the people who require AAC?

Benefits of Technology for Individuals with Complex Communication Needs

As we write this editorial, we are richly aware of the myriad potential benefits that technology offers for

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people who require AAC. Over the past 20 years, a limited handful of single-function AAC technologies has been replaced by a dizzying number of multi-function devices and apps (Light & McNaughton, 2012a; Shane, Blackstone, et al., 2012). The development of SGDs and the advent of mobile technologies with AAC apps have offered new possibilities to access greater functionality and interconnectivity than ever before. These technologies are not simply speech prostheses; rather, they are multi-purpose devices that offer access to a wide range of functions (e.g., the Internet, education, social networking, entertainment, gaming, information access) (Ball et al., 2010; Fager, Bardach, Russell, & Higginbotham, 2012; McNaughton & Light, 2013). As such, they offer the potential to expand the range of communication purposes and the breadth of social networks for individuals with complex communication needs (Hyatt, 2011; Williams, Beukelman, & Ullman, 2012). Current technologies provide a powerful array of communication, information, organization, and social networking options for individuals with complex communication needs that were previously not possible. Furthermore, these options provide exciting ways to overcome many barriers that individuals who require AAC confront on a daily basis, including use of social media to build broad social networks and overcome attitude barriers; and telework, on line education, and e-commerce to overcome transportation and architectural barriers, to name just a few. Technology has opened doors for individuals who use AAC, allowing them to enhance their communicative competence, attain higher education, secure employment, and participate more fully in society (Bryen, Potts, & Carey, 2006; Friginal, Pearson, Di Ferrante, Pickering, & Bruce, 2013; Isakson, Burgstahler, & Arnold, 2006; McNaughton, Bryen, Blackstone, Williams, & Kennedy, 2012).

Beyond the increased communication, education, employment, and social network options provided, AAC mobile technology apps have also brought AAC into the mainstream, resulting in increased public awareness and greater social acceptance (McNaughton & Light, 2013; Rummel-Hudson, 2011). They have resulted in increased adoption of AAC technologies and greater consumer empowerment when it comes to accessing AAC solutions (Hershberger, 2011; McNaughton & Light, 2013; Rummel-Hudson, 2011). As a result, AAC is being introduced to a larger and more diverse population than ever before – both younger and older, with a wide array of motor, sensory, cognitive, and linguistic skills (Light & McNaughton, 2012a).

Advancements in technology have also opened up new options for those individuals who have the most complex motor, sensory, cognitive, and linguistic needs and who previously were unserved or poorly served. For example, advancements in brain-computer interface offer the possibility of communication and computer access for those with severe motor impairments who were previously locked-in (e.g., Oken et al., in press; Orhan et al., 2012; Sellers, Vaughan, & Wolpaw, 2010). Preliminary investigations have uncovered the promise of more accurate, more efficient, and less fatiguing access for individuals with severe motor impairments through the use of multimodal access strategies (e.g., Ball et al., 2010; Deng et al., 2009; Fager, Beukelman, Fried-Oken, Jakobs, & Baker, 2012).

The Challenges of Technology Obsession

The technological revolution in the AAC field has come with challenges as well. Too often, it seems that providing AAC intervention is interpreted as simply providing AAC technology. Too often it is assumed that intervention begins and ends with the provision of a device, with limited training and support for the person who uses AAC and their communication partners (McCord & Soto, 2004; Rackensperger, Krezman, McNaughton, Williams, & D'Silva, 2005; Smith & Connolly, 2008).

It seems that a misplaced focus on technology instead of people has seeped into many practices. In some cases, families and clinicians jump to purchase AAC technologies without due consideration of the needs and skills of the individual with complex communication needs (Meder, 2012). There is a danger that technologies will be purchased for children or adults with complex communication needs without a clear sense of how the technology will be used or supported to enhance communication. Without careful consideration of individual needs, skills and preferences, there is great risk that the technology will fail and that such failure will result in rejection of AAC solutions generally. In these cases, it is not AAC but rather an inappropriate AAC device that has failed.

Too often, the focus is on providing a single piece of technology, despite the robust research results that demonstrate that communication is a multimodal process involving the integration of a range of means, depending on communication intents, environments, and partners (Blackstone, Williams, & Wilkins, 2007; Williams, Krezman, & McNaughton, 2008; Williams, 2004). Too often, the intervention process focuses on the purchase or prescription of AAC technology without due attention to intervention to support the individual in learning new skills and train communication partners in appropriate interaction strategies to ensure successful interactions (Baxter, Enderby, Evans, & Judge, 2012; Chung, Carter, & Sisco, 2012; Rackensperger et al., 2005). Too often, intervention focuses primarily on teaching the operation of the AAC technologies (e.g., learning the symbols, organization, navigation, and selection techniques), rather than also teaching the linguistic, social, and strategic skills necessary to develop communicative competence and participate fully in a broad range of environments (De Leo, Lubas, & Mitchell, 2012). Too often, when clinicians and families search for an appropriate AAC solution, there are limited technological options available that actually meet the communication needs and fit the skills of the individual with complex

communication needs. Too often, new AAC technology developments are driven not by the needs and skills of individuals with complex communication needs but rather by an interest in what is technologically possible, resulting in AAC technologies that are poor fits for those who use them.

How did we end up with this skewed focus, and a service delivery system that emphasizes devices and not people? There is no question that the explosion of communication technology throughout society is one factor. We live in an Information Age where technology permeates all aspects of our lives. At the same time, intervention to enhance the communication of individuals who require AAC is a complex and messy process (Light, 1999). Perhaps there is the temptation to believe that technology will be an easy solution. Providing technology offers visible evidence that we are at least trying to do something (Todis & Woodward, 2001).

The missteps resulting from the misplaced focus on technologies are problematic for all individuals who require AAC, but the consequences are especially serious for those who are most vulnerable, specifically those who are unable to advocate for themselves (e.g., young children, individuals with significant cognitive and/or linguistic limitations). Individuals with complex communication needs who have the skills and resources to self-advocate are better equipped to ensure that their needs and preferences are addressed; they are able to define their unmet needs, review available technologies, and make decisions about how and when to add new technologies to their multimodal approach to communication (Williams et al., 2012). However, many individuals with complex communication needs are not afforded the opportunity to provide meaningful input to AAC assessment and intervention planning. If they are unable to use the available technologies, they are frequently denied access to AAC services, with decision-makers concluding that they lack the necessary prerequisite skills. Recent research by Stancliffe et al., (2010) makes clear the scope of the unmet needs, and the implications of a failure to provide appropriate AAC services. In an analysis of the National Core Indicators data from 26 states in the United States, Stancliffe and colleagues reported that only a small percentage (8.6%) of individuals with intellectual disabilities who had complex communication needs had access to any form of aided or unaided AAC. The vast majority of people with severe and profound disabilities had no means to contribute to decisions on where they would live and how they would spend their day; they rarely, if ever, interacted with others in their community (National Core Indicators, 2012).

Putting the Person First

We need to ensure that the focus of assessment and intervention activities is on the person who requires AAC and his or her communication needs. As Michael Williams so eloquently reminded the student – the essence of the field is not the technology, but rather the people who require AAC. The technology is simply a tool. The end goal is to enhance communication for individuals with complex communication needs – to provide effective and efficient means and supports to allow them to express needs and wants, exchange information, develop social relationships, and participate in social etiquette routines (cf. Light, 1988). Technology use is not the end goal; in fact, technology use has no inherent value in and of itself. It is communication – not technology use – that is the essence of human life, for it is through communication that we are able to connect with one another and attain our full potential (Light, 1997). Communication underlies all aspects of life; it supports increased educational achievement, enhanced employment options, greater community inclusion, and improved quality of life overall. Maximizing communication for individuals with complex communication needs must be our end goal, and technology is just one tool to meet this goal.

If we are to truly harness the power of technology to maximize communication, improve outcomes, and enhance the overall quality of life of individuals with complex communication needs, then the following conditions must be met: (a) Rehabilitation and educational professionals must maintain their focus on the goal of communication, and must plan multi-faceted AAC intervention to truly maximize communication; (b) These same professionals must work collaboratively with persons who use AAC and their families to identify and evaluate AAC technologies that fit the needs, skills, and preferences of the individual who requires AAC; and (c) Researchers and developers must ensure that new AAC technologies actually reflect the needs and skills of those that use them.

Ensuring AAC Assessment-Intervention Focuses on Communication

In order to ensure successful outcomes, the AAC team must keep their focus on communication; the prescription of AAC technologies and other systems must be framed within the context of maximizing communication. In order to ensure that communication (not technology) drives the AAC intervention, it is critical that the assessment process starts with a comprehensive review of the individual's present and future communication needs (i.e., with whom, where, when, why, how, and about what the individual needs to communicate). It is these needs, specifically those that are unmet, that should drive the entire intervention process (Beukelman & Mirenda, 2013). Furthermore, in order to be maximally effective, intervention must focus on not only the selection and customization of appropriate AAC systems (the tools of communication) but also instruction in the necessary linguistic, operational, social, and strategic skills necessary to maximize communicative competence (De Leo et al., 2012). Communication is a two-way process, and the

success of the AAC intervention ultimately depends on both the individual who requires AAC and his or her communication partners (Blackstone et al., 2007). Therefore, intervention is also required to teach partners the necessary strategies and skills to support interaction with the individual who requires AAC on a daily basis (Binger, Kent-Walsh, Ewing, & Taylor, 2010; Binger, Kent-Walsh, Berens, Del Campo, & Rivera, 2008; Kent-Walsh & Light, 2003; Tsai, Lee, & Tseng, 2011). In a review of the issues associated with device abandonment, Johnson, Inglebret, Jones, and Ray (2006) reported that 8 of the 10 most frequently reported reasons for abandonment were related to partner training and support issues (e.g., lack of communication opportunities, outdated vocabulary that does not meet current needs). Thus, AAC intervention must address not only providing the individual with complex communication needs with effective means of communication, but also ensuring that he or she develops the necessary skills to enhance communicative competence and has the necessary supports (from partners in the environment) to communicate successfully.

Ensuring an Appropriate Person-Technology Fit

Although definitely not the only component, the selection of appropriate AAC systems is one important component of AAC assessment/intervention. Too often, however, AAC technologies are selected without due consideration of the individual's communication needs and skills. Instead of fitting the technology to the person, he or she is left to adapt to the demands of the technology.

In theory, the process of feature matching is well recognized as a key component of AAC assessment and intervention planning (Beukelman & Mirenda, 2013; Scherer, 2005). Through this process, the AAC team is expected to evaluate the skills and preferences of the individual with complex communication needs; consider his or her environments and communication needs (e.g., partners, tasks); define the features required within AAC technologies (e.g., language representation, display, feedback, rate enhancement, access methods, etc.); review the specific features of potential AAC technologies; and determine the best person-technology fit (Beukelman & Mirenda, 2013; Scherer, 2005).

In practice, this process is not always followed in AAC assessment and intervention planning. AAC technologies are more apt to be prescribed based on popularity rather than the needs and skills of the individual with complex communication needs. Given the rapidly expanding number of AAC technologies and apps, the temptation for clinicians to choose technology based on familiarity is understandable, but it is not acceptable. When clinicians choose AAC technologies based on their own familiarity, they minimize the demands on themselves to keep pace with recent technological advances in the field and to acquire operational skills for the wide range of technologies now available. Choosing AAC technologies based on popularity and clinician familiarity means that the person-technology fit may not be optimized, resulting in distinct disadvantages for the individual who requires AAC. He or she is forced to fit the technology selected and bear the burden of additional and substantial costs associated with learning the necessary operational skills to use the technology (cf. Beukelman, 1991).

This increased cost of learning is most apparent when the representations, layout, organization, output, and/or selection techniques of the chosen technology do not match the skills and needs of the end user (Cockerill et al., 2013; Johnson et al., 2006). The time and effort spent on learning operational skills could be better spent on other pursuits, such as learning language, literacy, and communication skills; maximizing educational achievement and employment skills; or building friendships and social networks. In the worst-case scenario, the lack of person-technology fit may actually result in the abandonment of AAC systems. In fact, Cockerill and colleagues reported that frustration in attempting to use an AAC system was a primary factor contributing to system abandonment (Cockerill et al., 2013).

It is not surprising that many families and clinical teams end up selecting AAC systems based on their own familiarity rather than the optimal person-system fit. There is still limited public awareness of the large number of AAC options available, and it is difficult for family members and clinicians to know the questions that should be asked and the criteria that should be considered in making decisions (Rackensperger et al., 2005). Many rehabilitation and educational professionals lack knowledge and skills in AAC generally (Costigan & Light, 2010) and in AAC technologies/apps specifically (Niemeijer, Donnellan, & Robledo, 2012). Keeping pace with the rapid changes in technologies and the proliferation of AAC apps can be an overwhelming challenge (RERC on Communication Enhancement, 2011). The problem is further aggravated because few preservice training programs include specific training in AAC technologies/apps and even fewer include comprehensive training and practice in working in partnership with consumers and family members to implement AAC interventions (Costigan & Light, 2010). In order to maximize the person-technology fit, those who provide AAC services must make a commitment to stay abreast of current technological developments; consider the full range of options available; and fit the technology to the person who requires AAC, based on his or her needs, skills, and preferences rather than fitting the person to the technology. For AAC to be effective, there must be a significant investment in selecting appropriate AAC systems and providing appropriate intervention supports at home, at school/work, and in the community (Cockerill et al., 2013).

Ensuring that New AAC Technologies Maximize the Human-Computer Interface

Of course, the search for an appropriate person-technology fit assumes that there are, in fact, AAC technologies available that provide good fits to the needs and skills of the full spectrum of individuals who require AAC across the life span, including children and adults with developmental disabilities (e.g., autism spectrum disorders, cerebral palsy, Down syndrome, other intellectual disabilities); acquired disabilities (e.g., disabilities such as those resulting from traumatic brain injury, stroke, spinal cord injuries); degenerative neurological conditions (e.g., progressive aphasia, dementia); and temporary conditions (e.g., intubation after surgery, Guillain-Barré). Although considerable progress has been made in recent years, there is still much work to be done in the development of technology that is truly a good match for the needs and skills of individuals who use AAC.

The need for increased attention to human factors design is not unique to the AAC field. Many mainstream technologies do not reflect designs that maximize human performance. For example, some have argued that the traditional QWERTY keyboard layout is by no means an optimal keyboard layout for typing as most key selections are in the top or bottom rows rather than the middle home row, and the left hand is required to make selections more frequently than the right hand (the dominant hand for most people) (Noyes, 1983). Norman (1988) provides some insight into the lack of consideration of human factors when he describes the design curve of many technological developments. Initially, technology designs are clumsy, as developers seek innovative solutions to complex problems. If these early designs enjoy widespread adoption, it is often difficult to replace them with more efficient approaches (e.g., more efficient keyboard layouts) at a later date. For other devices, however, these early designs improve with greater attention to human factors and system affordances; but then, in an effort to continue to release new products, designers begin to add more, typically unnecessary, features that add complexity to system operation and increase learning demands but do little to enhance functionality or utility. At both ends of this design curve, there is a lack of focus on human factors and the end user. Mainstream technology designs that fail to attend to human factors issues can be deeply frustrating for those that attempt to use them, even those who do not have the additional challenges of motor, cognitive, sensory, and /or language impairments. In fact, 80–90% of apps are abandoned by individuals without disabilities after a single use because they are too difficult to use or do not meet the individual's needs (Pramis, 2013).

People without disabilities can choose to struggle to learn a less than ideal interface or they can choose to abandon the app and stay with traditional solutions. However, individuals who require AAC may have limited options available to meet their communication needs. For these individuals, the lack of attention to human factors in technology design can create insurmountable barriers to operational competence and effective communication. When technologies are well designed, they can facilitate effective communication (Wilkinson, Light, & Drager, 2012). However, when systems are poorly designed, they may negatively affect, and in fact disrupt, communication performance. AAC technology design must be driven by the needs and skills of the end user; otherwise, the technology may impose significant processing demands that may negatively impact communication. For some individuals, these increased learning demands may simply be too great, leading clinicians to conclude erroneously that they are not ready for AAC, thus excluding them from the AAC services that they require.

Why do current AAC technologies impose such high learning demands? Why are these technologies a poor match for many people who have complex communication needs? Let's briefly consider the history of the field to better understand the current situation. According to Caves, Shane, and DeRuyter (2002), the first published reference to aided AAC systems was in a book by Goldberg and Fenton written in 1960, a guide to the development and use of low-tech conversation boards for individuals with cerebral palsy. Following this early reference, there were significant pioneering developments of nonelectronic communication boards (McNaughton, 1990; Zangari, Lloyd, & Vicker, 1994). For the most part, these communication boards utilized some form of graphic symbols (e.g., photos, line drawings, Blissymbols, letters, words) organized in a grid format of rows and columns. These developments offered important breakthroughs for individuals with complex communication needs who had, up to then, been without a viable means of communication. The focus was on proving what was possible for these individuals with the introduction of AAC. In the 1980s and beyond, there was growing interest in applications of computer technology to enhance communication for this population (Vanderheiden, 2003). Many of these early technologies (e.g., AutoCom) took the designs of the nonelectronic communication boards and simply mapped them onto computer technology. Over time, increased research and development resulted in a broad array of SGDs made available to individuals with complex communication needs from a range of assistive technology manufacturers (Hourcade, Pilotte, West, & Parette, 2004; Shane, Blackstone, et al., 2012). Despite variations in specifics, in many ways the designs of these SGDs uniformly conformed to the designs of the original nonelectronic communication displays (i.e., grid-based layouts of AAC graphic symbols). And, even with the recent explosion of iPads and mobile technologies, the majority of AAC apps have simply replicated the original designs, leading Light and McNaughton (2012b) to conclude, "Essentially we are running apps

reflecting designs from the 1980s/1990s on cutting edge 21st century hardware". (p. 36).

Understandably, the early designs of nonelectronic communication boards reflected our best guess at the time about the needs of individuals who required AAC, rather than scientific evidence. These early developments were critical in opening up new communication possibilities for individuals who required AAC and demonstrating what was possible with the provision of AAC. These designs were quickly adopted as the standard in the field and they have persisted ever since. In the past 30 years, there has been a range of studies to compare the effects of different variables in these designs on learning and communication performance. For example, there have been numerous studies to investigate the iconicity of graphic symbols such as photos, PCS, Blissymbols, and written words (e.g., Bloomberg, Karlan, & Lloyd, 1990; Mirenda & Locke, 1989; Mizuko, 1987); and the effects of various array variables on the accuracy and efficiency of selection via scanning of these grid displays (Dropik & Reichle, 2008; Lesher, Moulton, & Higginbotham, 1998; White, Carney, & Reichle, 2010). Yet, all of this comparative research has rested on the assumption that the fundamental design of the AAC interfaces is appropriate for individuals with complex communication needs. Few questioned the lack of scientific evidence to support what had become the accepted standard for AAC system design.

Only recently have researchers and developers started to question the assumptions underlying the accepted standard, in order to determine if there are alternative ways to design AAC technologies to better meet the needs and skills of individuals with complex communication needs and better support the communication process. The call is to re-think the design of AAC technologies to ensure that the representations, organizations, layouts, selection techniques, and output truly reflect the needs and skills of those who use them. This effort to re-think the design of AAC technologies has important implications for universal design for all, but it is particularly critical for those who are most vulnerable to learning demands due to age (the youngest and the oldest) and functional status (e.g., those with the most significant motor, cognitive, language, and sensory impairments). Our understanding of the optimal designs of AAC technologies is in its infancy. However, there is a growing body of research that is beginning to inform the problem. Let's consider just a few examples to illustrate.

Use of Background Color in Grid Displays. Early in the development of nonelectronic communication boards, clinicians began to group graphic symbols of similar word classes together and utilize background color to mark these groupings (e.g., yellow background for people, green for actions) in order to facilitate the construction of more complex messages. In fact, use of background color in this way has become a widespread practice in the field (Goossens', Crain, & Elder, 1999). But is this standard practice actually valid? A recent line of research by Wilkinson and colleagues suggests that the use of background color does not actually facilitate the location of symbols (e.g., Thistle & Wilkinson, 2009; Wilkinson & Coombs, 2010; Wilkinson & Snell, 2011). In fact, in a preliminary study, Wilkinson and Coombs (2010) found that background color did not enhance the accuracy and speed of locating symbols for typically developing children (ages 5–5;6) (years;months) and background color actually impeded the performance of younger typically developing children (ages 3;6–3;11) compared to grids with no background color. A follow-up study by Wilkinson and Snell (2011) had similar results: Although spatial groupings supported children in locating symbols, background color did not; children performed best when symbols were grouped on a white background, compared to when symbols were grouped on colored backgrounds. At first glance, these results seem surprising; however, there may be several hypotheses to explain the lack of facilitative effect for background color. Background color cues are intended to provide top-down processing cues as to the word class or taxonomic grouping of symbols; however, children may require metalinguistic/metacognitive skills to benefit from these cues. Young children and most individuals with complex communication needs utilizing grid-based displays of graphic symbols may not have the metalinguistic skills required to benefit substantially from these cues.

According to Wilkinson and colleagues, children seem to be able to derive some benefit from spatial groupings of similar types of symbols, but not from background color. What explains the difference between the effects of spatial arrangement and background color? The answer may be found at the more basic level of the children's bottom-up visual processing of the AAC display. The research in visual cognitive science indicates that color has a powerful effect on visual perceptual processing (Wilkinson & Jagaroo, 2004). Whereas the attraction to color can have a facilitative effect when it draws the child to the symbol itself (as with internal symbol color), background color may actually serve to distract young children from the important content (i.e., the symbols themselves), thus negatively impacting their performance. In contrast, when symbols are grouped on a white background, children can focus only on the important content of the display (i.e., the symbols themselves), thus facilitating the search process. It should be noted that this research is still very preliminary in nature and these hypotheses are speculative. All of the research to date has involved small numbers of children with typical development; individuals with complex communication needs, especially those with associated visual impairments, may function quite differently. Furthermore, none of the studies to date has actually investigated the use of background color to designate word class as it is typically applied in the AAC field; rather the studies have investigated the effects of background color as a cue to taxonomic

category. Clearly, future research is required to fully investigate the effects of background color on basic visual processing and the search for AAC symbols by individuals with complex communication needs. Nevertheless, these preliminary data raise serious questions as to the practice of using background color in AAC displays; these questions must be answered in order to maximize communication for individuals with complex communication needs.

Horizontal and Vertical Layouts. The challenge of determining optimal human-computer interfaces extends to selection techniques as well. Research by Costigan, Light, and Newell (2012) illustrates another potential mismatch between standard AAC technology designs and the needs and skills of end users. These researchers completed a study of typically developing children using a mouse to access computer technology and found that the performance of the youngest children (3-year-olds) was improved when access relied on vertical selections rather than selections on horizontal or diagonal planes. These researchers posited that a vertical layout lessened demands because it did not require the children to deviate from midline; thus, the vertical layout allowed the children to focus more resources on the fundamentals of the selection task than the horizontal or diagonal selections, which required the children to deviate from midline. These results suggest that it might be better to introduce beginning communicators to AAC technologies with displays organized vertically rather than following the accepted practice of using horizontal or grid-based layouts (Piche & Reichle, 1991). Could it be that menus and navigational bars for moving between displays within AAC technologies (or for controlling mainstream apps like Microsoft Word) will better facilitate use if they are laid out on a vertical axis rather than a horizontal one? Obviously these data are very preliminary in nature; future research is required to further investigate this issue, in order to determine what layouts will maximize selection accuracy and efficiency for beginning communicators and others with complex communication needs, especially those with significant motor impairments.

Grid Display and Visual Scenes Displays. Beyond questioning the specific design specifications for traditional grid-based AAC displays, researchers and developers have recently started to question the assumption that the standard grid display is the most appropriate fit for many individuals who use AAC, especially those that have significant language and cognitive limitations (e.g., young children with complex communication needs who are learning language, adults who have experienced language loss) (Fried-Oken, Beukelman, & Hux, 2012; Light & McNaughton, 2012b). The question is not whether individuals with complex communication needs can learn to use traditional grid displays – there is evidence that they certainly can; the question is, what type of design best fits the cognitive, language, sensory, and motor skills of individuals with complex communication needs and so will maximize their learning and communication performance?

In recent years, visual scene displays (VSDs) have been proposed as an alternative approach to the traditional grid display. VSDs are photos (or line drawings) of meaningful events within the individual's life that include language or vocabulary concepts embedded within the scene (Fried-Oken et al., 2012; Hux, Buechter, Wallace, & Weissling, 2010; Shane, Laubscher, et al., 2012). There is a growing body of research that demonstrates that individuals with complex communication needs who are learning language and those who experience language and/or cognitive limitations benefit significantly from access to VSDs to communicate with others. This research shows that (a) young children attend first and longest to photo VSDs compared to grid displays of symbols (Wilkinson & Light, 2013); (b) young children are more accurate selecting vocabulary with VSDs than grid displays (Drager, Light, Curran-Speltz, Fallon, & Jeffries, 2003); (c) children with complex communication needs are able to use VSDs to participate in social interactions at very young ages; they demonstrate significant increases in their communicative turns and the range of language concepts expressed as a result of AAC interventions utilizing VSDs (e.g., Light & Drager, 2012); (d) older children and adolescents with severe disabilities also demonstrate increases in their participation in social interactions with the introduction of AAC technologies utilizing VSDs (Drager & Light, in progress); (e) Adults with aphasia demonstrate improved communication with access to photo VSDs that are context-rich and provide access to the necessary language concepts to tell a story or share experiences; the photo VSDs serve as shared referents to support communication (McKelvey, Dietz, Hux, Weissling, & Beukelman, 2007); and (f) adults with progressive aphasia demonstrate increases in their spoken language and the exchange of new information through use of photo VSDs with written labels (Fried-Oken, Rowland, Daniels, Mooney, & Noethe, 2013).

Light and McNaughton (2012b) posited that VSDs offer a number of advantages for beginning communicators and those with significant language and cognitive limitations as compared to traditional grid displays. They noted that VSDs (a) capture the social interactions that are the contexts in which individuals learn and use language, thus providing visual supports for language learning and use; (b) replicate events actually experienced by individuals with complex communication needs, thus supporting access to language concepts via episodic memory, not just semantic memory; (c) present language concepts within familiar event schema, thus providing more contextual support for understanding of these representations; (d) preserve the conceptual relationships as well as the visual relationships (i.e., proportional size, location) between people and objects as they

are experienced in the real world; (e) exploit the human capacity for rapid visual cognitive processing of naturalistic scenes (in contrast to grids of isolated symbols); and (f) allow individuals to "chunk" the key elements (representations) in the scene together, thus imposing fewer working memory demands than traditional grid displays.

Based on this growing body of research, it seems that the standard grid designs utilized in most AAC technologies may not be the most appropriate fit for those individuals with complex communication needs who are most vulnerable to language and cognitive limitations (e.g., young children who are learning language, older individuals with severe disabilities, individuals with severe aphasia, and those with degenerative language/cognitive disorders). Future research is urgently required to determine the most effective layouts and organizations for individuals with complex communication needs – ones that are driven by the cognitive, language, sensory, and motor skills, as well as the communication needs, of the individuals who use them.

These are just a few examples illustrating the urgent need to question the standard designs that have been used in AAC technologies for so many years. This is not to say that the standard designs are inappropriate for everyone or that any of the innovative approaches proposed in these examples are, as of yet, optimized to the needs and skills of individuals with complex communication needs. We are only beginning to unravel the problem of designing effective human-computer interfaces in AAC. Concerted research is required to better understand the motor, cognitive, language, and sensory perceptual processing of AAC displays by individuals with a wide array of complex communication needs. These empirical data must be used to drive the development of a new generation of AAC technologies that will be based not on traditional practices, but rather on scientific knowledge of the needs and skills of end users. Concerted research and development is required to design a whole new generation of AAC technologies reflecting principles of user-centered design utilizing the tenets of human-computer interface research. No doubt this work will result in new and innovative approaches for AAC technologies not yet thought of. These innovations will have implications not just for improving AAC technologies to better meet the needs of individuals with complex communication needs, but also for enhancing the design of mainstream technologies to promote universal design for all. For just as curb cuts and ramps benefit many beyond those with disabilities (e.g., parents with strollers), so too will improved human-computer interfaces benefit many beyond those with complex communication needs. Few people wish to spend time learning the operation of technologies; strategies and techniques to improve the designs and reduce learning demands will benefit all.

Conclusion

There is no question that technological developments have offered many new opportunities for individuals with complex communication needs, including levels of communication and networking that were unthinkable even 10 years ago. Persons who use AAC are using AAC technologies to pursue post-secondary education (Chung, Behrmann, Bannan, & Thorp, 2012; Luciani, 2010), obtain and maintain employment (Isakson et al., 2006; McNaughton et al., 2012), and participate actively in the community (Collier & Self, 2010; Dattilo et al., 2008; Kennedy, 2010). But, along with the allure of these new and powerful technologies, there is a danger that people with complex communication needs will be forced to adapt to the demands of the technology, rather than ensuring that the technology responds to their needs, skills, and preferences. Furthermore, there is a danger that intervention will be limited to the provision of a device, without providing appropriate training and supports to maximize communicative competence. We must remember Michael Williams' words, reminding us that it is the people, not the technology, that must be the central focus of AAC intervention. Let us ensure that we are a field devoted to people who require AAC, not the field of AAC; that ours is a field not overly focused on technology but rather one that recognizes the need to maximize the communication and participation of individuals with complex communication needs, utilizing technology as one tool towards this end goal. In order to attain this vision, commitment is required from rehabilitation /educational professionals and from researchers and developers. AAC practitioners must provide high quality AAC services that focus not only on the selection of AAC systems, but also on intervention to build communicative competence and environmental supports. AAC practitioners must ensure that the selection of AAC systems is driven, not by the technology but rather by the individual's needs and skills, in order to maximize the person-technology fit. AAC researchers and developers must investigate the underlying cognitive, linguistic, sensory, and motor processing of individuals with complex communication needs of a wide array of ages and disabilities; and then use this foundational knowledge to drive the design of a new generation of AAC technologies that truly reflect the needs, skills, and preferences of end users. It is only then that we will truly attain the vision for people who require AAC to meet their full potential.

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Note

1. The iPad is a registered trademark of Apple Inc., Cupertino California. www.apple.com

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