The Changing World of Augmentative and Alternative Communication (AAC): Examining Three Realities Faced by Today's AAC Provider

Billy T. Ogletree

Department of Communication Sciences and Disorders, Western Carolina University
Cullowhee, NC

Summer McMurry

Megan Schmidt

Kaylan Evans

Department of Communication Sciences and Disorders, The University of North Carolina at Greensboro
Greensboro, NC

Disclosures

Purpose: *This article considers the following 3 realities facing augmentative and alternative communication (AAC) providers today: (a) Users are not homogeneous with respect to culture and language, (b) the traditional team-based AAC assessment process is not a necessary or preferred technology procurement route for many AAC users and their stakeholders, and (c) commonly held assumptions about AAC symbol transparency and display are not supported by data and can limit the effectiveness of AAC users. These realities represent a subset of many current issues in AAC and emerged as the authors participated in a doctoral seminar addressing critical AAC practice trends. Ideas are presented, and new directions for AAC providers are recommended.*

Conclusion: *AAC providers must be aware of and responsive to ever-changing practice realities in AAC.*

Since augmentative and alternative communication's (AAC) modern emergence in the 1950s and 1960s, the field of AAC has enjoyed an ever-broadening professional acceptance (Beukelman & Mirenda, 2013; Hourcade, Pilotte, West, & Parette, 2004). Researchers and practitioners from many disciplines have worked to establish and refine evidence-based practice principles to improve the communicative competence of persons with complex communication needs. Assessment and intervention models that are team based, inclusive of AAC stakeholders, and focused on increased participation for AAC users in all realms of life have emerged (Batorowicz & Shepherd, 2011; Beukelman & Mirenda, 2013). Although these models can be used to identify and promote the effective use of AAC systems and devices, they are often time-consuming and fraught with frustrating practice challenges. These include, but are not limited to, issues specific to provider preparedness, team dynamics, and services/device funding. Challenges to successful service delivery have long frustrated AAC stakeholders and frequently jeopardized the implementation of ideal AAC solutions.

As we move deeper into the 21st century, new challenges and realities are impacting existing AAC practices. The world is flattening as cultures and languages blur like never before; technology is ubiquitous, increasingly mobile, and more affordable than ever; and research is providing new, evidence-based insights that frequently counter accepted practices. By choice or by default, established assessment and intervention models are evolving in response to these and other trends.

This article considers three realities facing providers today: (a) AAC users are not homogeneous with respect to culture and language, (b) the traditional team-based AAC assessment process is not a necessary or preferred technology procurement route for many AAC users and their stakeholders, and (c) commonly held assumptions about AAC symbol transparency and display are not supported by data and can limit the effectiveness of AAC users. These realities represent a subset of many present-day issues in AAC and emerged as the authors of this article participated in a doctoral seminar addressing critical AAC practice issues. What follows is a discussion of each reality introduced above. As a point of information, this article is written with children and families in mind. We believe, however, that the issues addressed are germane across the lifespan of individuals with complex communication needs. Below, ideas are presented, and new directions for AAC providers and the broader AAC community are recommended.

Reality 1: The Impact of Culture and Bilingualism on AAC

Our world is changing. In the past two decades, a population shift has occurred from developing to industrialized countries and, more specifically, from rural areas within countries to cities (Soto & Yu, 2014). Thus, increasing numbers of children and families from diverse backgrounds are in position to be served by AAC providers worldwide. Individuals in this varied potential pool of service recipients bring unique cultures and languages to AAC assessment and intervention. It seems reasonable to question how these experiences will impact AAC services and what practice innovations are necessary for future providers.

Culture

Culture, as it relates to a group or community, is commonly defined as shared attitudes, values, goals, and practices (Spencer-Oatey, 2012). Today, one's culture is both reflective of predictable parameters such as race, ethnicity, and national origin and unique characteristics such as regional identity, religion, gender identity, and sexual orientation. Interestingly, individuals often identify with more than one of the cultural descriptors provided above.

The United States has long prided itself as a cultural melting pot, yet the impact of myriad cultures persists in the everyday fabric of American society. Simply put, people now living in the United States comprise a group that is far from homogeneous. Culture impacts most aspects of AAC services. For example, AAC team functioning (during assessment or intervention) can occur in a manner consistent with or in opposition to the attitudes and values of a group or community. If collaboration is honored culturally, team members may choose collaborative team models. If groups or communities value expert opinions, however, team members may defer to models more consistent with authoritative structures.

Culture may also impact a host of AAC assessment and intervention decisions. Choices for symbol sets and arrays, vocabulary, and prestored messages come to mind. Clearly, the attitudes, values, goals, and practices of groups or communities provide a rich and critical context for discussion specific to these and other areas.

Bilingualism

Recent U.S. Census Bureau (2010) data reveal that 20% of the U.S. population over the age of 5 years does not speak English at home. It is not surprising then that 95% of speech-language

114

pathologists in the United States report working with at least one individual who does not speak English as his or her primary language (Soto & Yu, 2014). In today's world, increasing numbers of individuals speak or understand more than one language. Fluency with at least two languages is, according to American Speech-Language-Hearing Association (ASHA), the definition of bilingualism (ASHA, 2004).

Many paths lead to bilingualism. The degree to which children can become functional users of more than one language, whether learning simultaneously or sequentially, depends on language exposure. For more than one language to be developed fully, both must be modeled frequently and during meaningful learning opportunities (Soto & Yu, 2014).

Children who are only receptively bilingual are at risk for low academic performance and social marginalization (Soto & Yu, 2014). In contrast, children competent (receptively and expressively) with all languages to which they have been exposed are more likely to develop advanced cognitive skills, graduate high school, appreciate family and cultural connections, increase social integration, and experience emotional health (Adesope, Lavin, Thompson, & Ungerleider, 2010; Soto & Yu, 2014). In addition, bilingualism has been associated with stronger performances in metalinguistic reasoning, increased attention, working memory, and symbolic representation skills, all of which are key skills for language/cognitive growth as well as competent AAC use (Barac, Bialystok, Castro, & Sanchez, 2014; Parette & Huer, 2002). Finally, a recent study reported benefits of bilingualism that span into adulthood. Specifically, Bialystok, Craik, and Luk (2008) noted that, in advanced adulthood, bilingual adults experienced cognitive decline at a slower rate than monolingual speakers.

New Directions for AAC Service Providers

Today's AAC providers are faced with a culturally diverse population of potential service recipients. Being prepared to meet this group's needs hinges on both a general awareness of the cultural heterogeneity all around us and a more specific commitment to cultural competence as a provider.

Becoming aware of society's diversity requires the ability to look beyond oneself—to achieve a conscious mindfulness of others. This awareness is advanced when, as providers, we solicit and are open to the perspectives of stakeholders close to the potential AAC user as well as the user himself or herself. An open invitation to incorporate culture into AAC decision making provides an open door for dialogue specific to a group or community's attitudes, values, goals, and practices. Openness, in turn, allows for both the exchange of cultural information and the occasional cultural faux pas. The central takeaway for AAC providers is to encourage mindfulness and cultural openness as a team value.

Cultural competence is the application of behaviors, attitudes, and policies that allow for effective cross-cultural exchange (ASHA, n.d.). Simply put, being culturally competent is aspirational. That is, people do not acquire cultural competence as much as they constantly work toward the actualization of this reality. An overarching goal of AAC providers and teams must be to commit to practice centered in cultural competence. Doing so requires myriad actions including, but not limited to, completing self-assessments on cultural biases and beliefs; respecting others; identifying and pursuing training opportunities in cultural competence; integrating the cultural beliefs, attitudes, and practices of AAC users into everyday clinical decision making; and using culturally appropriate communication with, and in regard to, AAC users and stakeholders (ASHA, n.d.).

As bilingual speakers increase, speech-language pathologists and others charged with AAC service delivery must make decisions from more than a monolingual perspective. For example, AAC assessment must include the competent evaluation of all languages to which the potential AAC user is exposed. This clearly requires the AAC assessment team to include stakeholders who are competent with target languages. Specific assessment team models (e.g., interdisciplinary and transdisciplinary) encourage team status for family members to utilize family knowledge while

115

promoting family interests and priorities (Ogletree, 1999). It seems reasonable that teams reflecting these models would have ample access to all languages of importance to the potential AAC user through family members. In addition to the presence of competent users of all target languages, assessment teams must utilize test materials accessing more than one language and inclusive of print exposure across languages of interest.

Reality 2: The Evolution of AAC Assessment

For years, students of speech-language pathology and others interested in AAC have studied and applied assessment guidelines and practices centered on team-based decision making. AAC assessment team models have generally promoted collaborative processes that include data generation, problem solving, collective solutions, trial runs of recommendations (e.g., unaided to aided solutions), and, when needed, system procurement (Batorowicz & Shepherd, 2011; Beukelman & Mirenda, 2013; Binger et al., 2012; Glennen & DeCoste, 1997). Often, myriad allied health, health, and other disciplines/partners are involved in assessment, offering perspectives on mobility, physical/sensory competence, system access, symbol knowledge, expressive/receptive language abilities/needs, and broad-based social/other device questions/applications (Binger et al., 2012). AAC team assessment, although cumbersome at times, has been considered a necessary path for those with complex communication needs.

A new day has dawned. Advances in technology and the ubiquitous nature of computer hardware and software have created a more direct path for those considering AAC solutions (McNaughton & Light, 2013). Central to this movement has been the advent of powerful and somewhat affordable computer tablets and the literal explosion of low-cost, simple-to-use computer applications (Dolic, Pibernik, & Bota, 2012). Whereas the team-based assessment process described above may take weeks to schedule and additional time to yield physical solutions, the alternative path of tablets and applications only requires a trip to the local technology store and a quick web search.

Change is often difficult, and changing (or averting) an AAC assessment process so valued by professional stakeholders is particularly challenging. Accordingly, AAC professional team members must examine and respond to the advantages provided by this new path to AAC solutions. Specifically, why are tablets and applications so appealing? First, they immediately address a need. The urgency of providing a communication solution for someone in need is a powerful motivator for action. If resources are available, it is difficult to fault family members or loved ones who take matters into their own hands. Second, costs can be quite reasonable. Literally, solutions can be in place for hundreds of dollars in comparison with the often-prohibitive costs associated with team-based AAC assessment and procurement. Finally, right or wrong, the Internet always has an answer. For the newcomer to AAC, most questions can be addressed by a simple Internet search, and media sites provide crowdsourced solutions to even the more challenging queries.

Now, we see why the tablet and application path is appealing. What are its disadvantages? First, individuals facing the need for AAC for their loved ones may not have informed questions to guide their search for solutions. Uninformed questions often lead to answers with limited utility. For example, a mother may search "AAC devices for children with autism," leading to a broad array of response options that could be less than helpful for her child. From this search, a decision may be made to purchase a speech output application for a tablet without taking into consideration child-specific needs related to access, symbol complexity, or a host of other features. Simply put, the expertise of the AAC team is invaluable. Team members have years of training and, often, years of experience that will improve the bottom line—the fit between a device or system and the communicative abilities and needs of the child. If one thinks of the very big notion of value, an informed AAC team process may be a time and money saver due to the fit and appropriateness of the solution. Furthermore, the purchase itself may also be less painful due to the collective knowledge of team members regarding funding alternatives.

116

Second, AAC assessment teams must look beyond the child to variables that impact system or device success. Beukelman and Mirenda (2013), in their discussion of their participation model, recommend the assessment of barriers to effective AAC use that extend well beyond the child to the policies and practices of his or her classroom and the partners and environments he or she encounters daily. The naive consumer of tablets and AAC applications is unlikely to look outside the immediate needs of his or her child, potentially compromising communication effectiveness.

The final disadvantage inherent in the tablet and application path to AAC occurs independent of the consumer purchasing the solution and relates more broadly to the construction of technology and the creation of applications. Designers of computer hardware and software do what they do with an audience in mind that presents no significant challenges as users and learners. Accordingly, they often fail to consider the needs of populations with physical, cognitive, social, or communicative limitations such as alternate access, screen glare, touch sensitivity, available symbol sets, capacity for importing data, and voice flexibility. The principle of universal design (i.e., access for and by all) has yet to be embraced by the everyday technology industry (DeRuyter, McNaughton, Caves, Nelson Bryan, & Williams, 2007).

New Directions for AAC Providers

As authors, we believe the AAC assessment is largely cast. That is, in today's consumer-driven and easy access market, there will continue to be some side-stepping of the traditional assessment process. What options then are left for AAC providers? One is to streamline and improve our traditional processes.

Clearly, we can seek ways to streamline AAC assessment, making it both more responsive and cost-efficient. In the world of communication service for infants and toddlers, Crais and Calculator (1998) advocate for in-depth preassessment staffing. Such staffing emphasizes time spent with families before the larger team process. This allows for early data collection, insight into family priorities and limitations, and discussions specific to the impending team process. Other changes to traditional assessment could include the formation of smaller core teams and the triaging of referrals to reduce wait times, and/or the creation of referral networks and collaborative partnerships to both catch families early in the diagnosis process and facilitate ease of system/device trial runs. With respect to referral networks, one can envision the generation of web-based tutorials and resources for pediatricians and primary care providers that describe the benefits of team-based AAC assessment and prepare interested parties for seamless participation on AAC teams. Similarly, teams could create easily accessible and interactive tutorials explaining system/device funding and roles of community partners, such as assistive technology lending sites.

Even with the suggestions mentioned above, AAC providers will continue to encounter consumers who have side-stepped the traditional team-based assessment process. Our options in these situations are more limited. One that comes to mind is to encourage technology developers to become more aware of the needs of users who are not in the mainstream, that is, to push developers for universal design features in mainstream hardware and software, such as tablets and applications. Along the same line, providers who are knowledgeable about AAC practice issues could enter the development and design game, ensuring the inclusion of features needed by AAC users. These suggestions call providers and their support organizations to a level of activism previously unseen among AAC professionals.

In summary, the AAC assessment world is changing, and we must change with it. Failing to do so will result in increasing numbers of children with complex communication needs who lack appropriate systems or devices.

Reality 3: Challenging Two Commonly Held Assumptions

In a rapidly changing world where AAC technologies advance more quickly than research regarding their optimal application, practice often proceeds without evidence. A research-to-practice

117

gap emerges when actions are taken in the absence of a sufficient evidence base (Olswang & Prelock, 2015). Identifying and addressing these gaps in the field of AAC is critical to effective practice and will result in improved outcomes for AAC users.

Although several AAC research-to-practice gaps exist, practices around symbol transparency and display arrangement are particularly concerning. Choosing and using symbols based on unsupported assumptions can unintentionally increase the instructional burden for clinicians while significantly challenging AAC learners. In the area of symbol recognition and representation in children, new data exist to support alternatives to previously held assumptions about symbol value and learning.

One long-held assumption is that children and adults see symbols the same way. Commonly chosen symbols in North America include Picture Communication Symbols (PCS), Widget symbols, pictograms, and pictures for the Picture Exchange Communication System, among others. These sets are used with a variety of both low- and high-tech AAC devices and systems (Beukelman & Mirenda, 2013; Glennen & DeCoste, 1997). Because of their relative ubiquitous nature, these common symbols are easy to access, affordable, and time efficient for clinicians. This, however, does not mean that their use with young children is supported by evidence.

A recent study challenged currently held assumptions about the representative nature of symbols for children. Janice Light asked young children to name/describe the meaning behind select PCS symbols and then requested that the children draw their own symbols for the concepts represented (Fried-Oken & Light, 2012). Children struggled to name many common PCS symbols, suggesting limited symbol transparency for some drawings in the set. Furthermore, children easily identified drawings they had created, which were typically characterized by higher levels of iconicity than the PCS counterparts. Light's efforts suggest that children's representations can differ significantly from adults. It is noteworthy that most adults, even many with communication challenges, understand and use PCS symbols with some flexibility (Sutton, Morford, & Gallagher, 2004).

Some of the children's responses to PCS symbols in the study by Light described above are enlightening. For example, the PCS symbol for "come" (illustrated by a hand with the index finger beckoning and two arrows indicating movement) was interpreted by children as "pointer finger," "a boo boo," and "two driveways and a hand." Only 10% of the children identified the symbol as "come." The PCS symbol "who," illustrated as a head with a question mark, was interpreted as "a back of a head," "a boy eating spaghetti," and "the number seven with ears." No children in the study identified the symbol correctly. When asked to draw the same symbols, the children drew contextually based pictures. For example, "come" was drawn as two people with outstretched arms looking toward each other. One takeaway from these examples is that more complex concepts (those that are not simple nouns) may be difficult to represent in ways that are interpretable to very young children (Musslewhite & Ruscello, 1984).

Some researchers are responding to the unique symbol needs of children with new symbol sets. For example, Worah (2008) developed Developmentally Appropriate Symbols (DAS) using factors such as concreteness, familiarity, context, wholeness, color, and focus. Worah found that the children could identify abstract concepts more successfully using DAS symbols over PCS symbols. This has implications for teaching abstract concepts or nonnouns to young children using picture symbols with more contextual relevance.

Our second AAC assumption to challenge is that traditional static symbol displays provide the optimal platform for assessing and teaching symbol use. Many AAC providers default to traditional static grids when working with young children with complex communication needs to introduce and promote symbol use. This likely occurs because it "makes sense" to us as examiners or trainers. That is, from our adult and nondisabled frame of reference, grids like those described above seem simple and ideal for assessment and intervention.

New research has provided evidence that symbol identification and use can be enhanced by the addition of animation and sound within dynamic grids. This is particularly true for concepts that are difficult to assess or teach, such as verbs and prepositions. Harmon et al. (2014) examined the addition of sound to animated graphic symbols for verb class. They concluded that sound plus animation activates multiple learning modalities for children, increasing the "guessability" of symbols and decreasing the instructional burden. Harmon et al. caution that the sound plus animation symbols are not meant to replace traditional static symbols for verbs but can be used as an instructional method to scaffold learners as they learn more static representations. These researchers also note that sound and animation are most critical when symbols are introduced to a child for the first time.

Schlosser et al. (2014) compared the effects of animation on the transparency of two symbol sets, the animation-assisted Autism Language Program and the commonly used PCS. The authors were particularly interested in symbol set naming and learning with more developmentally advanced word classes such as verbs, prepositions, and adjectives. Schlosser et al. suggested that the use of animation could highlight the relationship between objects, potentially making their identification easier. They also noted that motion perception develops earlier than other cognitive mechanisms, supporting the potential use of animation with verbs. Not surprisingly, Schlosser et al.'s study revealed a symbol set effect in that children named and identified more verbs and prepositions via Autism Language Program symbols.

It appears then that, as with symbol creation, assuming the appropriateness of a static symbol display could impede symbol learning and use. What about other aspects of the display? For many of the same reasons, AAC providers often choose static displays; some default to left-to-right symbol arrangement on children's grids. Typically, grids start with two symbol choices, then four, six, eight, and so forth, gradually becoming more complex as the child gains capacity. The utility of left-to-right grid organization, however, has not been empirically demonstrated. An alternative to traditional grid organization is the use of visual scenes.

Visual scene displays (VSDs; i.e., everyday scenes with imbedded hot spots for symbol access) are proving increasingly useful as a format for presenting symbol choices to children within relevant contexts. VSDs are typically displayed on touch accessible hardware, such as dynamic computer screens and computer tablets, and yield voice output messages. Research assessing the gaze of infants and toddlers is demonstrating young children's attraction to VSDs (especially faces) and supporting the use of contextualized, meaningful scenes for rapid symbol learning and use (Fried-Oken & Light, 2012; Wilkinson, Light, & Drager, 2012; Worah, 2008).

Wilkinson et al. (2012) recently discussed the value of visual scenes with young children given early visual and cognitive development. These authors explained that VSDs tap into context-supported and event-based learning mechanisms thought to underlie language learning. In summary, VSDs reduce the processing complexity, take advantage of the natural human attraction to human faces, and make use of relevant and meaningful scene choices for the user.

New Directions for AAC Providers

The purpose of this article is not to explore or argue the role of symbol transparency in AAC success. That has been done elsewhere (Bloomberg, Karlan, & Lloyd, 1990; Koul, Schlosser, & Sancibrian, 2001; Mizuko, 2009). Furthermore, as authors, we do not have critical insights to offer specific to grid construction and symbol displays. That said, inaccurate assumptions in these and other areas must be addressed in ways that improve AAC practice.

With respect to symbol learning and use, we simply offer the suggestion that those in the field of AAC make decisions based on variables that matter to young children. An examination of most available drawn symbol sets would suggest that they have been created from the perspective of an adult. New symbol options for young children, such as DAS mentioned earlier (Worah, 2008), are needed.

119

It is one thing to call for new symbols; it is another to make sure that new and old symbol sets are offered with credible evidence as to their effectiveness with young children and others. This requires empirical study to identify and advance salient features of symbols for young children. The factors applied by Worah (2008) in the creation of DAS symbols (i.e., concreteness, familiarity, wholeness, color, and focus) provide initial direction for this inquiry.

A final symbol-related takeaway is basic common sense. That is, when it comes to symbol selection for young children, see the world through their eyes. Do everything within your power to ensure that the symbols created or selected fit the abilities and needs of the children who will use them.

Moving to the issue of symbol animation, grids, and displays, we recommend a broad-based effort to introduce context into symbol organization and presentation. For very young children, increasing evidence supports the use of symbol animation and VSDs. Animated symbols provide users with perceptual and movement-based cues that seem particularly relevant for challenging tasks such as verb learning. Similarly, VSDs appear tailor-made for the early learning abilities and preferences of infants and toddlers.

In closing, providers creating visual scenes must remember that successful VSDs require knowledge of child-relevant contexts and settings heretofore unseen. Therefore, AAC providers must carefully and respectfully introduce themselves into the lives of young children and their families to create meaningful, contextually relevant, and socially valid AAC systems.

Final Thoughts

Introspection of any kind often results in change. As mentioned earlier, this article emerged from inquiry and introspection that occurred during a doctoral seminar examining critical issues in AAC. Our efforts revealed much to learn and apply to AAC practice specific to cultural diversity, bilingualism, and the proliferation of technology. Furthermore, we came to appreciate that many of our accepted actions as clinicians (e.g., symbol section and display) have been based on established rather than demonstrated practices.

Our efforts are only a start. As AAC expands and develops, new ideas will emerge and old ones will resurface. As providers, we must commit to the constant study of our society's evolution and accepted and emerging practices to ensure cutting-edge service delivery. Our challenge is to always see things through the eyes of those we serve while doubling our efforts to apply proven and effective practices.

References

Adesope, O., Lavin, T., Thompson, T., & Ungerleider, C. (2010). A systematic review and meta-analysis of the cognitive correlates of bilingualism. *Journal of Educational Research, 80*(2), 207–245.

American Speech-Language-Hearing Association. (n.d.). *Cultural competence* [Practice Portal]. Retrieved from http://www.asha.org/practice-portal/professional-issues/cultural-competence/

American Speech-Language-Hearing Association. (2004). *Knowledge and skills needed by speech-language pathologists and audiologists to provide culturally and linguistically appropriate services* [Knowledge and Skills]. Retrieved from http://www.asha.org/policy

Barac, R., Bialystok, E., Castro, D. C., & Sanchez, M. (2014). The cognitive development of young dual language learners: A critical review. *Early Childhood Research Quarterly, 29*(4), 699–714.

Batorowicz, B., & Shepherd, T. A. (2011). Team-work in AAC: Examining clinical perceptions. *Augmentative and Alternative Communication, 27*(1), 16–25.

Beukelman, D. R., & Mirenda, P. (2013). *Augmentative and alternative communication: Supporting children and adults with complex communication needs* (4th ed.). Baltimore, MD: Brookes.

Bialystok, E., Craik, F. I. M., & Luk, G. (2008). Cognitive control and lexical access in younger and older bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34,* 859–873.

Binger, C., Ball, L., Dietz, A., Kent-Walsh, J., Lasker, J., Lund, S., . . . Quach, W. (2012). Personnel roles in the AAC assessment process. *Augmentative and Alternative Communication, 28*(4), 278–288.

Bloomberg, K., Karlan, G. R., & Lloyd, L. L. (1990). The comparative translucency of initial lexical items represented in five graphic symbol systems and sets. *Journal of Speech and Hearing Research, 33,* 717–725.

Crais, E. R., & Calculator, S. N. (1998). The role of caregivers in the assessment process. In A. M. Wetherby, S. F. Warren, & J. Reichle's (Eds.), *Transitions in prelinguistic communication* (pp. 261–284). Baltimore, MD: Brookes.

DeRuyter, F., McNaughton, D., Caves, K., Nelson Bryan, D., & Williams, M. (2007). Enhancing AAC connections with the world. *Augmentative and Alternative Communication, 23*(3), 258–270.

Dolic, J., Pibernik, J., & Bota, J. (2012). Evaluation of mainstream tablet devices for symbol-based AAC communication. In G. Jezic, M. Kusek, N. T. Nguyen, R. J. Howlett, & L. C. Jain (Eds.), *2012 KES international symposium on agent and multi-agent systems: Technologies and applications* (pp. 251–260). Berlin, Germany: Springer.

Fried-Oken, M., & Light, J. (2012). Language and learning: Cognitive science considerations in the design of AAC technologies for children and adults. *Presentation from the annual RERC on AAC conference in June 2012.* Retrieved from http://aac-rerc.psu.edu/index.php/projects/show/id/14

Glennen, S. L., & DeCoste, D. C. (1997). *Handbook of augmentative and alternative communication.* San Diego, CA: Singular.

Harmon, A. C., Schlosser, R. W., Gygi, B., Shane, H. C., Kong, Y., Book, L., & Hearn, E. (2014). Effects of environmental sounds on the guessability of animated graphic symbols. *Augmentative and Alternative Communication, 30*(4), 298–313.

Hourcade, J., Pilotte, T. E., West, E., & Parette, P. (2004). A history of augmentative and alternative communication for individuals with severe and profound disabilities. *Focus on Autism and Other Developmental Disabilities, 19*(4), 235–244.

Koul, R., Schlosser, R., & Sancibrian, S. (2001). Effects of symbol, referent, and instructional variables on the acquisition of aided and unaided symbols by individuals with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 16*(3), 162–169.

McNaughton, D., & Light, J. (2013). The iPad and mobile technology revolution: Benefits and challenges for individuals who require augmentative and alternative communication. *Augmentative and Alternative Communication, 29*(2), 107–116.

Mizuko, M. (2009). Transparency and ease of learning of symbols represented by Blissymbols, PCS, and Picsyms. *Augmentative and Alternative Communication, 3*(3), 129–136.

Musslewhite, C. R., & Ruscello, D. M. (1984). Transparency of three communication symbol systems. *Journal of Speech and Hearing Research, 27*(3), 436–443.

Ogletree, B. T. (1999). Introduction to teaming. In B. T. Ogletree, M. A. Fischer, & J. B. Schulz, *Bridging the family-professional gap: Facilitating interdisciplinary services for children with disabilities* (pp. 3–12). Springfield, IL: Charles C. Thomas.

Olswang, L. B., & Prelock, P. A. (2015). Bridging the gap between research and practice: Implementation science. *Journal of Speech, Language, and Hearing Research, 58,* S1818–S1826. https://doi.org/10.1044/2015_JSLHR-L-14-0305

Parette, P., & Huer, M. B. (2002). Working with Asian American families whose children have augmentative and alternative communication needs. *Journal of Special Education Technology, 17*(4), 5–13.

Schlosser, R. R., Koul, R., Shane, H., Sorce, J., Brock, K., Harmon, A., . . . Hearn, E. (2014). Effects of animation on naming and identification across two graphic symbol sets representing verbs and prepositions. *Journal of Speech, Language, and Hearing Research, 57*(5), 1779–1791.

Soto, G., & Yu, B. (2014). Considerations for the provision of services to bilingual children who use augmentative and alternative communication. *Augmentative and Alternative Communication, 30*(1), 83–92.

Spencer-Oatey, H. (2012) *What is culture? A compilation of quotations.* Retrieved from http://www.globalpad.net/

Sutton, A. E., Morford, J. P., & Gallagher, T. (2004). Production and comprehension of graphic symbol utterances expressing complex propositions by adults who use AAC systems. *Applied Psycholinguistics, 25,* 349–371.

121

U.S. Census Bureau. (2010). *Census coverage measurement*. Retrieved from https://www.census.gov/2010census/

Wilkinson, K. M., Light, J., & Drager, K. (2012). Considerations for the composition of visual scene displays: Potential contributions of information from visual and cognitive sciences. *Augmentative and Alternative Communication, 28*(3), 137–147.

Worah, S. (2008). *The effects of redesigning the representations of early emerging concepts of identification and preference: A comparison of two approaches for representing vocabulary in augmentative and alternative communications (AAC) systems for young children.* Doctoral Dissertation, Pennsylvania State University.