AAC INTERVENTIONS FOR AUTISM: A RESEARCH SUMMARY

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Fifty-six studies from 1980 to 2007 involving the use of augmentative and alternative communication (AAC) by individuals with autism were reviewed. The majority of the studies used single-subject research designs and emphasized language production skills. Many investigations were held in artificial language learning settings, and a few involved parents and teachers as intervention agents. Gaps in the provision of the participants' cognitive, language, and sensory-motor measures were detected in the analysis of the 51 studies that provided individual participant data. Despite these limitations, this report revealed that communication interventions for individuals with autism that have incorporated sign language/total communication, visual-graphic symbols, and/or speech generating devices have had successful outcomes.

Introduction

Impairments in verbal and nonverbal communication are core defining features of autism (National Research Council [NRC], 2001). Expressive communication problems range from complete mutism to echolalia (Klin, 2006). Studies have shown that persons with autism fail to compensate speech impairments with gestures or facial expressions (Heflin & Alaimo, 2007). This population generally presents deficits in communicating for social purposes, orienting or attending to social partners or sharing affective or emotional states with others (Wetherby, Prizant & Schuler, 2000). Persons with autism tend to avoid eye contact and exhibit limited use of symbolic communicative gestures, such as showing, waving, nodding or pointing (NRC, 2001; Wetherby et al., 2000). In terms of comprehension, some individuals present deficits in processing audio-vocal information, such as verbal language (Wong & Wong, 1991) or understanding nonverbal forms of communication, such as conventional gestures (Wetherby, et al., 2000).

The poor prognosis that individuals with autism have in developing language and communication skills make them good candidates for augmentative and alternative communication (AAC) interventions, either to supplement their existing speech or as a substitute method for expressive communication. In the present report, a narrative summary of the studies published on AAC interventions with a focus on individuals with autism will be discussed. This analysis will be guided by the following topics: (a) the types of AAC strategies used; (b) experimental designs; (c) language intervention goals; (d) setting and intervention agents and (e) participant characteristics. This paper provides an update of the studies analyzed by Mirenda (2003).

Peer-reviewed studies from the fields of special education and communication disorders published in the years 1980 through 2007 were consulted. The search method consisted of three strategies: computerized searches, hand searches and footnote inspection.The articles found in these references were included in this review considering two selection criteria: First, the investigations had to involve participants with a diagnosis of autism, using AAC. Second, the study had to report measures of some aspect of language (form, content or use). A total of 56 published studies were identified for this report.

More rigorous criteria to evaluate the adequacy of these studies, such as those normally used in meta-analysis, were not applied. Book chapters and unpublished literature, such as theses and dissertations, were excluded from this analysis. Thus this paper does not provide definitive conclusions regarding the effectiveness of the approaches used, but a general review of studies published in peer-reviewed journals, which can be valuable for researchers and practitioners in the field.

Types Of AAC Strategies For Individuals With Autism

In this review, eighteen of the fifty-six studies analyzed used total communication/sign language, or gestures as an alternative or augmentative system of communication. Twenty-six investigations taught

the participants to use visual symbols, such as pictures. Nine studies utilized speech generating devices (SGD); and three studies used a *hybrid approach*, combining aided and unaided systems.

Sign Language/Total Communication

Sign language teaching has been in the autism literature for over thirty years and emerged as an alternative to speech training methods. Research from the early 70's revealed that individuals with autism who were echolalic often benefited from speech training, whereas those who were mute generally did not (Lovaas, 1977). The use of sign language as an alternative form of communication is justified when considering that approximately thirty percent of people with autism are functionally mute (Klin, 2007) and that even after years of intensive speech training, only about half of these individuals acquire spoken language (Seal & Bonvillian, 1997). The idea of using sign language rather than speech was based on the assumption that manual communication would be easier to generalize to nontreatment settings (Bonvillian, Nelson & Rhyne, 1981); that signs were more iconic and therefore required less symbolic processing than spoken language (Mirenda & Erickson, 2000); that signs were easily molded/prompted and could be shaped in the absence of other social skills (Rotholz, Berkowitz & Burberry, 1989); and that the use of a visual-motor mode of communication would bypass the auditory-vocal processing difficulties observed in this population (Wong & Wong, 1991).

In the last 27 years, the studies reported in the literature have evaluated the effects of teaching expressive and receptive vocabulary using speech, manual signs, gestures, sign language and total communication (speech and sign) on the language development of children with autism. These studies have produced interesting findings: (a) Some reported that total communication was more effective for teaching receptive and expressive vocabulary than speech alone methods (Barrera, Lobato-Barrera & Sulzer-Azaroff, 1980; Barrera & Sulzer-Azaroff, 1983; Yoder & Layton, 1988); (b) Others found no differences between the use of total communication and sign language to promote expressive (Remington & Clarke, 1983); or receptive sign language and speech (Wherry & Edwards, 1983); (c) Sign language was suggested to serve as a mediating system for speech for some participants in one study (Barrera & Sulzer-Azaroff, 1983) and even for improving verbal articulation of another participant in a related investigation (Ferrarese & Norton, 1982). In another set of studies, good verbal imitators were considered better at comprehending speech than poor verbal imitators (Carr & Dores, 1981; Carr et al., 1984; Yoder & Layton, 1988; Layton, 1988).

The effectiveness of assorted methods used for teaching sign language or total communication to this population was another topic of investigation. These studies revealed that naturalistic teaching strategies, such as environmental arrangement and incidental teaching, was an effective method of teaching sign language to children with autism (Kouri, 1988; Schepis, Reid, Fitzgerald, Faw, Pol & Welty, 1982), as well as discrete trial approaches (Bartman & Freeman, 2003; Buffington, Krantz, McClannahan & Poulson, 1998; Carr, Kologinsky & Leff-Simon, 1987; Sundberg, Endicott & Eigenheer, 2000, Walker, Hinerman, Jenson & Peterson, 1982; Watters, Wheelers & Watters, 1981; Wherry & Edwards, 1983).

Communication Systems that Use Visual-Graphic Symbols

Visual-graphic symbols such as photographs and pictograms have been successfully incorporated in AAC interventions with persons with autism (NRC, 2001). Some of the reasons for adopting graphic rather than manual systems or speech training interventions are related to the fact that certain individuals with autism may present disorders in prerequisite skills or cognitive deficits essential for signing or speaking. Specifically, these would include poor imitation skills and motor functioning disorders (NRC, 2001). The static feature of visual-graphic systems allows the individual to rely on recognition rather than recall memory to comprehend language (Heflin & Alaimo, 2007). The information-processing problems and precisely working memory deficits presented by this population would, therefore, justify the use of nontransient systems of communication (Mirenda & Marthy-Laikko, 1989). Additionally, the use of nontransient systems enhances the awareness of relevant environmental cues (von Tetzchner, Øvreeide, Jørgensen, Ormhaug, Oxholm, & Warme, 2004). The individual becomes able to check back and forth between the graphic utterance (which represents the relevant cue) and other aspects of the situation during a social interaction. Within a linguistic perspective, static graphic systems may facilitate the establishment of a signifier-significant relationship (von Tetzchner et al., 2004). In this context, it is hypothesized that the use of such systems facilitates the establishment of joint attention and the understanding of shared context.

In this review, a large group of studies were consistent in indicating that individuals with autism respond better (expressively and receptively) to nontransient systems of communication, such as pictures, than to transient systems, such as speech or sign language (Peterson, Bondy, Vincent, & Finnegan, 1995; Rotholtz et al., 1989; Tincani, 2004, Vaughn & Horner, 1995; von Tetzchner, et al., 2004). Tincani (2004), however, found that a picture based system was more effective for teaching requesting to one participant in her study, while the other participant showed superior gains using sign language.

Another group of studies found that naturalistic strategies (e.g. mand-modeling, time-delay, and environmental arrangement) present in approaches such as the Natural Language Paradigm and Aided Language Stimulation were effective at teaching individuals with autism to use picture based systems to communicate (Cafiero, 2001; Hamilton & Snell, 1993; Nunes & Hanline, 2007; Stiebel, 1999). These investigations also reported that the use of these strategies resulted in gains in receptive vocabulary (Cafiero, 2001), vocalizations (Nunes & Hanline, 2007; Cafiero, 2001), as well as an increase in the use of gestures (Nunes & Hanline, 2007).

Picture communication symbols have also been successfully used to reduce problem behaviors and increase on-task responses with this population (Bryan & Gast, 2000; MacDuff et al., 1993; O'Neill & Sweetalnd-Baker, 2001; Schmitt, Alper & Raschke, 2000; Cafiero, 2001). In this review the Picture Exchange Communication System (PECS) was proven to be an effective strategy for: (a) facilitating vocal/verbal imitation (Cummings & Williams, 2000; Charlop-Christy, Carpenter, Le, LeBlanc, and Kellet, 2002), (b) increasing the frequency of communicative initiations, responses (Kravits, Kamps, Kemmerer & Potucek, 2002; Charlop-Christy et al., 2002; Magiati & Howlin, 2003; Marckel, Neef and Ferreri, 2006) and comments (Cafiero, 2001; Schwartz, Garginkle, & Bauer, (1998); and (c) decreasing problem behaviors (Cummings & Williams, 2000; Cafiero, 2001). On the other hand, the level of communicative competence of some participants in one study (Stoner, Beck, Bock, Hickey, Kosuwan and Thompson, 2006) and the frequency of verbalizations of other participants in a related investigation (Ganz, 2004) was not significantly altered with the use of PECS. Additionally, no significant gains were observed in the frequency of word approximations or number of intelligible words during PECS training in another research (Ganz, Simpson and Corbin-Newsome, 2007).

Yoder and Stone (2006) found that Responsive Education and Prelinguistic Milieu Teaching (RPMT) was better than PECS at developing generalized turn taking and joint attention skills in preschoolers, while PECS was better at facilitating generalized requests. In the study conducted by Tincani (2004), sign language was more effective for teaching request to one child with autism, while the other participant had better outcomes with the use of PECS.

As discussed by Ganz et al. (2007) and Stoner et al. (2006) the cognitive and/or language abilities of the individual may influence PECS outcomes. Individuals with higher cognitive and language abilities may progress easily with picture-based systems, such as PECS, while those with significant delays may require more iconic and less cognitive demanding systems.

Speech Generating Devices (SGD)

Technological development in the field of AAC has furnished a *voice* to many individuals through speech generating devices (Schlosser & Blischak, 2001). SGD can be portable AAC mechanical apparatus that produce synthesized or digitized speech (NRC, 2001). The activation of the *speech* is done by physically touching graphic symbols (written words, letters, pictures) displayed on the device/switch.

Using artificial speech rather than visual symbols or sign language permits communication at a larger distance, makes the presence of an interpreter unnecessary and allows the programming of messages of varying lengths. Data from studies with adolescents with intellectual disabilities have also suggested that the use of SGD contributes to gains in receptive and expressive communication (Romski & Sevcik, 1993, 1996). Prelinguistic communicative behaviors in adolescents with autism have also been successfully substituted for more symbolic communication when speech generating devices were introduced (Sigafoos, O'Reilly, Seey-York, Weru, Son, Green & Lancioni, 2004a).

In this literature review, two studies were consistent in suggesting that the use of SGD may enhance other communicative behavior, such as the use of gestures (Sigafoos et al., 2004a) and gestures combined with verbalizations (Schepis et al., 1998). On the other hand, studies that compared the participants' communicative responses with SGDs turned on and off presented inconsistent results. While in one investigation the participants increased the frequency of communicative interactions and verbalizations with the SGD on (Dyches, 1998), in other studies, some of the participants presented no differences in the two conditions (Sigafoos, Didden & O'Reilly, 2003; Schlosser, Sigafoos, Luiselli, Angermeier, Harasymowyz, Schooley and Belfiore, 2007).

The use of SGDs as a component of Computer Assisted Instruction (CAI) was effective at promoting vocabulary acquisition and word retention (Bosseler & Massaro, 2003), as well as increasing verbalizations (Parsons & La Sorte, 1993) and vocal imitation (Bernard-Opitz, Sriram & Sapuan, 1999) in isolated clinical environments. In a study conducted in a naturalistic setting, SGDs were considered effective at replacing prelinguistic communication or as a communicative repair strategy (Sigafoos, Drasgow, Halle, O'Reilly, Seely-York, Edrisinha & Andrews, 2004b).

Hybrid Systems

Aided or unaided systems of communication should be adopted considering not only the individual's cognitive, sensory-motor and language/communication abilities, but also the context of his social interactions. In light of the results of this assessment, more than one type of system may be considered appropriate. Light and colleagues (1998), for instance, described a case study where a boy (age 6) with autism utilized various types of communication systems during social interactions. After performing a thorough assessment of the child's skills and needs as well as identifying important social and environmental variables, three types of augmentative systems of communication were adopted, since the child was capable to functionally use verbal language. Interestingly, the contexts of the interactions determined the type of system to be utilized.

In a related study, Keen, Sigafoos and Woodyat (2001) taught 4 children with autism to replace prelinguistic behaviors with aided and unaided modes of communication. The investigation was held in the participants' classroom and was conducted by the children's teachers. As a result of this intervention, the four child participants effectively substituted nonfunctional responses with manual signs, picture systems and vocalizations.

The AAC literature has further emphasized the importance of conducting symbol assessments prior to choosing a symbol system to be incorporated in AAC interventions (Beukelman & Mirenda, 1998). The AAC user's ability to comprehend the relationship between an object and its referent may be a determining factor when choosing more or less iconic symbols. Kozleski (1991) compared the vocabulary learning rates of individuals with autism exposed to various visual and tactile systems of communication. Using a multiple baseline design, the researcher found that the participants learned how to use Rebus and photopictorical symbols faster than less iconic symbols, such as Blissymbols and orthography.

Method

Five of the studies analyzed used group designs (Layton, 1988; Magiati & Howlin, 2003; Schwartz et al., 1998; Yoder & Layton, 1988; Yoder & Stone, 2006) while the remaining investigations worked with individual or small group data. Three investigations were descriptive case studies (Bondy & Frost, 1994; Light et al., 1998; Schwartz et al., 1998; von Tetzchner et al., 2004), while the others used some type of experimental research design methodology. From the experimental studies reviewed, 44 used some type of single-subject research methodology (Barlow & Herson, 1984). This type of approach seemed adequate, considering the heterogeneous characteristics of the population involved and the limited number of participants (Barlow & Hersen, 1984).

Language Intervention Goals

Forty-three (77%) of the 56 studies reviewed focused on teaching communicative/language production skills. Eight (14%) investigations centered in receptive skills and five studies (9%) worked with both receptive and expressive communication. This trend is consistent with findings from the AAC literature, where a lack of focus on AAC as an input strategy for individuals with communication and language impairments is reported (Romski & Sevcik, 1993).

Settings And Intervention Agents

Twenty (36%) of the fifty-six studies analyzed took place in artificial learning environments, such as therapy rooms or isolated booths in the schools. Eight (14%) investigations combined an artificial setting with a natural environment, such as the participants' school or home. Nineteen (34%) studies occurred in schools or community settings, six (11%) took place in the children's homes, while 3 (5%) others combined the school and the home.

In more than half of the studies the participants worked solely with the experimenter or a clinician. In thirteen investigations a teacher or facility staff were the primary interventionists. Only four investigations involved parents as primary intervention agents. Five studies combined teachers, parents and experimenters as interventionists. In one study the main interventionist was unclear.

Participant Characteristics

From the 56 studies analyzed, 51 provided information on individual participant characteristics. Data revealed that the 154 participants (128 males and 26 females) involved in these 51 studies ranged in age from 2 to 31 years. Fifty (32%) of these individuals were between ages 2 and 5; 41 (26%) between 6 and 8; while 65 (42%) of the participants were above age 9. There was only one investigation involving a child below the age of 3 (Bartman & Freeman, 2003). This is critical, considering that communication intervention has proven to be more effective when provided before the age 3 ½ (Harris & Handleman, 2000). Despite the importance of evaluating how socioeconomic status, race and ethnicity may impact treatment initiatives (NRC, 2001), only eight investigations reported the participants' ethnicity/race (Cafiero, 2001; Charlop-Christy et al., 2002; Ganz & Simpson 2004; Ganz et al., 2007; Nunes & Hanline, 2007; Tincani, 2004; Walker et al., 1982; Wherry & Edwards, 1983). From these participants, 5 individuals were categorized as African-Americans; four as Asians, five as Causcasians, one as Indian, and one Ethiopian. Only two studies (Cafiero, 2001; Nunes & Hanline, 2007) provided psychosocial measures of the individuals involved.

The assessments of cognitive and sensory perceptual functions (hearing and vision) are important in the implementation of AAC interventions (Beukelman & Mirenda, 1998). These data provide useful information regarding any limitations that might impact channels of input and instruction for potential AAC users. Level of intellectual functioning was provided for 111 (72%) of the 154 participants described. From this population, 102 participants were described as having some degree of intellectual disability, 2 functioned at a normal level, and 7 were regarded as high-functioning. Four of the 154 participants had some degree of hearing loss and two presented visual impairments. The deficits described were not reported to affect the optimal use of the communication/language systems adopted.

Individuals with autism may present poor motor imitation skills (NRC, 2001) and have motor functioning disorders which may impact the use of aided and unaided systems of communication. The incapacity to program movements may cause fine motor problems and the incapacity to adequately learn sign language (Seal & Bonvillian, 1997). Researchers have also reported that children with autism have difficulty in pointing to objects (Tsai, 1998). This may interfere with the optimal use of AAC strategies that require the user to point to pictures on communication boards or to activate a device by holding down a switch in a SGD system. In this context, it becomes necessary to assess the motor functioning abilities of this population in order to identify individuals who might successfully use the various types of AAC strategies as expressive modes of communication.

In this literature review, researchers from 13 investigations (Cafiero, 2001; Carr et al, 1987; Kouri, 1988; Nunes & Hanline, 2007; Light et al., 1998; Remington & Clark, 1983; Rotholz et al., 1988; Schlosser et al., 2007; Sigafoos, 1998; Sigafoos et al., 2003; Sigafoos et al., 2004; Stiebel, 1999; Walker et al, 1982) provided measures on the participants' motor skills. In total, 4 of the participants analyzed were regarded as having some degree of motor impairments. In the studies conducted by Carr et al. (1987) and Walker et al. (1982) these deficits did not seem to interfere with sign language use. Rotholz et al. (1989), on the other hand, reported that a communication book was chosen, considering participants' limitations in using sign language. Schlosser and colleagues (2007) reported that all participants had adequate motor abilities to verbalize and operate an SGD.

The assessment of receptive language/communication skills are essential for identifying when/how the augmentation of spoken language is required as well as identifying alternative forms of language input.

Measures of expressive language/communication are crucial to determine how language can be augmented or what type of system would be considered an alternative for persons who are nonverbal. Receptive language data were provided for 78 (51%) of the 154 participants; expressive language measures were reported for 141 (92%) participants. Most of the participants analyzed were reported to comprehend simple one-step verbal commands, mainly when accompanied by gestures. In terms of expressive language the majority of the individuals were characterized as nonverbal or having limited functional verbal skills.

Discussion

A review of 56 studies published in the last 27 years has provided valuable information regarding the nature of AAC interventions for individuals with autism. The three types of communication systems described in this report seemed to be effective for individuals with autism that presented some degree of intellectual disability, were essentially nonverbal, and, in general, above the age of 5.

The majority of the studies used single-subject research designs and emphasized on language production skills. A high percentage of these investigations was held in artificial language learning settings, involving solely a clinician or an experimenter. Most researchers provided general intellectual functioning scores of the participants involved, but few described their motor or sensory abilities. Likewise, information of participants' socioeconomic status, race or ethnicity was limited.

Since a reduced number of studies compared the efficacy of different types of AAC strategies, not much can be stated regarding the advantages of one system over another. Nonetheless, many investigators in this review anecdotally discussed the benefits of each system. Some of the advantages of using sign language included (a) its *portability*; (b) its characteristic of being a true language system and (c) the possibility of communication occurring at a faster pace. Among the positive aspects of using a visual-graphic system were: (a) its iconicity; (b) its nontransient nature; and (c) the limited motor requirements for its use. SGDs were considered advantageous for (a) they allowed communication to occur at larger distances; (b) they permitted messages to be easily deciphered; and (c) required limited cognitive and motor demands.

Despite the gaps identified in this discussion, many positive changes have occurred in these last decades. The most important is, perhaps, the fact that researchers and clinicians stopped viewing language as being equivalent to speech. Investigations have, alternatively, expanded the focus of language intervention programs from speech training to the use of nonverbal systems, such sign language or visual-graphic strategies. The adoption of nonverbal systems for individuals who are unable to speak, but motorically and cognitively competent also suggests that interventionists are focusing on enhancing skills that individuals with disabilities have, rather than centering on what this population is incapable of doing.

References

References marked with an asterisk (*) indicate studies included in the literature review.

American Speech-Language-Hearing Association. (1991). Report: Augmentative and alternative communication. *Asha*, 33 (Suppl. 5), 9-12.

American Speech-Language-Hearing Association. (2002). Augmentative and alternative communication: knowledge and skills for service delivery. *Asha Supplement 22*, 97-106.

Barlow, D. & Herson, M. (1984). *Single case experimental designs: Strategies for studying behavior changes* (2nd ed.). New York: NY: Pergamon Press.

* Barrera, R. & Sulzer-Azaroff, B. (1983). An alternating treatment comparison of oral and total communication training programs with echolalic autistic children. *Journal of Applied Behavior Analysis*, 16, 379-394.

* Barrera, R., Lobato-Barera, D. & Sulzer-Azaroff, B. (1980). A simultaneous treatment comparison of three expressive language training programs with a mute autistic child. *Journal of Autism and Developmental Disorders,* 10, 21-37.

* Bartman, S. & Freeman, N. (2003). Teaching language to a two-year-old with autism. *Journal on Developmental Disabilities,* 10 (1),47-53

* Bernard-Opiz, V., Ross, K. & Tuttas, M.L. (1990). Computer assisted instruction for autistic children. *Annals of the Academy of Medicine*, 19, 611-616.

Beukelman, D. & Mirenda, P. (1998). *Augmentative and alternative communication: Management of severe communication disorders in children and adults* (2nd ed). Baltimore: Paul H. Brookes Publishing.

* Bondy, A. & Frost, L. (1994). The Picture Exchange Communication System. *Focus on Autistic Behavior,* 9, 1-19.
Bonvillian, J., Nelson, K. & Rhyne, J. (1981). Sign language and autism. *Journal of Autism and Developmental Disorders*, 11, 125 – 137.
* Bosseler, A. & Massaro, D. (2003) Development and evaluation of a computer-animated tutor for vocabulary and language learning in children with autism. *Journal of Autism and Developmental Disorders,* 33(6):653-72
* Bryan, L. C., Gast, D. L. (2000). Teaching on-task and on-schedule behaviors to high-functioning children with autism via picture activity schedules. Journal of Autism and Developmental Disorders, 30(6), 553-567.
* Buffington, D. M., Krantz, P. J., McClannahan, L. E., & Poulson, C. L. (1998). Procedures for teaching appropriate gestural communication skills to children with autism. *Journal of Autism and Developmental Disorders,* 28, 535-546.
* Cafiero, J. (2001). The effect of an augmentative communication intervention on the communication, behavior and academic progress of an adolescent with autism. Focus on Autism and Other Developmental Disabilities, 16 (3), 179-189.
* Carr, E. & Dores, P.A. (1981). Patterns of language acquisition following simultaneous communication with autistic children. Analysis and Intervention in Developmental Disabilities, 1, 347-361.
* Carr, E. & Kologinsky, E. (1983). Acquisition of sign language by autistic children. II: Spontaneity and generalized effects. *Journal of Applied Behavior Analysis*, 16 (3), 297-314.
* Carr, E., Kologinsky, E. & Leff-Simon, S. (1987). Acquisition of sign languageby autistic children. III: Generalized descriptive phrases. *Journal of Autism and Developmental Disorders*, 17 (2), 217-229.
* Carr, E., Pridal, C. & Dores, P. (1984). Speech versus sign comprehension in autistic children: analysis and prediction. Journal of Experimental Child Psychology, 37, 587-597.
* Charlop-Christy, M. H., Carpenter, M., Le, L., LeBlanc, L. A., & Kellet, K. (2002). Using the picture exchange communication system (PECS) with children with autism: Assessment of PECS acquisition, speech, social-communicative behavior, and problem behavior. *Journal of Applied Behavior Analys*is, 35, 213-231.
* Cummings, A. R., & Williams, W. L. (2000). Visual identity matching and vocal imitation training with children with autism: A surprising finding. Journal on Developmental Disabilities, 7, 123–141.
* Dyches, T, (1998). Effects of switch training on the communication of children with autism and severe disabilities. *Focus on Autism and Other Developmental Disabilities*, 13, 151-162.
* Ferrarese, R., Norton, P. & Whitmont, S. (1982). Can signing improve the quality of autistic speech? *The Exceptional Child*, 29, 117-125.* Frea, W., Arnold, C. & Vittimberga, G. (2001). A demonstration of the effects of augmentative communication on the extreme aggressive behavior of a child with autism within an integrated preschool setting. *Journal of Positive Behavior Intervention*, 3, 194-198.
* Ganz J.B. & Simpson, R.L. (2004). Effects on communicative requesting and speech development of the Picture Exchange Communication System in children with characteristics of autism. Journal of Autism and Developmental Disorders, 34(4), 395-409.
* Ganz, J. B., Simpson, R. L., & Corbin-Newsome, J. (in press). The impact of the Picture Exchange Communication system on requesting and speech development in preschoolers with autism spectrum disorders and similar characteristics. *Research in Autism Spectrum Disorders*.
* Hamilton, B. & Snell, M. (1993). Using the Milieu Approach to increase spontaneous communication book use across environments by an adolescent with autism. *Augmentative and Alternative Communication*, 9, 259 – 272.
Harris, S. & Handleman, J. (2000). Age and IQ as predictors of placement for young children with autism: a four-to six-year follow-up. *Journal of Autism and Developmental Disorders*, 30, 137-142.
Heflin, L. & Alaimo, D.F. (2007). *Students with Autism Spectrum Disorders: Effective Instructional Practices.* Upper Saddle River, N.J.: Pearson Prentice Hall.
* Keen, D., Sigafoos, J., & Woodyatt, G. (2001). Replacing prelinguistic behaviours with functional communication. Journal of Autism and Developmental Disorders, 31(4), 385-398.
Klin, A. *Autism and Asperger syndrome: an overview*. Rev. Bras. Psiquiatr.[online].[cited 2007-08-19]. Available at:
<http://www.scielo.br/scielo.php?script=sci_arttext&pid=S151644620060005000002&lng=en&nrm=iso>. ISSN 1516-4446.
* Kouri, T. (1988). Effects of simultaneous communication in a child-directed treatment approach with preschoolers with severe disabilities. *Augmentative and Alternative Communication*, 4 (4), 222-232
* Kozleski, E. (1991). Visual symbol acquisition by students with autism. *Exceptionality*, 2, 173-194.

* Kravits, T., Kamps, D., Kemmerer, K. & Potucek, J. (2002). Brief report: Increasing communication skills for an elementary-aged student with autism using the Picture Exchange Communication System. *Journal of Autism and Developmental Disorders*, 32, 225-230

* Layton, T. (1988). Language training with autistic children using four different modes of presentation. *Journal of Communication Disorders*, 21, 333-350.

Light, J., Collier, B. & Parnes, P. (1985). Communicative interaction between young nonspeaking physically disabled children and their primary caregivers: Part II – communicative function. *Augmentative and Alternative Communication,* 1 (3), 98-107.

* Light J., Roberts, B., Dimarco, R. & Greiner, N. (1998). Augmentative and alternative communication to support receptive and expressive communication for people with autism. *Journal of Communication Disorder*, 31, 153-180.

Lovaas, O. I. (1977). *The autistic child: Language development through behavior modification.* New York: Irvington.

* MacDuff, G. S., Krantz, P.J., & McClannahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: Maintenance and generalization of complex response chains. Journal of Applied Behavior Analysis, 26, 89-95.

* Magiati I, Howlin P (2003). A pilot evaluation study of the Picture Exchange Communication System (PECS) for children with autistic spectrum disorders.Autism, 7(3), 297-320.

* Marckel, J., Neef, N. A., & Ferreri, S. J. (2006). A preliminary analysis of teaching improvisation skills with the Picture Exchange Communication System to children with autism. *Journal of Applied Behavior Analysis*, 39, 109-115.

Mirenda, P. & Erickson, K. (2000). Augmentative communication and literacy In A.M. Wetherby & B.M. Prizant (Eds.), *Autism spectrum disorders: A transactional developmental perspective* (pp. 333 – 367). Baltimore: Paul H. Brookes

Mirenda, P. (2003). Toward functional augmentative and alternative communication for students with autism: Manual signs, graphic symbols, and voice output communication aids. *Language, Speech, and Hearing Services in Schools,* 34, 203-216.

Mirenda, P. & Mathy-Laikko, P. (1989). Augmentative and alternative communication for persons with severe congenital communication disorders: An introduction. *Augmentative and Alternative Communication,* 5 (3), 3-13.

National Research Council (2001). *Educating children with autism*. Committee on Educational Interventions for Children with Autism. Catherine Lord and James McGee (Eds). Division of Behavioral and Social Sciences and Education. Washington, DC : National Academy Press.

* Nunes, D. & Hanline, M.(2007) Enhancing the AAC use of a child with autism through a parent-implemented naturalistic intervention. *International Journal of Disability, Development and Education*, 54, 177-197.

* O'Neill, R. E., & Sweetland-Baker, M. (2001). Brief report: An assessment of stimulus generalization and contingency effects in functional communication training with two students with autism. *Journal of Autism & Developmental Disorders, 31* (2), 235-240.

* Parsons, C. & La Sorte, D. (1993). The effect of computers with synthesized speech and no speech on the spontaneous communication of children with autism. *Australian Journal of Communication Disorders*, 21 (1), 12-31.

Paul, R. (1998). Communicative development in augmented modalities: Language without speech? In S. Warren & J. Reichle (Series Eds.) & R. Paul (Vol. Ed.) *Communication and language intervention series: Vol. 8. Exploring the Speech-language connection* (pp.139-161). Baltimore: Paul H. Brookes Publishing.

* Peterson, S., Bondy, A., Vincent, Y. & Finnegan, C. (1995). Effects of alternating communication input for students with autism and no speech: two case studies. Augmentative and Alternative Communication, 11, 93-100.

Prizant, B (1987). Clinical implications of echolalic behavior in autism. In T. Layton (Ed.), *Language and treatment of autistic and developmentally disorderd children*. Springfield, IL: Charles Thomas.

* Remington, B. & Clarke, S. (1983). Acquisition of expressive signing by autistic children: an evaluation of the relative effects of simultaneous communication and sign alone training. Journal of Applied Behavior Analysis, 16 (3), 315-328

Romski, M. A., & Sevcik, R. A. (1993). Language learning through augmented means: The process and its products. In Steven F. Warren, & Joe Reichle (Eds.), Enhancing children's communication: Vol 2. Communication and language intervention series. Baltimore: Paul H. Brookes Publishing.

Romski, M.A. & Sevcik R. A. (1996). Breaking the speech barrier: language development through augmented means. Baltimore: Paul H. Brookes Publishing.

* Rotholz, D. A., Berkowitz, S.F., Burberry, J. (1989). Functionality of two modes of communication in the community by students with developmental disabilities: a comparison of signing and communication books. Journal of the Association of Persons with Severe Handicaps, 14 (3), 227-233.
* Schepis, M., Reid, D., Fitzgerald, J.R., Faw, G., Pol, R., Welty, P. (1982). A program for increasing manual signing by autistic and profoundly retarded youth within the daily environment. *Journal of Applied Behavior Analysis,* 15 (3), 363-379.
* Schepis, M., Reid, M. & Behrmann, M., Sutton & Sutton, K. (1998). Increasing communicative interactions of young children with autism using a voice output communication aid and naturalistic teaching. *Journal of Applied Behavior Analysis*, 31, 561-578.
Schlosser, R. & Blischak, D. (2001). Is there a role for speech output in interventions for persons with autism? A review. *Focus on Autism and Other Developmental Disa*bilities, 16 (3), 170-178.
* Schlosser, R., Sigafoos, J., Luiselli, J., Angermeier, K., Schooley, K., Harasymowyz, U., & Belfiore, J. (2007). Effects of synthetic speech output on requesting and natural speech production in children with autism. *Research in Autism Spectrum Disord*ers, 1, 139-163.
* Schmitt, J., Alper, S., Raschke, D. & Ryndak, D. L. (2000). The effects of using a photographic cueing package during routine school transitions with a child with autism. Mental Retardation, 38(2), 131-137.
* Schwartz, I., Garginkle, A. & Bauer, J. (1998). The picture exchange communication system: communicative outcomes for young children with disabilities. *Topics in Early Childhood Special Education 18 (*3), 144-159.
Seal, B. C. & Bonvillian, J. D. (1997). Sign language and motor functioning in students with autistic disorder. *Journal of Autism and Developmental Disorders*, 27 (4), 437-466.
* Sigafoos, J. (1998). Assessing conditional use of graphic mode requesting in a young boy with autism. Journal of Developmental and Physical Disabilities, 10, 133 – 151.
* Sigafoos, J., Drasgow, E., Halle, J., O'Reilly, M., Seely-York, S., Edrisinha, C. & Andrews, C. (2004a).Teaching VOCA use as a communication repair strategy. Journal of Autism and Developmental Disorders, 34, 411-422.
* Sigafoos, J., Didden, R., & O'Reilly, M. (2003). Effects of voice-output technology on requesting and vocalizations in three children with developmental disabilities. *Augmentative and Alternative Communication,* 19, 37–47.
* Sigafoos J, O'Reilly M, Seely-York S, Weru J, Son Sh, Green V, Lancioni G. (2004b). Transferring AAC intervention to the home. *Disabil Rehabil*. 26(21-22):1330-4.
* Stiebel, D. (1999). Promoting augmentative communication during daily routines: a parent problem-solving intervention. *Journal of Positive Behavior Interventions* 1 (3), 159-169.
* Stoner, J.B., Beck, A.R., Bock, S.J., Kosuwan, K., Hickey, K., & Thompson, J.R. (2006). The effectiveness of the Picture Exchange Communication System with nonspeaking adults. *Remedial and Special Education,* 27(3), 154–165
* Sundberg, M. L., Endicott, K. & Eigenheer, P. (2000). Using intraverbal prompts to establish tacts for children with autism. *The Analysis of Verbal Behavior*, 17, 89-104.
* Tincani, M. (2004). Comparing the Picture Exchange Communication System and sign language training for children with autism. Focus on Autism and Other Developmental Studies, 19, 152-163.
Udwin, O. & Yule, W. (1991). Augmentative communication systems taught to cerebral-palsied children – a longitudinal study. III. Teaching practices and exposures to sign and symbol use in schools and homes. *British Journal of Communication Disorders*, 26, 149-162.
* Vaughn, B. & Horner, R. (1995). Effects of concrete versus verbal choice systems on problem behavior. *Augmentative and Alternative Communication*, 11, 89-92
* VonTetzchner, S., Øvreeide, K.D., Jørgensen, K.K., Ormhaug, B., Oxholm, B.M., Warme, R. (2004). Acquisition of graphic communication by a young girl without comprehension of spoken language. *Disability and Rehabilitation*, 26 (2), 1335-1346.
* Walker, G. R., Hinerman, P. S., Jenson, W., Petersen, P. (1982). Sign language as a prompt to teach a verbal "yes" and "no" discrimination to an autistic boy. *Child Behavior Therapy*, 3 (4), 77-86.

* Watters, R., Wheeler, L. & Watters, W. (1981). The relative efficiency of two orders for training training autistic children in the expressive and receptive use of manual signs. Journal of Communication Disorders, 14, 273-285.
Wetherby, A., Prizant, B., Schuler, A. (2000). Understanding the nature of communication and language impairments. In S. Warren & J. Reichle (Series Eds.) & A. Wetherby and B. Prizant (Vol. Eds.) Communication and language intervention series: Vol. 9. Autism spectrum disorders (pp.109-141). Baltimore: Paul H. Brookes Publishing.
* Wherry, J. & Edwards, R. (1983). A comparison of verbal, sign, and simultaneous system for the acquisition of receptive language by an autistic boy. Journal of Communication Disorders, 16, 201-216.
Wong, V., & Wong, S. N. (1991). Brainstem auditory evoked potential study in children with autistic disorder. *Journal of Autism and Developmental Disorders*, 21, 329-340.
* Yoder, P. & Layton, T. (1988). Speech following sign language training in autistic children with minimal verbal language. *Journal of Autism and Developmental Disorders*, 18, 217 – 229.
* Yoder, P. & Stone, W. (2006). Randomized comparison of two communication interventions for preschoolers with autism spectrum disorders. *Journal of Consulting and Clinical Psychology* 74, (3) 426–435.