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Effects of AAC interventions on communication and language for young children with complex communication needs

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Abstract. Children with complex communication needs (CCN) who require augmentative and alternative communication (AAC) are at considerable risk in many aspects of their development: (a) functional communication skills, (b) speech development, (c) language development, (d) cognitive/conceptual development, (e) literacy development, (f) social participation, (g) access to education, and (h) overall quality of life. Early intervention is critical to address these areas and provide successful and functional outcomes. AAC offers the potential to enhance communication, language, and learning for children with significant communication disabilities. This paper provides an overview of the effects of AAC interventions on communication, behavior, language, and speech outcomes for young children with CCN for pediatricians and other medical and rehabilitation professionals. Future research directions to maximize the communication development of young children with CCN are also discussed.

Keywords: Young children, AAC, language, communication, assistive technology

1. Introduction

Most young children develop speech and language skills rapidly and seemingly effortlessly. At birth, an infant is unable to understand the words that others speak, is unable to talk, and is limited to reflexive cries and vocalizations that may be indicative of emotional state. In just 4 or 5 years, typically developing children learn to participate actively in social interactions with others, acquire thousands of words, learn to use complex sentences to communicate their thoughts and ideas with others, and begin to develop the phonological awareness skills and sound-symbol correspondences necessary for reading and writing [36]. This early speech and language development is critical so that young children can communicate effectively with others, express needs and wants, interact socially to develop friendships and social bonds, learn about the world, expand their cognitive skills, and develop the foundations for later language and literacy skills [25]. However, some young children do not develop speech, language, and literacy skills as expected due to motor, language, cognitive, and /or sensory perceptual impairments; as a result, they may have limited access to the environment, interactions with their communication partners, and opportunities for communication and for language and literacy development.

The goal of this paper is to provide an overview of augmentative and alternative communication (AAC) applications for young children with complex communication needs (CCN) for pediatricians and other medical and rehabilitation professions. The goals specifically are to: a) review information on the demographics

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of the population of children with CCN; b) examine the impact of significant communication disabilities on the development of children with CCN; and, c) summarize the research related to the effects of AAC interventions on communication and language outcomes for these children.

2. Demographics

Children who have CCN form a heterogeneous group that varies significantly with respect to motor, sensory perceptual, cognitive and linguistic skills, socioeconomic and cultural background, and environmental factors (e.g., communication partners, participation in instructional activities). This group includes infants, toddlers, and preschoolers with a wide range of developmental disabilities such as autism spectrum disorder (ASD), cerebral palsy, and Down syndrome, and acquired disabilities such as those resulting from traumatic brain injury and stroke [3]. These children may have little to no intelligible speech and thus, experience serious difficulties in communicating and in making their needs and wants known. Others may have developed some speech, but are unable to rely on speech as a primary means of communication.

For young children with CCN, many different types of AAC systems can support interaction and facilitate the development of communication skills. These include *unaided* and *aided* communication systems. Communication using unaided systems relies solely on the person's body, with no external tools or equipment. Signs and gestures (e.g., a child using her hands to sign MORE while playing with bubbles) are examples of unaided systems. Aided systems refer to systems that involve external equipment. Picture boards, communication books, and electronic speech generating devices (i.e., computer-based systems used for communication) are all examples of aided systems. Aided systems can contain a wide variety of vocabulary items, which can be represented and used in a wide variety of ways - for example, a child may point to a picture symbol of *HUG* to indicate that he wants to hug his mother. Young children can use a combination of aided and unaided communication systems to express their thoughts and feelings and interact with others.

Currently, there are only limited demographic data on children with CCN who require AAC. A recent survey of speech language pathologists (SLPs) serving preschoolers (ages 3–5 years) in Pennsylvania, USA, found the following: More than 11.5% of preschoolers who were enrolled in special education services required AAC and approximately 24% of the caseloads of preschool SLPs were children who required AAC [4]. Demographic studies in other countries have shown various results (e.g., 0.15% of the total student population in New Zealand [44]; 30% of children enrolled in special education settings in Israel [45]; 39% of students with severe intellectual disability in South Africa [1]). Unfortunately, specific data are not available on the incidence of children at risk for CCN at younger ages (0–3 years). However, at a minimum, the prevalence may equal or even exceed the prevalence of preschoolers.

3. Impact of significant communication disabilities

Children with CCN are at considerable risk in many aspects of their development: (a) functional communication skills, (b) speech development, (c) language development, (d) cognitive / conceptual development, (e) literacy development, (f) social participation, (g) access to education, and (h) overall quality of life. The effects of significant communication disabilities are especially limiting for young children since early childhood is typically a time of rapid learning and development [19]. Communication is fundamental to all aspects of learning; without access to functional communication, children with CCN fall further and further behind their peers and have limited opportunities for communication, language, literacy learning, and socialization [24]. They may demonstrate lower rates of intentional communication, resulting in fewer opportunities for adults to respond and to facilitate their language development [31]. Further, individuals with CCN may have fewer social contacts than typically developing peers, allowing for even more limited opportunities for social development [7].

The challenge is to provide children who have CCN with access to the magic and power of communication at the earliest possible age to circumvent the negative effects of communication disabilities [27]. Interventions that utilize AAC approaches may allow children with CCN to develop functional communication skills, as well as promote cognitive/conceptual development, provide the foundation for literacy learning, and improve social participation, and allows for increased independence in activities of daily living, such as choice making, thereby enhancing overall quality of life. However, despite the demonstrated benefits of AAC, many young children with significant disabilities

Table 1
Effects of AAC interventions on areas of development

Area of development	Effects of AAC interventions
Functional Communication Skills	– Can increase functional communication goals: the expression of needs and wants, the development of social closeness, the exchange of information, and the fulfillment of social etiquette expectations. – Has positive effects on the expression of needs and wants by young children with developmental disabilities (e.g., requesting, rejecting, making choices). – Can promote social closeness interactions and information exchange (e.g., play activities, social routines).
Challenging Behaviors	– Functional communication training (FCT) can reduce the challenging behaviors demonstrated by young children. – Visual schedules can be used to reduce challenging behaviors associated with a lack of understanding and anticipating daily schedules and routines.
Expressive Language Skills	– Can have a positive effect on the language skills of young children with complex communication needs, including: – pragmatic language (social uses of communication, such as turn taking), – semantic meanings (the meanings of words and sentences, such as vocabulary acquisition), – syntactic language/morphological markers (the order and combination of words to form sentences, such as increases in the length and/or complexity of messages, and the construction of word forms such as plurals or tenses). – Aided AAC modeling has a positive effect on the production of multi-symbol messages.
Receptive Language Skills	– AAC as augmented input can enhance children's comprehension of verbal language and improve communication. – Augmented input has been used with children with cognitive disabilities and other developmental disabilities and ASD. – Augmented input may provide: – a model for the child of how AAC can be used to communicate – visual language support to facilitate comprehension of spoken language.
Speech Production	– There is no evidence that AAC intervention hinders speech production in children with CCN. – The majority of cases reviewed demonstrated gains after AAC interventions with individuals with developmental disabilities and ASD.

are not identified or referred for AAC services until they are older and have already missed out on valuable years of learning. In a chart review of children receiving AAC services (through the University of Wisconsin – Madison between 1999–2004), Hustad, Berg, Bauer, Keppner, Schanz, and Gamradt found that more than 80% of the children were not initially referred until they were older than 2 years of age [20]. Typically developing children begin building the foundations for communicative development at birth and usually say their first words at approximately one year of age. During the first 3 years of life, children are neurologically primed for rapid and vast amounts of learning [34]. Delaying communication intervention for children with CCN during this time means they must forever try to "catch up" for the valuable years of learning lost [24].

Evidence of the effectiveness of early intervention for children with CCN who require AAC is building; in a systematic review of AAC use with infants and toddlers across 12 studies, Branson and Demchak reported that improved communication occurred for 97% of the sample (190 participants) [10]. In summary, early AAC intervention maximizes opportunities to enhance the development of children with CCN, minimizes the potential for continued delay, and provides support and assistance to the family. Additionally, the earlier intervention begins, the better the outcome may be [46], resulting in increased quality of life for individuals and decreased cost(s) of later intervention.

4. Effects of AAC interventions with young children

What do we know about the effects of AAC interventions on communication, behavior, expressive and receptive language, and speech outcomes for young children with CCN? Table 1 summarizes the effects of AAC interventions in each of these areas.

4.1. Effects of AAC on functional communication skills

Appropriate AAC interventions can have a positive effect on the functional communication skills of young

children with CCN with a wide range of disabilities. The improvement of functional communication skills (i.e., communication necessary to participate in a given environment) is a primary goal of AAC interventions. Light suggests that functional communication goals include: the expression of needs and wants, the development of social closeness, the exchange of information, and the fulfillment of social etiquette expectations [24, 26]. In a retrospective analysis of clinic records of children under the age of 48 months who received AAC services, nearly 90% of the stated goals addressed functional communication, including the use of multiple modes of communication and expanding the repertoire of communicative intents [21]. The goal of building functional communication skills is a priority not only for professionals, but also from the perspective of individuals who use AAC. In a focus group, adults who use AAC stated that they would like to see more research that identifies skills that result in "greater functional success" [35, p. 95]. Greater functional skills can contribute to increased independence in many activities of daily living, allowing for the ability to make choices and decisions that affect self-determination skills.

Although functional communication goals include four areas (expression of needs and wants, development of social closeness, exchange of information, and fulfillment of social etiquette expectations), to date, most AAC interventions with young children with developmental disabilities have focused on expressing needs and wants [30]. The evidence shows the positive effects of a variety of AAC interventions in this area: For example, use of signs to make requests for preferred items [2,13] or to communicate rejection of non-preferred items [43]; use of signs, photographs and/or conventional gestures to communicate choices and make requests [23]; use of Picture Exchange Communication System (PECS) to request preferred items [8,17]; and, use of speech generating devices (SGDs) to initiate requests [12,22].

There are some studies that suggest the effectiveness of AAC interventions as a means to promote social closeness and information exchange. For example, Light and Drager used a multiple baseline design across nine young children with cerebral palsy, Down syndrome, and other developmental disabilities (ages 1–3) and documented the positive effects of AAC interventions on social interaction and communication [28]. During play activities, early intervention personnel modeled how the AAC system could be used in social routines (e.g., playing hide and seek) and recognized and encouraged the child's use of AAC at these times. In a study using similar methodology, Drager et al. demonstrated the benefits of AAC intervention in promoting social closeness and interaction with 4 preschoolers with ASD (ages 3–5) [15]. In summary, the evidence of the positive impact of AAC intervention on functional communication cuts across population groups (e.g., ASD, cerebral palsy, Down syndrome), across AAC interventions and systems (e.g., use of sign, PECs, speech generating devices) and across communication goals (e.g., expression of needs and wants, social closeness, information exchange).

4.2. Effects of AAC on challenging behaviors

By building appropriate channels of functional communication to express needs and wants or establish social attention, AAC interventions can also reduce challenging behaviors. Challenging behaviors are "behavior emitted by a learner that results in self-injury, or injury to others, causes damage to the physical environment, interferes with the acquisition of a new skill and/or socially isolates the learner" [14, p. 215]). Some individuals with communication disabilities use aggression toward themselves or others, tantrums, or other challenging behaviors to either gain access to a preferred item or attention, or to escape from non-preferred events or tasks or from attention [11]. For example, a young child may repeatedly hit his head against the wall when no one is paying attention to him, resulting in immediate adult attention. Another example is a child who tantrums after mealtimes because a preferred meal is ending or she is unaware of what is coming up next.

4.2.1. Functional communication training

Functional communication training (FCT) can reduce the challenging behaviors that are sometimes demonstrated by young children [33]. First, the communicative function (e.g., request for a preferred item/action, request for attention, escape) of the child's challenging behavior is determined; and, then, a socially appropriate communicative behavior (e.g., touching an AAC symbol, activating a single switch to retrieve a recorded message) that serves the same function is introduced to replace the challenging behavior [11]. For example, the child who hit his head against the wall might be taught to activate a switch with the message, "Can you come here?" to request adult attention. If the adult responds quickly, then the incidence of the challenging behavior should decrease. Evidence utilizing single subject experimental designs documents the

effectiveness of FCT using AAC with participants of all ages. For further details, see the narrative review of FCT studies from 1985 to 1996 by Mirenda [33], as well as the review of selected studies of FCT using AAC for individuals with ASD by Bopp, Brown, and Mirenda [9].

4.2.2. Visual schedules

The use of visual schedules may help to support children in understanding and anticipating daily schedules and routines and reduce challenging behaviors. Visual schedules typically use photographs, line drawings, symbols, or text, displayed in a vertical or horizontal line, to depict the sequence of events or activities in a day (or a longer time period) or to depict the sequence of steps within a single activity [9]. For example, a child is shown a photograph of the meal activity, followed by a photograph of getting dressed (the next activity) to allow her to anticipate the next event.

Visual schedules are typically used to assist young children, especially those with ASD, in understanding and preparing for transitions between activities. Bopp et al. conducted a review of the experimental research (along with a few pre-experimental case studies) on visual schedules, and concluded that appropriate use of visual schedules results in substantial and rapid decreases in problem behaviors (e.g., noncompliance, off-task behavior, aggression) and immediate substantial increases in transition compliance [9].

4.3. Effects of AAC on expressive language skills

In order to communicate effectively to meet a wide range of goals, young children need to develop language skills (e.g., have vocabulary available to express different purposes and the use of these vocabulary in different ways and within interactions). Research shows that AAC interventions can have a positive effect on all aspects of language skills of young children with CCN. These positive effects include facilitating the development of pragmatics, or the social uses of communication, including using language for different purposes and following rules and conventions such as turn taking. AAC interventions can also facilitate the development of semantics (the meanings of words and sentences), and syntax/morphology (the order and combination of words to form sentences, and the construction of word forms such as plurals or tenses). For example, Light and Drager demonstrated that AAC interventions positively impacted the language development of young children with CCN across the early stages of language development [28]. They report on nine children (ages 1–3) with developmental disabilities (e.g., Down syndrome and cerebral palsy). Each demonstrated: (a) significant increases in turn taking; (b) expression of a range of communicative functions (e.g., social closeness as well as expression of needs and wants); (c) substantial gains in vocabulary acquisition; and, (d) increases in the length of utterances. In addition, some of the children demonstrated acquisition of early emerging morphological markers [e.g., plurals (*DOLL*/*DOLLS*), regular past tense (*DANCE*/*DANCED*), and present progressive (*PLAY*/*PLAYING*)], and phonological awareness skills. Drager et al. demonstrated gains in similar aspects of language development in preschoolers with ASD (ages 3–5), including significant increases in turn taking, gains in vocabulary acquisition, and increases in the length of utterances [15].

Binger and colleagues [5,6] found that aided AAC modeling had a positive effect on the production of multi-symbol messages by Caucasian and Latino preschoolers who used AAC; furthermore their intervention research showed that these children generalized to novel vocabulary and novel contexts.

4.4. Effects of AAC on receptive language skills

Historically, most AAC interventions have focused on the development of expressive communication skills (producing language). In recent years, there has been increased attention to the use of AAC as *augmented input* to enhance comprehension, or receptive language (understanding language). As in the use of visual schedules (discussed previously), augmented input involves use of AAC symbols by the child's communication partner to supplement speech (e.g., the adult combines speech with sign, or combines speech with pointing to a picture symbol on a communication board or speech generating device). According to Romski and Sevcik, use of AAC by the partner benefits the child by providing: (a) a model for the child of how AAC can be used to communicate; and, (b) visual language support that may "permit the individual who uses AAC to extract previously unobtainable spoken words from the language learning environment" [38, p. 153]. There is emerging evidence that augmented input can positively impact comprehension. In a longitudinal study, Romski, Sevcik, and colleagues compared spoken language intervention and augmented language intervention with 2- and 3-year olds who were not speaking. Children who were provided with an augmented

language intervention made greater gains in communication over those who participated in a traditional spoken language intervention. Also, the AAC intervention group had more intelligible communication, demonstrating that gains in expressive language skills can accompany gains in receptive language skills [39, 42].

Drager et al. used a single subject multiple baseline design to investigate the effects of providing augmented input during interactive play with two preschoolers with ASD (age 4 years) [16]. Results demonstrated increased symbol comprehension and elicited symbol production from baseline levels for both children. Harris and Reichle demonstrated similar gains to Drager et al. in comprehension and symbol production with preschool children with moderate cognitive disabilities as a result of AAC intervention utilizing an augmented input strategy [18].

Prizant, Wetherby, Rubin, and Laurent proposed that using visual materials such as topic boards and cue cards can support children's understanding of verbal language as well as non-verbal behavior [37]. They developed the SCERTS Model, an educational/treatment approach for young children with ASD, which emphasizes the partner's use of AAC to enhance: communication and expressive language, understanding of language and behavior, expression and understanding of emotion, and emotional regulation [40].

4.5. Effects of AAC on speech production

Despite the documented benefits of AAC interventions on the development of functional communication, and expressive and receptive language skills, some clinicians and parents still hesitate to adopt AAC interventions for fear that AAC will impede the development of speech. However, there is evidence that AAC intervention does not inhibit speech production in individuals with developmental disabilities. Millar, Light, and Schlosser completed a meta-analysis of the research documenting the effects of AAC interventions on the production of natural speech by individuals with developmental disabilities [32]. *None* of the cases demonstrated decreases in speech production as a result of AAC intervention; the vast majority (89%) demonstrated *gains* in speech after AAC intervention. The positive effects of AAC intervention on speech production were observed across children and adults with intellectual disability and ASD, ranging in age from 2 years to 60 years; the effects were robust across very different intervention approaches. The majority of the studies investigated the effects of unaided AAC (e.g., signs and gestures).

Recently, Schlosser and Wendt completed a systematic review of the effects of AAC intervention on speech production in children with ASD or pervasive developmental disorder-not otherwise specified (PDD-NOS) [41]. Across nine single subject studies (total of 27 participants) and two group design studies (total of 98 participants), the majority of studies reported some gains in speech production for the participants, and *no* evidence that AAC intervention hinders speech production in children with ASD or PDD-NOS. No published study meeting their search criteria reported a decline in speech production as a result of AAC intervention.

5. Conclusions

The research suggests benefits of AAC interventions on the functional communication skills, challenging behaviors, language development (both receptive and expressive skills), and speech production of young children with CCN. To date, most research with children has focused on AAC interventions with preschoolers who require AAC (ages 3–5) rather than children with CCN under the age of 3, despite the critical importance of early intervention to establish functional communication and to maximize language development.

More research is required to ascertain the effectiveness of all types of AAC options with the youngest children with CCN. Light and Drager discuss beginning AAC intervention by the age of 6–9 months when a disability that places communication development at risk is first identified [28]. Clearly, interventions for infants will be different than interventions for toddlers and older children and critical features of these interventions need to be further identified and evaluated. Additional research is also required to investigate the use of AAC to promote social closeness and foster information exchange for children with CCN so they can develop critical social skills, and establish and maintain social networks. Future research is also required to maximize language development, both expression and comprehension, and support natural speech production using AAC intervention approaches. Research investigations should consider the early stages of pragmatic language development and turn taking as well as the acquisition of complex syntactic structures. Further, research is required to help children with CCN make the transition to literacy, which is critical for academic and vocational success [29].

Although there are still challenges to confront (e.g., the cost of AAC systems, issues of portability and durability), existing research provides evidence of the positive effects of AAC for young children with CCN. Early intervention is critical to maximize these positive effects. Pediatricians and other medical and rehabilitation professionals may be among the first professionals with an opportunity to identify children with CCN and refer children and their families to programs that can support access to AAC and functional communication. Early intervention can serve as the foundation for their lifelong learning and success.

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Conflicts of interest

The authors report no conflicts of interest in accordance with the journal's policy.

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