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**The Effects of Augmentative & Alternative Communication on Children
with Autism Spectrum Disorder: A Meta-Analysis**

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Abstract

The purpose of this study was to examine the effects of Augmentative and Alternative Communication (AAC) on children with autism spectrum disorder (ASD). This study examined the question: “What is the role of Augmentative and Alternative Communication (AAC) devices in aiding individuals across the autism spectrum and what perspectives do parents of children across the autism spectrum have with regard to this technology?” This study involved interviewing a parent of an autistic child to glean her perspectives on AAC. The findings from this interview guided the meta-analysis research. Three main categories arose: benefits of AAC, disadvantages of AAC and parent perspectives. Three speech-language pathology journals were searched using the terms *AAC*, *autism*, and *children* for the first search with the addition of *parent perspectives* for the second. The inclusion criteria for studies were as follows: January 2000-August 2021, report on the findings of an experiment in which autistic children 18 and younger used AAC; and/or include parent’s perspectives of their children’s (18≤) AAC use. Benefits include increased speech/vocalizations, developing more advanced communication i.e., responding to greetings and questions, use of expressive and receptive language and requesting. Disadvantages include difficulty generalizing to new settings, learning symbols and integrating AAC. Parents were too focused on becoming operationally competent, some saw benefits, others noted difficulties and another wanted more AAC modeling for her son. AAC has benefits and disadvantages, but should be evaluated on a case-by-case basis as every child has different needs.

Keywords: Autism, children, AAC, parent perspectives

The Effects of Augmentative & Alternative Communication on Children with Autism Spectrum Disorder: A Meta-Analysis

Autism is a prevalent condition in our society. Autism is currently more common than Down syndrome, juvenile diabetes, and childhood cancer, so it deserves our attention. More families, communities and schools are confronting challenges with autism (Simpson, 2019). According to the Center for Disease Control and Prevention (CDC), as of 2018 (the most recent survey year), about 1 in 44 children have autism spectrum disorder. It is four times more common in boys than in girls (CDC, 2020). “Autism spectrum disorder (ASD),” according to the American Psychiatric Association (2013), “is a neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction across multiple contexts, including deficits in social reciprocity, nonverbal communicative behaviors used for social interaction and skills in developing, maintaining, and understanding relationships.” This disorder also includes “restricted, repetitive patterns of behavior, interests, or activities” (American Psychiatric Association [APA], 2013, p. 31). A tremendous amount of research has been done on autism and how it manifests itself in individuals across the lifespan. Augmentative & alternative communication (AAC) has also been the subject of research. Iacono, Trembath and Erickson (2016) share that “AAC encompasses various modalities that can replace or augment a person’s speech and other existing communication skills. These modalities are either unaided, usually in the form of manual signs, or aided, with systems including graphic symbols displayed on communication boards and in books, or devices relying on technology, such as speech generating devices (SGD), including mobile technologies” (Iacono, et al., 2016. pp. 2349-2350). There are a variety of AAC technologies which individuals with impairments use to communicate. This meta-analysis will provide details about research that focuses on autistic children and their use of AAC.

Overview and Treatment of Autism

Autism has been an intriguing subject for many in the past two decades and researchers and doctors alike are still learning about the condition that affects so many lives.

Autism Diagnosis Criteria and Assessment

Language and communication play a large role in diagnosing autism spectrum disorder (Simpson, 2019). The *Diagnostic & Statistical Manual of Mental Disorders, 5th edition* (DSM-5) classifies mental disorders with related criteria to create more dependable diagnoses (APA, 2013, p. xli). The manual's current criteria for autism diagnosis follows:

Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history

- 1) Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back and forth conversation...to failure to initiate or respond to social interactions
- 2) Deficits in nonverbal communicative behaviors used for social interaction,
- 3) Deficits in developing, maintaining, and understanding relationships.

Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history:

- 1) Stereotyped or repetitive motor movements, use of objects, or speech,
- 2) Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior,
- 3) Highly restricted, fixated interests that are abnormal in intensity or focus,
- or 4) Hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment. (APA, 2013, p. 50)

There are several approaches to diagnose whether a child has autism. The gold standard assessment tools are the *Autism Diagnostic Observation Schedule 2nd edition* (ADOS-2) and the

Autism Diagnostic Interview, Revised (ADI-R) as they are the most sensitive and specific. Together, they provide information on when a child first started experiencing symptoms of autism and current behavior. According to Riccio and Prickett (2019), ADOS-2 allows for direct observation of individuals 18 months to adults. The 30–40-minute observation gathers information and then caregivers typically provide further details. The algorithm results in a score for social communication and restricted and repetitive behavior based on the age of the individual and a score for autism diagnosis. It may not provide adequate information about the restrictive and repetitive behavior, but it does provide insight in verbal, nonverbal and social communication. The ADI-R is a parent interview that begins with the basic history of their child's behavior. The questions are open-ended to gather more information and usually build on one another. The diagnostic section is scored based on the areas of "reciprocal social interaction, abnormalities in communication, and restrictive and repetitive behavior" and the communication section includes the minimally and nonverbal categories, providing information on language ability, social skills and behaviors (Riccio & Prickett, 2019, p. 25).

Autism can be diagnosed at 18 months, but about 9% of those diagnosed do not meet the criteria by the time they are young adults, according to Hyman, Levy, Myers and the Council on Children with Disabilities, Section on Developmental and Behavioral Pediatrics (2020). Screening tests are recommended at 18 and 24 months to help physicians identify those who are at risk. There are several cues to look for that could point to autism. For example, when children at 12 months do not respond to their name, ignore objects at 14 months or do not pretend play by 18 months, these symptoms should be investigated. Some general warning signs present later include not making eye contact, difficulty knowing what others are feeling and being able to express what they feel, delayed speech and repetition. In addition, they tend to dislike change,

have obsessive interests, repetitive movements and different sensory stimulations. It is difficult to recognize autism in early childhood in children with less severe symptoms and average or above intelligence. But when they start going to school and interacting more with peers, symptoms of autism present themselves and interfere with communication. Autism usually cannot be diagnosed in one visit to a doctor's office, but instead, the doctor needs experience with the child and his or her history as children with additional medical conditions complicate autism diagnosis and the seriousness of it. For example, sleep disorders and seizures, ADHD, anxiety, mood and behavioral issues can coincide with autism. One single observation tool i.e., a questionnaire, is not sufficient for all situations or for diagnosis. One tool is often used in conjunction with other approaches to create an accurate diagnosis (Hyman, et al., 2020).

Autism Prevalence

Autism's rates of incidence and prevalence, according to Bennett, Webster, Goodall and Rowland (2018), have been increasing. Incidence is the number of new cases in a population in a certain time frame while prevalence is the number of people in a population who have autism compared to the entire population. This increase is due to expansion of the criteria for diagnosis, so more people fall into the category. In 1994, the single diagnosis criterion for autism was increased to five and the criteria continues to change, so more individuals are able to get autism diagnoses (Bennett, et al., 2018). According to Hyman et al. (2020), the fourth edition of the DSM expanded the definition of "pervasive developmental disorder," the growing recognition of autism and how it manifests itself as well as suggestions for autism screening and more early intervention and school programs to support those with autism have led to higher incidence rates. Diagnosing autism in older children who were previously thought to have a different intellectual disability also plays a role (Hyman, et al., 2020, p. 2). Bennett et al.

(2018) note that another factor includes changing monitoring and reporting procedures used by public health officials; data can be presented in a many different ways. But the increasing incidence does not rule out a possible growing prevalence in children. Lower prevalence rates are reported in countries with less resources than the US. On a national level, autism prevalence seems to be balancing out (Hyman, et al., 2020).

Communication Difficulties Across the Autism Spectrum

All autistic individuals do not behave the same. According to Bennett et al (2018), autistic individuals vary in language ability, communication and learning. As a result, no single approach will work for everyone (Bennett, et al, 2018). Children can vary from being cognitively low functioning to high-functioning with high literacy skills and the abilities to think abstractly and use complex language. Socially, autistic children range from not making eye contact with others to showing affection through frequent hugging and enjoying being around people. Some may seem to demonstrate negative emotions or none at all. Behaviors can include repetitive actions or movements, self-injury, fixation with something and a desire for sameness. In regards to language, children can use gestures, single words, early word combinations or progress to simple and complex sentences. Some higher-functioning children can read and write (Haynes, Moran & Pindzola, 2006). Bennett et al. (2018) stress that “the voice of autistic individuals is critical to transforming myths about autistic communication and empathy” (p. 31). Autistic individuals’ thoughts and perspectives must be discovered and considered to provide them with the most appropriate communication system to suit their needs (Bennett, et al., 2018).

Communication is key in accomplishing most everyday tasks and reaching achievements. According to Bennett et al (2018), for some autistic individuals, deficits in

social communication often present them with challenges when they interact with non-autistic individuals. The minimally verbal tend to be looked on as ignorant while the social communication needs of the highly-verbal are often overlooked. This is due to onlookers believing the myth that “language is the primary indicator of competence” (p. 137) so they assume highly-verbal autistic children experience no communication challenges. Higher functioning autistic children may miss out on necessary services because they may not meet the funding criteria which measures language and intelligence. Due to their higher-functioning abilities, they are viewed as not having communication issues and may be deemed difficult if they don’t follow directions or behave appropriately (Bennett, et al., 2018).

Current Autism Interventions

There are many types of interventions aimed at alleviating autism. Some are relationally oriented, according to Hyman et al. (2020), focusing on social development. The parent or caregiver “coaches” the child to help increase responsiveness through repeating what the adult said or did, expanding on that or participating in play. This targets joint attention, imitation and social skills. For example, the Developmental, Individual Differences, and Relationship-Based model, helps parents become less directive, resulting in their autistic children becoming more socially responsive. In naturalistic developmental behavioral interventions, the child initiates teaching and there are natural occasions for learning, turn-taking and play. Combined approaches mix the two (Hyman, et al., 2020).

In regards to education, according to Hyman, et al. (2020), Learning Experiences and Alternative Programs for Preschoolers and their Parents (LEAP) and the Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) are two interventions used in the classroom. LEAP is used for Elementary students and utilizes special

education teaching styles to improve students' social, thinking and speaking abilities while reducing negative patterns of behavior. TEACCH classrooms emphasize visuals, structure and predictability and making tasks user friendly, but result in few benefits and neglect functional skills and negative behaviors. It is good for children with autism to interact and play with normally developed children, but spending over 75% of their time in the normal classroom is not the sole factor responsible for their success (Hyman, et al., 2020).

Parents need to help their autistic children develop social skills with adults and with their peers. In child-directed interventions, according to Hyman et al. (2020), an adult works with a child individually or in a small group of similar children. Social narratives help children think about a situation and explain their thoughts about it. A systematic review of this intervention for children 6-21 demonstrated improvements in social understanding and friendships, but not in understanding emotions and social communication. Also, not everyone in the studies were able to apply the skills to other situations. Interventions need to take place in specific social settings for them to be applicable. In these contexts, such as the playground, students have demonstrated improved interactions with other children (Hyman, et al., 2020).

Speech therapy is another intervention. According to Hyman et al. (2020), many autistic children have delayed speech. Speech therapists teach speech sounds and use exaggerated imitation to help children grasp pronunciation. Preverbal autistic children may benefit the most from speech therapy. Parent involvement in speech therapy helps their children reinforce what they are learning (Hyman, et al., 2020).

Types of ACC Devices

According to Mirenda (2019), there are two main types of AAC devices, unaided and aided. Unaided requires no equipment to produce and includes natural gestures, body language,

vocalizations and manual signs (sign language) whereas aided require a device external to the user, such as a communication board or speech-generating device (Mirenda, 2019). Carson and Holyfield (2019) share that there are several reasons why AAC devices may be a good fit for autistic children. Some struggle using their vocal muscles to produce speech, so pointing and manual signs are easier. Many autistic children have auditory processing difficulties, so pictures allow them to utilize their visual-spatial skills (Carson & Holyfield, 2019).

According to Mirenda (2019), AAC can be a tool for young children to communicate with parents before they learn how to talk. These devices may help children slow in developing speech to learn how to communicate in appropriate ways, such as asking for something or sharing their wants and needs. One concern not supported by the data is that AAC hurts the development of speech (Mirenda, 2019). According to Hyman et al. (2020), AAC does not delay speech and may encourage social interaction and understanding communication. AAC may aid the beginning of speech by incorporating verbal and nonverbal communication (Hyman, et al., 2020). Mirenda (2019) points out that when children with autism do not have a way to communicate, the result is frustration, behavior, learning and social issues. It is best to begin AAC early, children will vary with how long they need to use it (Mirenda, 2019).

Unaided AAC

Mirenda (2019) notes that natural gestures and body language, which includes behaviors such as pointing, putting a finger to your lips to ask someone to be quiet, shrugging and shaking your head “yes” or “no” are one form of unaided AAC. Another unaided AAC are manual signs or sign language. A communication partner may utilize signs and speech to communicate to an autistic child who then responds using sign language (Mirenda, 2019).

Another method is the Picture Exchange Communication System (PECS) in which a

user learns to exchange pictures to ask for items rather than point to them on a communication board. Instruction begins with single pictures and grows to combining pictures to produce complex communication. As the learner moves through the six phases, he or she learns to form more complex sentences. Phases 4-6 lack research support (Mirenda, 2019).

Aided AAC

One type of low-tech (nonelectric) aided AAC, according to Mirenda (2019), are tangible symbols which are physical objects such as a fork that could represent food or eating. These objects can be regular sized or smaller for transportation. Autistic children may use a tangible symbol to let their parents know they are thirsty by bringing them a cup. Pictorial symbols include photographs or drawings. Children can point to these pictures and drawings that symbolize people, places, activities, items, feelings, descriptors and common words/phrases to communicate (Mirenda, 2019).

In regard to high-tech (electric) AAC, Carson and Holyfield (2019) explain that it is especially useful for autistic children at early language and communication development. AAC intervention at this time, can build upon what the child already knows and further their communication effectiveness. Visual symbols can aid children's visual processing skills, but displays that are not organized well and lack concrete symbols (as opposed to abstract) can hinder learning (Carson & Holyfield, 2019).

According to Mirenda (2019), static display devices are pictures usually printed on laminated paper and attached to the front of the device. After pressing a symbol, the device will speak the prerecorded message that corresponds to that picture. There are usually multiple levels on the device with messages that go with a different set of symbols. The number and size of symbols vary. Many users are beginning communicators with visual or motor

impairments. The disadvantage is that someone needs to change the vocabulary and level so that the user has access to further vocabulary (Mirenda, 2019).

A type of speech-generating device is called Language Acquisition for Motor Planning (LAMP). According to the Center for AAC & Autism (n.d.), the app is based on visual learning and structure in language. LAMP was originally created to aid nonverbal autistic individuals in communication, but it can also be used for other kinds of disabilities. LAMP has been shown to increase spontaneous communication (The Center for AAC & Autism, n.d.). According to Prentke Romich (n.d.), LAMP has thousands of frequently used words and users can even add new ones. Words are paired with each picture to support language development. LAMP users can string words together to communicate their thoughts. The symbols keep the same location on the app, so users memorize where they are stored. Users can search for words on the app and there are different vocabulary levels. It is currently only available for the iPad at a cost of \$299.99 (Prentke Romich Company, n.d.). Alzrayer (2020) showed that instructions for speech along with speech-generating device interventions increased “vocalizations in children with limited functional speech” (Alzrayer, 2020, p. 162).

Parent Perspectives

Park (2020) explains that parents play a large role in the acceptance, refusal, success or failure of their autistic children’s AAC use. Some parents noted that AAC increased their children’s speech, aided pronunciation and helped with making sentences and sharing emotions. Others were delighted at being able to communicate better with their children. Some regretting not introducing AAC sooner. Parents learned their children knew more than they originally thought and they changed their parenting to allow them to speak and answer for themselves. They advocate improving the limited symbol quality and speech output for SGD devices as well

as making devices easier to carry around. The graphic symbols could be improved to accurately represent emotions and a quicker process to form sentences would be beneficial. They noted that AAC training for special education teachers and parents is important (Park, 2020). Doak (2021) concluded in her study that a wide range of emotions surround AAC devices for parents and families. Some self-blame or feel guilty about not implementing AAC devices for their children. AAC did not have a large part in any of the homes of the participants. Other communication strategies such as eye gaze and facial expression were more widely used. “It was suggested that apparent lack of enthusiasm for AAC may be an understandable act of self-preservation in the face of considerable demands and few supports, with families learning to quickly anticipate their child’s needs in order to prevent problems before they occur” (Doak, 2021, p. 208). Moorcroft, Scarinci, and Meyer (2021) researched why parents reject AAC and found that parents thought it was not easy to integrate into their lives as it was hard to remember to take it places, it took time to program or make AAC systems and devices were slow and either too big or too small. Additionally, parents said the language in high-tech AAC was either too simple or complicated for their children. Others shared that there was not enough vocabulary and their children had difficulty finding vocabulary in the device (Moorcroft, Scarinci & Meyer, 2021).

Lack of Research on Autistic Children & AAC

According to Iacono et al. (2016) there is a lack of detailed evidence “for children with the most significant learning needs, including those who are minimally verbal” (Iacono, et al. 2016, p. 2359). As a result, the present study seeks to synthesize the existing research on autistic children who use AAC to portray a clear picture of the benefits and costs. This study seeks to answer the following question: “What is the role of Augmentative and Alternative Communication (AAC) devices in aiding individuals across the autism spectrum and what

perspectives do parents of children across the autism spectrum have with regard to this technology?” I will first provide direction with a parent interview about her autistic son’s use of LAMP and then delve into the meta-analysis.

Methods

Preliminary Interview

My research instruments include an interview directed at a parent of a 10-year-old who has moderate to severe autism. The questions are listed in Appendix A and focus on AAC and their function, parents’ views toward them and their effectiveness for their children. This study received IRB approval to interview the participant. The purpose of the interview was to provide direction for the meta-analysis, specifically examining advantages and disadvantages of AAC devices and parent perspectives toward them. According to Burns (2010), interviews are good because they are a non-observation tool that allow researchers to collect people’s “views, beliefs and opinions” about an area of interest. Interviews offer flexibility in structure and participants, adding to their desirability (Burns, 2010, p. 90). Mann (2010), providing advice on conducting interviews, shares that the interviewer should build rapport with the interviewee before conducting the interview to make the interviewee comfortable and ready to open up. In conducting my 25-minute interview over Zoom, I began by asking how the interviewee was doing, about her occupation and family before delving into the interview questions. I recorded the interview so I could listen to it several times and transcribe the content for analysis. After conducting the interview, I contacted the interviewee and relied on member checking i.e., verifying the interview findings (Burns, 2010) to confirm the accuracy of my information.

Study Identification

I chose a meta-analysis as the best way of revealing the relationship between AAC and

children with autism. A meta-analysis, according to Ortega (2010), is a synthesis of the research on a given topic in which the results are quantitatively summarized to draw conclusions on the current consensus (Ortega, 2010). Before determining search terms, I defined the inclusion and exclusion criteria. In order to be included, a study had to be conducted between January 2000-August 2021, report on the findings of an experiment in which autistic children 18 years old or younger used AAC devices; and/or include parent's perspectives of their children's (18≤) AAC use. The beginning of the timeframe is 2000 as, according to the National Council of State Legislators (2016), the Children's Health Act of 2000 was enacted, establishing the National Center on Birth Defects and Developmental Disabilities at the CDC and authorizing the Centers of Excellence at the CDC and the National Institutes of Health. Their centers research and regulate issues related to the diagnosis and treatment of autism. As this act put autism in the minds of the public and medical personnel, it jumpstarted autism research (National Council of State Legislatures [NCSL], 2016) so studies after this date are included. Exclusion criteria include adult AAC users (older than 18) and non-autistic AAC users. Ortega (2010) recommends developing a systematic coding scheme to synthesize the research. Following suit, I have selected the search terms *AAC, autism, children, and parent perspectives* to get at the components of my research question. I am following Glass' (1976) widely supported method of taking a broad approach to research. He advocates a more liberal position in regard to the criteria studies must meet before they can be included. His method will allow me to present a comprehensive picture of the research that has been done on AAC in relation to autistic children and their parents' perspectives.

Journal Impact Factors

The meta-analysis combed through the following three Speech-Language Pathology

journals using an advanced search: the *American Journal of Speech-Language Pathology*, the *Journal of Speech, Language, and Hearing Research*, and *Language, Speech and Hearing Services in Schools*. A broad study looking through several databases would have been ideal, but due to time constraints it was necessary to narrow the scope of the research to these three journals. These journals have impact factors approaching 3. Impact factors, according to Sharma, Sarin, Gupta, Sachdeva, and Desai (2014), indicate the importance of a journal to its field, not the quality of the journal. The higher the impact factor, the higher the importance. Journal impact factors measure how many times articles from a journal are cited over a two-year period. For example, to calculate the 2022 impact factor, the number of times articles published in 2020 and 2021 were cited by journals is divided by the total number of citable items the journal published in that time (Sharma, et al., 2014). Speech and hearing journals, according to Scimago Journal & Country Ranking (2021), have impact factors ranging from under 1-3.30, so these three journals are cited more often than others (Scimago Journal & Country Ranking, 2021). According to the American Speech-Language-Hearing Association (2022), as of 2020, *The American Journal of Speech-Language Pathology* has an impact factor of 2.408, the *Journal of Speech, Language, and Hearing Research* is 2.297, and *Language, Speech and Hearing Services in Schools* is 2.983 (American Speech-Language-Hearing Association [ASHA], 2022).

Findings

The meta-analysis and the interview data revealed interesting benefits as well as disadvantages. I'm reporting the interview data first and then the meta-analysis advantages, disadvantages and parent perspectives. The advantages found from the meta-analysis appear to be learning new words and developing more advanced communication i.e., responding to greetings and questions, using receptive and expressive language, requesting, using nouns and

verbs and increasing vocalizations and/or speech; the disadvantages appear to be lack of generalization to new settings, challenges learning static compared to animated symbols, difficulty integrating into everyday situations and lack of generalization of learning to new AAC systems. A chart of the meta-analysis studies can be found in Appendix B.

Interview Data

In regards to the interview conducted, the AAC device LAMP helps the interviewee's autistic son to speak more in sentences rather than in phrases. Instead of saying "red apple" or "me apple," he would say "I want an apple," or "Get me an apple, please." When he was diagnosed at 2 ½, he was not saying much at all, but would communicate by typing on an iPad. The iPad allowed his parents to get access to things he wanted or was thinking even though he did not know how to ask a question. For example, when he typed "Monsters Incorporated, a Pixar animation film," his parents knew he wanted to watch that movie. He is severely limited in his speech and communication so his classroom aide helps him stay on task and understand his teacher's directions. He currently only uses LAMP in speech therapy sessions which he has 2-3 times per week.

Advantages and Disadvantages of LAMP

The student is motivated by electronics, so LAMP has the potential to increase his motivation and participation in speech sessions. LAMP helps him expand into complete sentences as opposed to speaking in phrases. It can help him include a subject, verb and object if needed.

A disadvantage of the technology is that LAMP is not able to help him communicate what he is thinking and feeling. He is only able to communicate his wants and needs. His enjoyment of technology tempts him to use it for fun instead of to communicate in speech

sessions. He can use LAMP to answer questions correctly, but the interviewee noted that he uses it about “50-50 for constructive use and just being silly.” He will press a button for the app to read aloud his sentences over and over because he knows he will get a reaction. In speech therapy, he will sometimes type dialogue from shows instead of answering the question he was asked. For example, when describing a person’s emotions, he may type “This person” followed by a favorite movie quote. A third disadvantage is that it would be pretty cumbersome on an iPad to integrate into everyday life as the app would need to be opened and he would need to type what he wanted to say every time he wanted to interact with someone.

LAMP is a very intricate system in which some of its categories are intuitive and others are not. It took the interviewee a while to figure out where the verbs are and how they are categorized, but her son learned how to use LAMP quickly. He is very intelligent. She shared that he likes to make jokes on LAMP or be silly. She and her husband are unable to tell if he is purposefully making a joke to get them to laugh, because he thinks it is funny or just to be silly. He will create sentences that don’t make sense and then laugh because he knows they are wrong.

Parent Perspectives

His parents were indifferent at first to have him try an AAC device as they had assumptions that it wasn’t going to help more than speech therapy. Also, his mom was overwhelmed at the prospect of another doctor’s appointment for yet another intervention. She does not remember what their thoughts were at first. In order to get services, individuals need to go through evaluations and each doctor’s office or therapy facility wants their own evaluation. This is hard as his mom said “nobody wants to take the word of someone else.” She did have doubts at first as to how this technology would help her son more than speech therapy. Now, she thinks LAMP has helped a little more than she anticipated, but she is not sure about the extent.

She noted that it is hard to judge the effectiveness of AAC because her son uses AAC along with other interventions. Also, a lot of these programs are aimed at forming simple sentences, but her son can handle complex ideas, has the vocabulary and knows the correct syntax. It is just a matter of pulling the words out of him.

Meta-Analysis

The search in the *American Journal of Speech-Language Pathology*, the *Journal of Speech, Language, and Hearing Research*, and *Language, Speech and Hearing Services in Schools* yielded 147 research studies, 18 of which met the inclusion criteria of studies conducted between January 2000 and August 2021 involving autistic children 18 and younger who use AAC. The second search resulted in 49 studies on parent perspectives of their children's AAC use and one of those met the inclusion criteria which is the same as noted above with the addition of *parent perspectives*. A few parent perspectives were included from other studies focused on AAC benefits and disadvantages. The findings are broken up into the following categories: benefits of AAC, disadvantages of AAC and parent perspectives. It is important to note that studies involved a variety of topics related to AAC with not many investigating the same constructs.

Benefits of AAC Devices

Of the 18 studies, 4 found that AAC teaches communication functions, another 4 found that AAC aids requesting, 3 found that vocalizations and speech can increase with AAC, 2 discovered AAC increases symbol comprehension, and 1 study found benefits related to spelling.

Four studies found that AAC teaches communication functions and nouns and verbs during book reading activities (Brady, Storkel, Bushnell, Barker, Saunders, Daniels & Fleming, 2015; Chavers, Morris, Schlosser & Koul, 2021; Finke, Davis, Benedict, Goga, Kelly, Polumbo,

Peart & Waters, 2017; Holyfield, 2021). Brady et al. (2015) share that AAC can help children with limited expressive vocabularies learn new words and increase speech. The four high-responders learned between 14-17 of the 20 target words. The fifth high responder learned 7 of 10 words as he could only participate in two sets. The five low responders did not demonstrate success after intervention though three improved from baseline and learned either 1, 3 or 4 words. Regarding receptive word learning, 4 of the children learned 15-20 of 20 words and the fifth child only had time for two sets, learning 10 of 10 words. The low responders had similar results to the expressive words at 4,3, or 0 words learned (Brady et al., 2015). Chavers et al. (2021) found that SGD's help children to develop more advanced communication such as responding to greetings and questions. Additionally, SGDs helped them chat with the experimenter. Later, they generalized to talking with familiar people who were not part of the experiment (Chavers, et al., 2021). Finke et al. (2017) note that AAC is useful for teaching multi-symbol messages (combining symbols to produce one message). All participants learned two symbol messages and some branched out to three. Finke et al., (2017) went on to explain that intervention allowed these children to interact more effectively in their classroom (Finke, et al., 2017). Holyfield (2021) shares that instruction using text and pictures with text resulted in children learning high-imageability words (i.e., nouns). All participants generalized high-imageability words in the text-only condition using the unfamiliar LAMP app. They did not generalize the pictures with text to the different set of symbols. Intervention improved understanding of low imageability words (i.e., verbs), but performance was less rapid than for high-imageability words. They all improved in using low imageability words in both conditions, though one student struggled to make progress with the text + symbol condition. Generalization for low imageability words increased for the text-only condition. Maintenance was somewhat

higher for the text-only condition compared to the pictures with text (Holyfield, 2021).

Four studies found that AAC helps children request items (Chavers et al., 2021; Bourque & Goldstein, 2020; Thiemann-Bourque, Brady, McGuff, Stump & Naylor, 2016; Thiemann-Bourque, McGuff & Goldstein, 2017). Chavers et al. (2021) note that speech generating devices allow children to make multistep requests for snacks or activities. They are able to choose the correct symbols to communicate their message. Later, they generalized to asking for untrained snacks (Chavers, et al., 2021). Bourque and Goldstein (2020) added that AAC intervention improved initiating requests for objects the most, followed by requests for actions and commenting (Bourque & Goldstein, 2020).

Three studies found that AAC can increase children's vocalizations and/or speech (Babb, McHaughton, Light, & Caron, 2021; Brady, et al., 2015; Gevarter, Horan & Sigafos, 2020). Babb et al. (2021) noted that three of the four participants increased use of speech (Babb et al., 2021). Brady et al. (2015) share that AAC can help children with limited expressive vocabularies learn new words and increase speech (Brady, et al., 2015). Gevarter et al. (2020) found that AAC can increase functional target word use for preschoolers. All increased response rates, but they fluctuated depending on what toy they were playing with. The high-tech AAC device video visual scene displays (VSDs) increased vocalizations for all but one participant. Learners used VSDs and the grid to initiate, indicate behavior, or to respond after an instructor command or opportunity. All improved labeling items (Gevarter, et al., 2020).

Two studies found that AAC can increase symbol comprehension (Drager, Postal, Carrolus, Castellano, Gagliano & Glynn, 2006; Schlosser, Brock, Koul, Shore and Flynn, 2019). Drager et al. (2006) found that children could comprehend symbols faster than produce them, but as the sessions went on, one of the children's rates of comprehension and production grew to be

about the same. They maintained symbol comprehension and production to varying degrees. Intervention resulted in one of the children responding more to verbal stimuli than graphic until the third activity while the other child responded similarly to both modes after fluctuating between the two (Drager, et al., 2006). Schlosser et al. (2019) found that AAC animated symbols are easier to identify than their static counterparts. The symbols were rated based on being exceptional, effective adequate and inadequate. All of the animated symbols were either adequate, effective or exceptional compared to 79.8% of static symbols. Additionally, 21 static symbols were categorized as either adequate or inadequate while 18 animated symbols were either effective or exceptional. For 10 verbs, animation improved their comprehensibility by one category over their static equivalents. But animation did not improve the symbols for the verbs “cover, sing, take and wave.” The static image for “eat” was more effective than its animated symbol (Schlosser, et al., 2019).

One study, Schlosser and Blischak (2004), noted that autistic children with little or no functional speech can use high-tech AAC to spell with feedback. Three of the participants spelled words more efficiently when print was involved by itself or with speech whereas one of the participants performed best when receiving input from speech and print and was not successful with solely print (Schlosser & Blischak, 2004).

Disadvantages of AAC Devices

Only 7 studies identified disadvantages, and of those 7, only two identified a similar disadvantage of having to do with symbol comprehension and the type of symbol used.

Two studies discovered issues with AAC symbols (Drager, et al., 2006 and Schlosser, et al., 2019) Drager et al. (2006) found that symbol production tends to trail comprehension (Drager et al., 2006). Schlosser et al. (2019) found that static symbols are more difficult to

recognize than animated symbols (Schlosser, et al., 2019).

One study, Bourque and Goldstein (2020) found that SGDs do not increase speech for all autistic children (Bourque & Goldstein, 2020).

One study, Holyfield (2021), found that shared book reading did not result in generalization of the picture symbols with text to an AAC app with a different symbol set. Pictures with text did not increase the learning of low imageability words (Holyfield, 2021).

One study, Gevarter et al. (2020), noted that correspondence errors, using the SGD to say something that doesn't match behavior and activation errors are the most common errors when using VSDs. Additionally, AAC experience does not guarantee generalization to other AAC without intervention (Gevarter, et al., 2020).

One study, Vidal, McAllister and DeThorne (2018) found that AAC is hard to integrate into everyday interactions, especially when others are unfamiliar with it. Classmates in Vidal et al.'s (2018) study did not know what the iPad did and referred to it as something "special needs kids use". Also, sometimes paraprofessionals treat AAC as last resort instead of thinking of it as a way to clarify communication (Vidal, et al., 2018).

One study, Schlosser & Blischak (2004), found that generalization of spelling from speech and print feedback is not always clear. Two of the participants in Schlosser & Blischak (2004) study were not able to generalize at all, two generalized to produce novel words that rhymed with the target words used in the study, but it was not consistent or at the same level as acquisition (Schlosser & Blischak, 2004).

Parent Perspectives

Only four studies identified parent perspectives of AAC, and of those four, none identified the same perspectives.

DeCarlo, Bean, Lyle and Cargill (2019), found that parents viewed operational competency as an important skill for using AAC. Their operational competency averaged 0.61 and buy-in at 0.66 on a 0-1 scale. Those whose children used AAC for longer periods of time did not report greater buy-in and their buy-in was not affected by their children's verbal ability. Only 10 of the 29 children involved used AAC at home during the weekends, but the time frame studied included three random school days and one random weekend (DeCarlo, et al., 2019).

Therrien and Light (2018), reported that parents indicated after watching video clips of an intervention, that it had a positive effect on communication engagement, they supported its use in the classroom and would recommend it to others (Therrien & Light, 2018).

Vidal, Roberts and Dethorne (2018) noted that a mom of an autistic son thought it was important for her son to see other examples of how he can use his AAC to communicate at school (Vidal, et al., 2018).

Thiemann-Bourque, Feldmiller, Hoffman and Johner (2018) shared that after a peer intervention activity with AAC, parents rated their children in the treatment group with trained peers higher than the parents who had children in the comparison group with untrained peers (Thiemann-Bourque, et al., 2018).

Discussion

There are both benefits and disadvantages to Augmentative and Alternative Communication for children on the autism spectrum, but there is no one size fits all answer to help everyone communicate. For example, manual signs may be more applicable for those who struggle to produce speech and pictures may be more appropriate for those with auditory processing difficulties (Carson & Holyfield, 2019). AAC can be a tool for young children to communicate with parents before they learn how to talk and even help those slow in

developing speech (Mirenda, 2019). High-tech AAC is useful for children at early language and communication development (Carson & Holyfield, 2019). This technology provides answers on a case-by-case basis.

AAC Advantages

This meta-analysis of 18 previous studies conducted to determine the advantages and disadvantages of AAC demonstrates that they can be beneficial. In reference to Alzrayer (2020), speech-generating devices increased “vocalizations in children” who had limited speech (Alzrayer, 2020, p. 162). Likewise, three studies confirm that AAC can increase children’s vocalizations and/or speech (Babb, et al., 2021; Brady, et al., 2015; Gevarter, et al., 2020). Intervention in the Finke et al., (2017) study may have resulted in more two and three symbol messages if the children were allowed to use their own AAC devices rather than iPad communication boards with which they were unfamiliar.

Different AAC symbols are more appropriate for teaching nouns and verbs. Either text by itself or an image alone are more effective than a picture with text (Holyfield, 2021) so symbol construction must be paid attention to in determining what is most effective for children.

Some children are able to pay attention to spoken and graphic symbols which is contradictory to the belief that autistic children are strong visual learners. They are not solely visual learners (Drager, et al., 2006). The five high-responders in Brady et al.’s (2015) study had higher scores on the *Peabody Picture Vocabulary Test-Fourth Edition* and the *Communication Complexity Scale*, thus they had more advanced receptive and prelinguistic communication before beginning the study. This helped them learn more words than the lower responders (Brady, et al., 2015).

An additional interesting finding that was not directly related to the research question

involves peer intervention. Eight studies found that AAC with peers increases social interaction, back and forth communication, turn taking and joint attention both for autistic children and peers, increases speech, initiations and responses for both autistic children and peers, making requests and use of expressive and receptive language (Babb, et al., 2021; Bourque & Goldstein, 2020; Therrien & Light, 2018; Brady, et al., 2016; Thiemann-Bourque, et al., 2016; Thiemann-Bourque, et al., 2018; Thiemann-Bourque, et al., 2017; Vidal, et al., 2018). Therrien and Light (2018) found that peers surveyed afterward noted that the AAC helped them and their partner talk to one another. Most improvements were made with using symbols to request with smaller gains in sharing toys, commenting and gaining a peer's attention. (Thiemann-Bourque, et al., 2018). Thiemann-Bourque et al. (2017) found that communication increased when toys were introduced and even more with snacks for both autistic children and their peers (Thiemann-Bourque, et al., 2017).

Allowing autistic children to work with peers provides more language input and someone of the same age. Working with peers may help to decrease the social communication deficits of autistic children (Bennett, et al., 2018). Additionally, Hyman et al. (2020) affirm that it is good for autistic children to play and interact with normally developed children. The advantages of peer intervention are important to consider for autistic AAC users. Peers also benefited by increasing their turn taking, developing positive perceptions of children with communication needs and learning how to communicate with those different than them. Additionally, both autistic children and their peers communicate more when the context is favorable i.e., when eating a snack or playing with a fun toy. As Bennett et al. (2018) note that autistic children face challenges interacting with non-autistic individuals, the finding that AAC with peers can help autistic children to make requests, communicate wants and needs, increase social interaction and

turn taking and even occasionally comment provides a viable option for developing friendships and interacting with others.

A second interesting finding noted by Vidal, Robertson and DeThorne (2018) is that supports-based approaches can be used to integrate AAC into shared activities with peers. Supports-based approaches encourage others to value autistic children's contributions to the situation instead of teaching appropriate skills for certain settings. For example, an autistic boy's therapist put together a music group with him and some peers to perform for the class, incorporating his AAC (Vidal, et al., 2018). This is an important step to valuing and listening to what autistic children have to say, as noted by Bennett et al. (2019).

A third interesting finding involves parents and siblings in AAC intervention. Douglas, Biggs, Meadan and Bagawan (2021) found that integrating the whole family into AAC intervention can increase communication turns and use of AAC for autistic children as well as help their family members improve modeling (Douglas, et al., 2021). Wright and Benigno (2019) share that involving siblings in intervention helps autistic children build social skills in natural environments outside of school or speech therapy. Social stories (pictures and words that depict how to do something) can be used to help autistic children interact with others and be adjusted to focus on any topic or interaction that is challenging, such as turn taking or cooperation (Wright & Benigno, 2019). The inclusion of the whole family in intervention tends to increase autistic children's communication and social interaction (Douglas, et al., 2021; Wright & Benigno, 2019). Siblings are good sources for communication modeling as they interact with each other on a daily basis. It is important that the whole family is on board so that the child's AAC can be incorporated into daily life.

AAC Disadvantages

While there are numerous advantages of AACs, there are several disadvantages that cannot be dismissed. Turn taking learned from book reading may not generalize to different situations (Therrien & Light, 2018).

As Bourque and Goldstein (2020) found that SGD's do not increase speech for all autistic children, intervention needs to be individualized as autistic AAC users are not all the same (Bennett, et al., 2018).

In relation to the additional interesting finding about AAC and peer intervention, Babb et al. (2021) found that VSDs are hard for peers to use when their autistic partners are not feeling well. It was difficult for a peer to encourage the participant to communicate (Babb, et al., 2021). Thiemann-Bourque et al. (2018) noted that the children declined in communication when working with unfamiliar peers (Thiemann-Bourque, et al., 2018). Another difficulty of peer intervention was noted by Therrien and Light (2018) who found that AACs are more engaging for some, causing them to not want to share the device with their communication partners. Lastly, Thiemann-Bourque et al. (2016) found that communication with PECS and peers varies. Generalization affects fluctuate depending on the participant and location (Thiemann-Bourque, et al., 2016). It is important to take these issues into consideration when examining potential AAC devices and when working with peers.

Schlosser et al., (2019) pointed out that animated symbols for verbs are overall easier for autistic children to recognize and use than static symbols. As such, more animated symbols should be incorporated into AAC devices, especially for verbs. Along this same vein, unorganized and abstract visual symbols hinder learning (Carson & Holyfield, 2019). As AAC is challenging to integrate into everyday situations (Vidal, et al., 2018), parents and speech therapists can work to help normalize AAC and get more people comfortable with how the

devices operate. In terms of them being cumbersome, as noted by the interviewee, AAC apps could incorporate more preprogrammed sentences that the user could quickly locate and press. But typing other messages still take time.

These disadvantages make AAC devices not applicable for all autistic children needing assistance. As this technology, especially high-tech, is generally a large investment, steps should be taken to outline the goals of the autistic child and match those goals to a specific device or look into other interventions besides Augmentative & Alternative Communication, such as speech therapy. Even though AAC can teach communication besides requesting, results are limited which is a large negative aspect of them. Most of these studies were conducted in a classroom or educational facility. Interventions need to take place in specific social settings for children to learn from them (Hyman, et al., 2020). As such, there needs to be more research and integration of AAC at home and in community settings.

Parent Perspectives

Parent's perspectives of the technology and their child's AAC use, according to Park (2020), have an impact on the acceptance and success of the technology for their autistic children. More family support for AAC implementation may increase its use (Doak, 2021). Park's (2020) findings are supported by DeCarlo et al. (2019) as parents surveyed held too much regard for operational competency thus neglecting modeling for their children (DeCarlo, et al., 2019). Parents need to create more opportunities for their children to use their AAC device at home. The preliminary interview conducted for this study and described in the findings section of this paper, highlighted some parent perspectives. Specifically, the interviewee and her husband were indifferent at first about having their son try an AAC device. They had assumptions that it wasn't going to help more than speech therapy. Contrary to this, Park (2021)

noted that some parents regretted not implementing AAC sooner. The interviewee pointed out that she has seen a few benefits from her son using LAMP. There have also been drawbacks such as LAMP not being able to help him express his thoughts and feelings as well as it being cumbersome to use throughout his day if that was something he had the opportunity to do. This is in line Park (2021) as parents shared that AAC should be made easier to carry around and Moorcroft et al. (2021) noted that it was not a good size and hard to remember to take places. Parents in the Therrien & Light (2018) study did acknowledge positive effects of children working with peers and AAC that they observed in videos. Parents also noted positive benefits for their children after receiving AAC intervention with trained peers (Thiemann-Bourque, et al., 2018). These findings are affirmed by Park (2021) as parents noted improvements in their children's speech, pronunciation, communication and sharing of emotions. The parent in Vidal et al.'s (2018) study thought it was important for her son to see other ways he could use AAC at school. Parent's perspectives on the functional issues of AAC should be taken into account in order to develop more appropriate AAC devices (Moorcraft, et al., 2021). Both parents and their children should be taught how to use AAC (Doak, 2021; Park, 2021; Vidal, et al., 2018) and these opportunities should incorporate real-life examples applicable to them. Parent education on the benefits and disadvantages of AAC can be used to correct wrong perspectives, accurately inform and support the use of AAC.

Conclusions

This study addressed the research question "What is the role of Augmentative and Alternative Communication (AAC) devices in aiding individuals across the autism spectrum and what perspectives do parents of children across the autism spectrum have with regard to this technology?" The question has been addressed through a preliminary interview with a parent of

an autistic son who used AAC to guide the meta-analysis research on the technology.

There are advantages to AAC as reported by the parent interviewed for this study and as described in multiple research studies. The major findings include that LAMP benefited the interviewee's son by helping him speak more in sentences and share wants and needs. LAMP is not able aid his communication of thoughts and feelings and it is difficult to integrate into daily life. His parents were on the fence at first about AAC but since allowing their son to use AAC, they have noticed some improvement in his communication at the sentence level. In terms of the meta-analysis, benefits of AAC include that AAC helps children learn new words and develop more advanced communication, increases symbol comprehension, use of receptive and expressive language, requesting, use of nouns and verbs and vocalizations and/or speech. In regard to peer and family intervention, benefits include increased social interaction and communication such as turn taking, joint attention and initiations and responses.

Disadvantages include that these devices do not always aid generalization to new settings. Children have difficulty learning static symbols, there is a lack of symbol generalization to new AAC systems and it is hard to incorporate into daily life. The peer intervention studies point out that peers may take over AAC due to their interest with it and autistic children decrease in communication with unfamiliar peers.

Lastly, parent perspectives vary, some seeing benefits, others seeing challenges and the need to improve instruction to autistic children on how to use AAC in various settings. Parents need to focus less on operational competency and more on modeling for their children. More support for parents and how to use AAC may increase acceptance and implementation (Doak, 2021). In line with the interviewee, both Park (2020) and Moorcroft et al. (2021) explained that AAC needs to be made easier to use and incorporate in daily life. The interviewee's perspectives

have provided useful insights into how LAMP functions for autistic children.

This study has the potential to benefit autistic individuals in educating them about how they could use AAC to further their communication. It may promote a greater awareness of the autistic community, fostering respect for both AAC and non-AAC users across the autism spectrum.

Limitations and Future Research

Limitations to this study include a lack of time to spend conducting the meta-analysis. More time would have allowed me to use further search terms that may have pulled up more articles relevant for the study as only the search terms *AAC, autism, children, and parent perspectives* were used. Though the three speech therapy journals cover much of the research, searching databases could have brought more sources to the surface.

Future research should involve developing profiles of children who would benefit from specific AAC devices and looking into ways AAC can become more normal in different settings for those who need them. Additional research could be based on the advantages and disadvantages identified here compared to the perspectives of multiple parents. Also, as this study only searched studies involving children, future studies could look into addressing autism and AAC for the adult population and similarities and differences between them and children.

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Appendix A: Interview Questions

Can you tell me a little bit about your family?

How did he (her son) get introduced to AAC devices?

Where is he on the autism spectrum?

What are some thoughts about the usefulness or non-usefulness of AAC?

Does he like using the device?

Were you and your husband hesitant at first to have [son's name] use AAC or were you excited to get him to use that?

What do you think some pros and cons of LAMP are?

What are some other things he'll do in speech therapy sessions?

Has he ever been looked down upon or anything because of his AAC use?

Do you think AAC is especially good for the minimally verbal and high-functioning kids may not need to use it, or is it a good option across the spectrum?

With [son's name] LAMP, are there also pictures that he can click on?

So, then it'll speak for them and help them with communicating in that way?

Appendix B: Meta-Analysis Demographics

Author(s):	Date:	# Participants:	Participant Age(s):	Autism Diagnosis:	AAC:
Schlosser & Blischak	(2004)	4 (all boys)	8, 9, 12, 12	Mild to Moderate; little to no functional speech	<i>LightWRITER-SL35™</i> SGD & Black-on-white picture communication symbols
Drager, Postal, Carrolus, Castellano, Gagliano & Glynn	(2006)	2 children	4	Moderate ASD and average probability of ASD on <i>GARS</i> Autism rating scale. Used 10-20 single words expressively.	3X3 inch colored line drawing pictures on communication board
Brady, Storkel, Bushnell, Barker, Saunders, Daniels, Fleming	(2015)	10 children	6-10	ASD; unable to describe severity; less than 20 spontaneously spoken words	<i>Proloquo2Go</i> app
Thiemann-Bourque, Brady, McGuff, Stump & Naylor	(2016)	4 children 7 peers (2 moved after study began)	3-5 3-4	Moderate to severe ASD; nonverbal or minimally verbal (20 words or less).	<i>Picture Exchange Communication System (PECS)</i>
Finke, Davis, Benedict, Goga, Kelly, Polumbo, Peart & Waters	(2017)	6 children	9-12	ASD; first words stage of development	<i>Proloquo2Go</i> app (books and grid displays) communication board, sign language, gestures, vocalizations
Thiemann-Bourque, McGuff & Goldstein	(2017)	3 children 3 peers	4	Severe ASD; 20 words or less.	<i>GoTalk 4+</i>
Therrien & Light	(2018)	5 children 5 peers 3 parents	3-5 3-4	Mild-moderate to severe ASD; 1 child monitored for ASD and had an older sibling with ASD. Sig. impairments comprehending language.	<i>GoTalk NOW</i> app

Author(s):	Date:	# Participants:	Participant Age(s):	Autism Diagnosis:	AAC:
Thiemann-Bourque, Feldmiller, Hoffman & Johner	(2018)	45 children 95 peers 42 special education team members	2-5	ASD; minimally verbal-nonverbal	<i>SoMuch2Say</i> (discontinued after 1 year due to “ <i>limited flexibility, slow button release time</i> ”) <i>Touch Chat HD</i> , <i>Proloquo2Go</i> (2 users).
Vidal, Roberts & DeThorne	(2018)	1 child 4 peers	7 8-9	ASD; 13 word vocabulary and 18 signs	<i>Vantage Lite</i> dynamic display
DeCarlo, Bean, Lyle & Cargill	(2019)	29 children 29 parents 14 teachers	3-16	ASD; no vocalizations to speaking many words	<i>Words For Life</i> app
Schlosser, Brock, Koul, Shore & Flynn	(2019)	27 children	3-7	Mild to severe ASD	24 ALP Animated Graphic Symbols.
Wright & Benigno	(2019)	1 child	6-7	ASD	Social Stories
Bourque & Goldstein	(2020)	6 children 15 peers	3-5	Severe ASD; nonverbal or minimally verbal (less than 20 functional words)	<i>TouchChat</i> app
Gevarter, Horan & Sigafos	(2020)	5 children	3-5	Minimal-Severe ASD	<i>GoTalk NOW</i> created photo VSDs and drawing grid displays.
Vidal, McAllister & DeThorne	(2020)	1 child	9	ASD; minimally verbal	<i>LAMP Words for Life</i> app
Babb, McNaughton, Light & Caron	(2021)	4 teenagers 4 peers	16-18 15-17	Severe ASD	<i>EasyVSD</i> app
Chavers, Morris, Schlosser & Koul	(2021)	3 children	7-9	Severe ASD; less than 10 functional words	Indi 7 Communication tablet with <i>Snap + Core First⁴</i> ; Picture Communication Symbols (PCS)
Douglas, Biggs, Meadan & Bagawan	(2021)	1 child	4	ASD	<i>CoughDrop</i> app
Holyfield	(2021)	4 children	9-11	Moderate -severe ASD; limited or no functional speech; preliterate.	<i>Proloquo2Go</i> and <i>LAMP Words for Life</i> app.