

Case reports

Use of a robust alternative communication system in autism spectrum disorder: a case report

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Research support source: PIBEXC – announcement of financial support to public outreach programs and projects of the Universidade Federal de Pernambuco.

Conflito de interesses: Inexistente



Received on: December 13, 2021

Accepted on: May 30, 2022

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ABSTRACT

This study aimed at investigating the impact of using a robust augmentative and alternative communication (AAC) system on the communication of a child with autism spectrum disorder. This longitudinal intervention research is a single case study. Skills were assessed with data obtained with the protocol Communication Assessment in Autism Spectrum Disorder at the beginning and end of the intervention. Receptive and expressive communication and behavioral skills increased respectively by 62.5%, 36.84%, and 55.53%. Hence, positive results were found in communication development using the robust AAC system in the intervention, as verified in the progress in receptive and expressive communication and behavioral skills.

Keywords: Autistic Spectrum Disorder; Communication Aids for People with Disabilities; Communication; Speech, Language and Hearing Sciences

INTRODUCTION

Autism spectrum disorder (ASD) is described as an early-onset neurodevelopmental disorder, characterized by behavioral, social skills, and communication changes, possibly requiring different levels of support¹.

This population's communication changes are heterogeneous. They may range from absence of speech or production of few words to greater verbal skills – though with persistent deficits in the functional use of communication².

Communication changes manifest in nonverbal communication, with a special impact on pragmatic skills, shared attention, taking turns, eye contact, limited gestures, facial expressions, vocalizations, smiling, and playing with others³. Verbal communication, in its turn, is stereotyped and rigid, with echolalia and prosody changes. Linguistic impairments may be present in pragmatics, semantics, morphosyntax, and phonology – which is the least impaired aspect of language⁴.

Intervention approaches that help develop functional communication skills in people with ASD include augmentative and alternative communication (AAC). This is a subfield of assistive technology addressing multiple communication modalities, encompassing the integrated use of symbols, resources, techniques, and strategies to give access to information and communication⁵. AAC makes communication possible for people with limited, unintelligible, or absent speech^{6,7}.

The review of the national literature indicates that studies on autism and AAC are promising and relevant. However, this scenario shows little variety of AAC system types and AAC teaching methods. There is a scarcity of broader AAC modalities to meet individual needs, considering their cognitive, sensory, motor, and linguistic skills, as well as studies with better methodological designs⁸.

“Autismo Comunica” is a public outreach program based on the sociopragmatic theory and focused on the Development of Communication Skills in Autism (DHACA, in Portuguese). The sociopragmatic perspective presupposes the cultural origin of language – i.e., the understanding that linguistic signs are culturally transmitted in everyday social interaction and develop through shared attention and ever-increasing understanding in-between speakers as intentional agents; hence, imitation and collaboration are the main forms of transmission^{9,10}.

DHACA aims to develop communication skills in language intervention, using a robust AAC system and behavioral strategies such as modeling (i.e., aided

language input/stimulation) and physical, visual, and verbal cues⁹. These are carried out in play activities (according to each child's preferences) in the social contexts to which they belong.

Robust communication systems and modeling have been currently used in clinical practice as therapeutic AAC strategies for subjects with complex communication needs, such as children with ASD.

A robust AAC system is characterized by selected pictograms, based on core and fringe words. Core words encompass essential language (usually verbs, adjectives, adverbs, and pronouns and rarely nouns), which is highly frequent in general interaction. Fringe words encompass nouns and a range of words more related to the specific interest of AAC users¹¹. Modeling, in this sense, emphasizes using core vocabulary 80% of the time and fringe vocabulary 20% of the time in interactions.

Studies on different languages and age groups indicate that approximately 50 words correspond to 40-50% of everyday communication. About 100 words represent 60%, and 200-400 words represent 80% of the words used on a daily basis¹¹.

A robust AAC system provides its users with a more encompassing communication tool, which exposes them to language more broadly and receptively through modeling. Meanwhile, they can combine various symbols to make statements and express a wide range of ideas and communicative functions at will. The variety of words available gives access to a vast array of sentence patterns^{12,13}.

Modeling consists in simultaneously and contextually associating one or more elements in the adults' speech with symbols in the robust AAC system, thus providing a consistent language usage model (i.e., input) to AAC users. This strategy benefits children who have difficulties understanding spoken words, giving them additional visual information. Hence, they perceive that the AAC system is useful for their expression.

Modeling is relevant particularly because it is implemented in natural and significant communicative contexts. It creates various linguistic input opportunities (encompassing a variety of language structures and communicative functions), and increases vocabulary¹⁴.

It is important to highlight that children must be immersed in an environment with communication partners using AAC to learn to use the system. Language input is essential to language acquisition¹¹.

Given the lack of national research on children presented with ASD using robust AAC systems, the

objective of this study was to investigate the impact of using a robust communication system, structured as a low-technology communication book, with a child on the spectrum.

CASE PRESENTATION

This study is an integral part of the research project named: “Speech-language-hearing and autism: Knowledge, intervention, and inclusion”, approved by the Ethics Committee of the *Universidade Federal de Pernambuco* – UFPE, Brazil, under protocol number 2.106.800.

J.P., a 3-year and 11-month-old-male, was diagnosed with ASD by a child psychiatrist. He had normal hearing thresholds and no comorbidities.

The parents reported that J.P. acquired his first words by 1 year and 6 months old. After reaching this linguistic milestone, he produced a few isolated words, which did not lead to the first sentences. The parents reported having noticed the first atypical behaviors as soon as 5 months when J.P. did not cry after receiving an injection, as well as afterward, as nothing seemed to interest him. The child’s communication consisted of guiding an adult’s hand to the item he wanted and rare verbal productions, such as “take” and “open”. He had not been previously submitted to language intervention or used any type of AAC system.

J.P. attended individual 40-minute weekly sessions, totaling 24 visits, at the speech-language clinic at UFPE. His parents also received weekly instructions for home activities and participated in two guidance meetings with the group of parents of children with ASD assisted at the teaching clinic.

Communication skills were assessed with a pilot of the protocol Communication Assessment in ASD (ACOTEA-1)¹⁵, with 32 statements divided into expressive and receptive communications skills and behavioral skills. Its application requires the therapist to establish communicative situations with the child using play activities with various toys (kitchen items, dolls, cars, balls, shape sorters, guitars, stuffed animals, and bathtub). After two assessment sessions, it was found that the child would rather be alone and was not interested in any of the activities, except for lining up shape sorter pieces. Regarding pragmatic functions, he did not point or verbalize to ask for anything at any moment of the session; instead, he only took the toy from the therapist’s hands. Neither did he use social expressions or ask for information. He verbalized the numbers printed in the shape sorter pieces and made

a comment “Oh, cool!” when lining up the pieces; other than that, he produced no sentences. He made vocalizations during the sessions and presented hand stereotypies. When called, sometimes he looked; but he did not respond to simple commands or obey when he was said “stop” or “no”. The child was not stubborn or aggressive when questioned and showed no interest in interacting with the therapist.

The intervention used DHACA⁹, employing the pictogram communication book – which initially had 66 core vocabulary pictograms on a single page, as well as smaller overlapping pages with a single 10-pictogram line (Annex A). These pages, separated by lexical category, contain fringe vocabulary that is gradually introduced throughout the therapeutic process. In this version, the method aims to develop four skills, namely: constructing sentences with “I want” and another word, constructing sentences with “I want” and another two words, constructing sentences with four or more words, and constructing narratives.

The first skill was developed by leading the child to ask for the desired object by constructing sentences with “I WANT + a word” (CSIWX). To acquire this skill, the child should be able to ask the interlocutor for something by pointing to the pictures I + WANT + a picture in the fringe vocabulary. The sentence is sequentially constructed as the child points to the pictures, with or without speech. To this end, the child’s preferences were analyzed (numbers, colors, shapes, and foods) and then the related pictograms were placed in the fringe vocabulary tab in the communication book. Then, the activities to be used with these pictograms in the sessions were defined. In the activities, the items that interested the child were placed in his visual field, and he was encouraged to ask by pointing in the communication book the pictograms that referred to the sentence I + want + word (e.g., “I want popcorn”). Initially, the child was taught the skill with physical cues, which were gradually replaced with visual and verbal cues. Also, the interlocutor used modeling to demonstrate how to construct the targeted sentence, until the child was able to ask without cues. The child received the desired item after asking for it with the communication book. Six sessions were used before continuing to the following skill.

In the second skill, the child was encouraged to construct sentences with “I + WANT + two words” (CSIWXX). Physical, visual, and verbal cues were used to teach the new skill, and they were likewise gradually removed. Besides stimulating him to ask with the

CSIWXX skill, modeling was also used for lexical development regarding colors and shapes, numbers, and foods. For instance, the therapist modeled “I + WANT + LETTER ‘B’ + BLUE” during play activities. In the process of acquiring the second skill, another lexical category was added – the parts of the human body. This skill took five sessions to be developed when the child began asking interlocutors in different contexts.

The third skill was developed throughout 13 sessions, which explored the use of various personal pronouns, interrogative pronouns, and concepts, constructing sentences with four or more words (CS4MW). Activities to develop this skill used music and musical instruments, the alphabet, animals and numbers, shapes, foods, bowling, and puzzles. Also, new pictograms were added to the communication book, encompassing the following lexical categories: animals, alphabet, feelings, cartoons, and the notion of time – this last one at the family’s request. Physical, visual, and verbal cues and modeling were used.

To develop the fourth skill, the child was stimulated to make comments, describe actions and develop narratives (CND). However, this skill was not achieved by the end of the 24 sessions. In all skills, when pointing at the communication book, J.P. also made verbalizations – which were increasingly present and constant with time, as he developed the communication skills.

In this case study, modeling was initially used with some keywords (e.g., now, later, no, more, where, is, leave, over, under) while the therapist or parents spoke to the child and pointed at the pictograms. It favored the child’s receptive language and the acquisition of new concepts (broadened vocabulary), new morpho-syntactic structures, and different communicative functions.

Modeling, used to give children an example of how to construct linguistic structures, occurred more often in the third skill. In various moments, the child did not properly produce the targeted sentence, building them with more verbs, articles, adverbs, prepositions, and interrogative pronouns, which belonged to the core vocabulary page. Then, the therapist or parents

repeated, modeling the sentence the child wanted to say and including these core words in the conversation with the patient, as he made comments or questions and named or asked for things. For instance, the therapist once asked: “Where is letter ‘A’?”, pointing to the pictograms; J.P. was expected to answer: “Under the car”. However, he answered by pointing only to the pictogram “under”. So, the therapist modeled by pointing and saying: “That’s right, it’s under the car. Let’s get it?”

Some time was dedicated in each session to both parents’ participation. They were encouraged to use the communication book with their child, in communicative interaction previously structured by the therapist with activities that interested the child. The therapist could thus observe the parent-child interaction and instruct them on how to use the book and model properly. These moments were also used to suggest home activities aimed at the skill being developed, creating further stimulation opportunities. Parents welcomed activities suggested throughout the intervention and practiced them routinely.

They were instructed to make the communication book always available by both leaving it in an easily accessible place and taking it wherever they went. Each skill stimulated in the session was also taught to parents so they continued using it at home during their routine and activities that interested the child, always using the same vocabulary (the keywords used in the session). Parents practiced modeling with the communication book, thus, enhancing the child’s exposure to the resource and showing how to use it for language enhancement.

Data on the child’s progress was collected during 10 months. After the intervention, ACOTEA-1 was once again applied. The information obtained with the protocol in the initial and final assessments was converted into a numerical scale, whose maximum score for each axis was respectively 38, 14, and 8 points, with a overall total of 60 points. The scores were transformed into percentages and presented in charts.

RESULTS

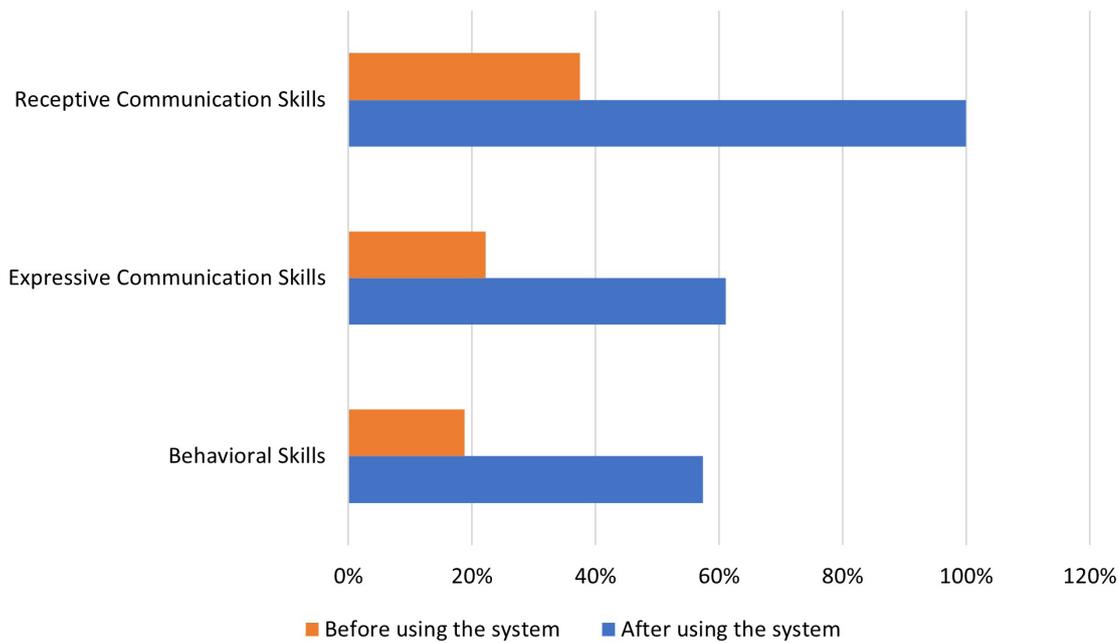


Figure 1. Descriptive chart with pre- and post-intervention ACOTEA-1 results in percentages

ACOTEA-1 score results are presented in percentages in Figure 1, showing the progress in communication and behavioral skills following intervention with the robust communication system. Receptive skills varied the most from the initial to the

final assessment, increasing by 62.5% from before the intervention. It was followed by expressive communication and behavioral skills, which respectively increased by 36.84% and 55.53%.

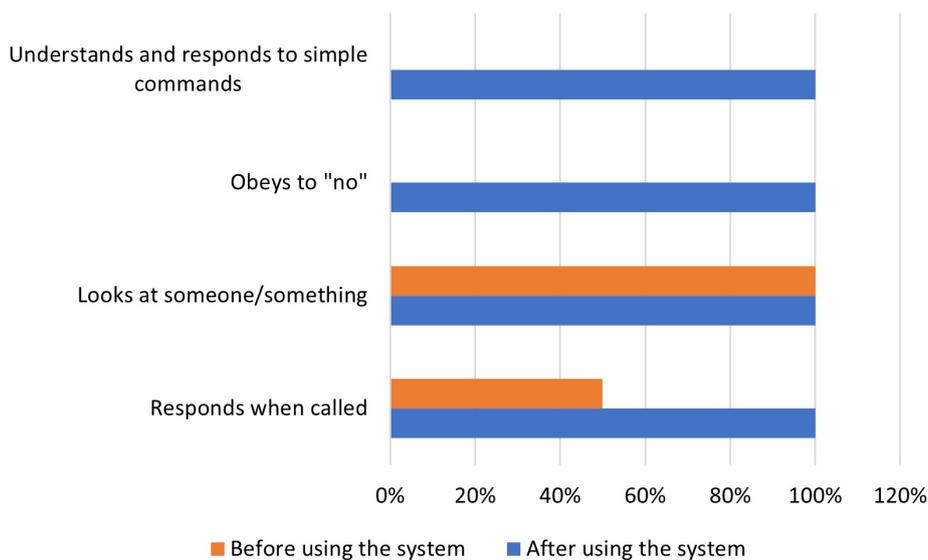


Figure 2. Percentage frequency of receptive communication skills before and after the intervention

The frequency of use of receptive communication skills is shown in Figure 2. It demonstrates that all skills were established after using the robust AAC system,

including the acquired abilities to understand and respond to simple commands and obey “no”.

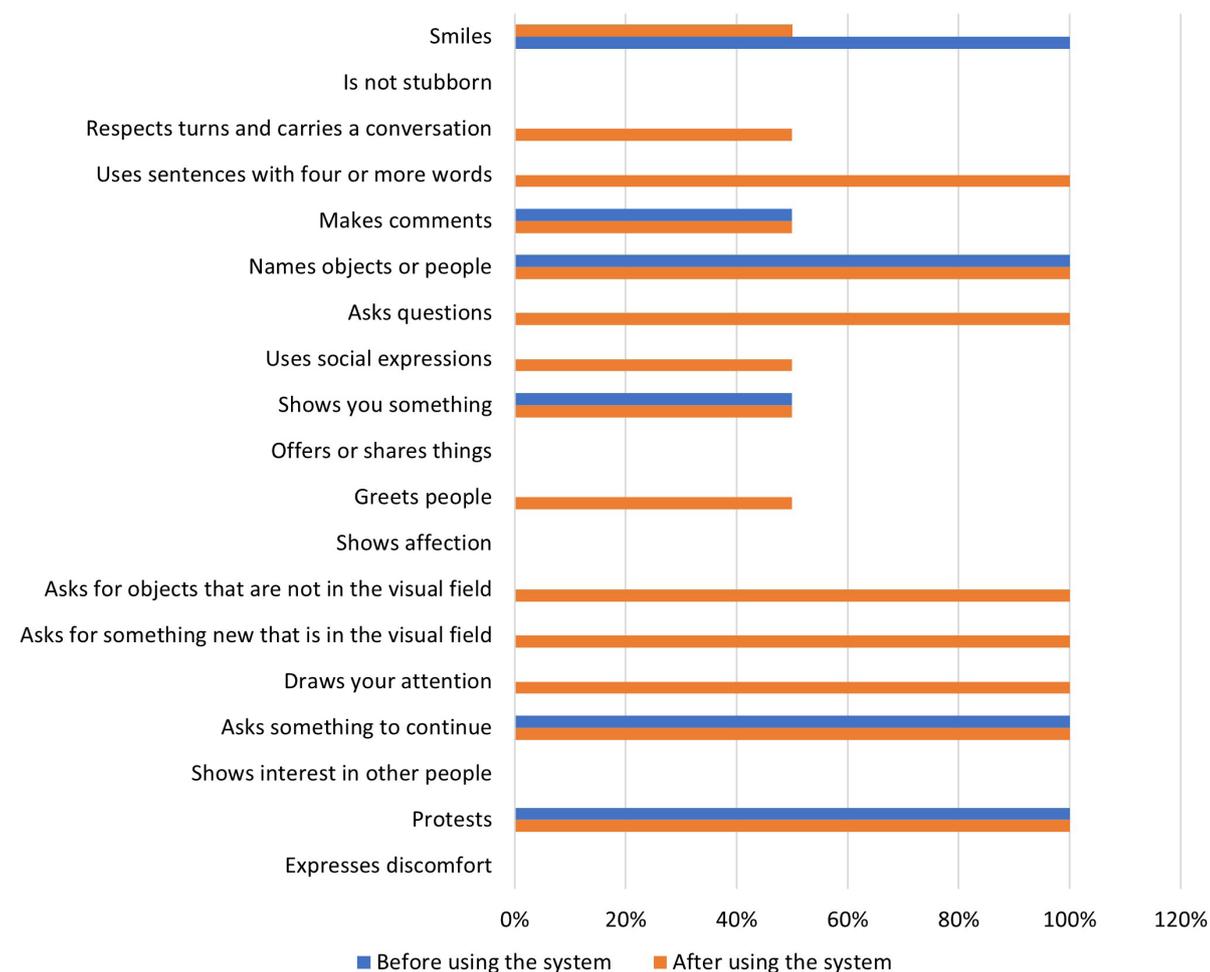


Figure 3. Percentage frequency of expressive communication skills before and after the intervention

Figure 3 presents the frequency of use of expressive communication skills before and after intervention with AAC. It highlights the acquisition of five skills, namely: using four or more words in a sentence, asking

questions, asking for objects that were not in the visual field, asking for something new that was in the visual field, and drawing the attention of the communication partner.

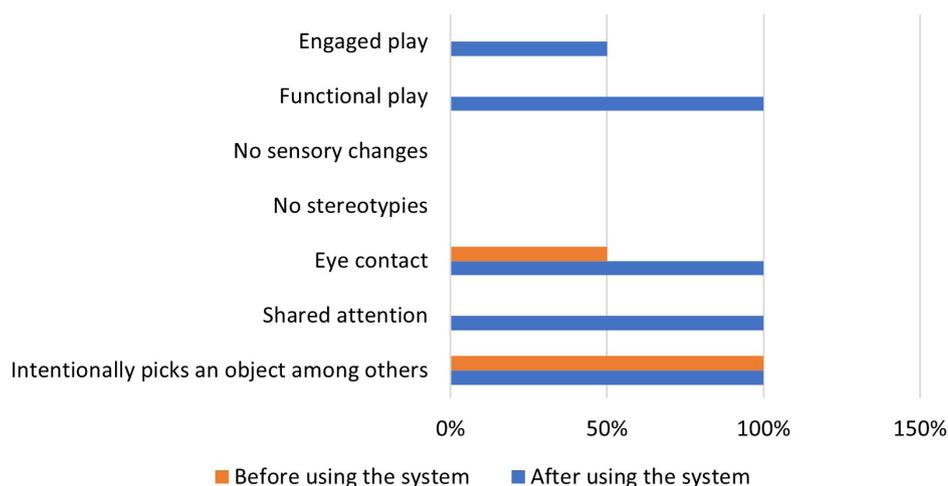


Figure 4. Percentage frequency of social behavior skills before and after the intervention

Figure 4 shows the frequency of use of behavioral skills before and after using the robust communication system. It highlights the acquisition of functional play and shared attention and increased frequency of eye contact.

DISCUSSION

The data described above demonstrate that the language intervention with a robust communication system favored the development of all skills, particularly the receptive ones. Interventions with AAC had positive results in all the intended behavioral aspects; however, it had a greater effect on communication skills than the other ones¹⁶.

Results show that using the robust AAC system helped the child understand the adults' intentional actions toward him, making shared attention and other receptive communication skills arise.

These skills are related to the interest in interacting with another person, the comprehension of social cues, and the intentionality of actions between people, such as the ability to “look at someone/something” and “respond when called”. According to Tomasello (2003)¹⁰, understanding the intentionality of other people's actions enables powerful social and cultural learning – which is directly responsible for the special forms of cultural heritage typical of humans¹⁰. Through intentional actions and the perception of others as interlocutors and intentional communication agents, the child better understood the use of linguistic signs supported by the AAC system and his goal when communicating.

Modeling helped develop communication skills during therapeutic sessions. The interlocutor used the communication book to stimulate the communication process, demonstrating the use of grammatical constructions with the corresponding pictograms and modeling the use of AAC⁹. Modeling fostered receptive language expansion due to the visual information available. As the communication partner pointed to the picture while speaking, it increased linguistic input opportunities¹⁴ for the child.

Physical and verbal cues were used whenever teaching a new skill and then gradually removed as the child acquired the skill. Individuals with ASD in different age groups may find it easier to interact with visual stimuli – i.e., they seem to perform better in visual processing and visuospatial tasks and benefit from concrete stimuli with visual and tactile cues. Those ensure greater comprehension and motivation to perform proposed activities¹⁷.

After the intervention using AAC, the development of five expressive skills stood out: using four or more words in a sentence, asking questions, asking for objects that were not in the visual field, asking for something new that was in the visual field, and drawing the communication partner's attention. According to the sociopragmatic theory, when children begin to understand other people's intentionality toward them, they start manipulating the partner's attention, as shown in “asking for objects that are not in the visual field and objects that are in the visual field”¹⁰.

Moreover, this result demonstrates an increase in communication initiatives (such as asking questions and drawing the partner's attention), broadening the

pragmatic communication profile. Interventions using the robust communication system contributed to an increased frequency of communication turns, helping develop pragmatic skills. Being more robust, this communication tool allows access to broader vocabulary and communicative functions as well as the development of more diversified sentence patterns.

The analysis of the child's language development showed that the use of core words (e.g., "I", "you", "want", "more", "where", "no", "is", "play", "what?", "under", "over", and "the") provided morphosyntactic structures for various communicative functions.

Intervention with AAC helped engage in a wide range of interactions and participate in activities chosen, thus to express self-determination. More specifically, communicative interactions helped participants express their needs and wishes; share information; approach to establish, maintain, or develop social engagement and build relationships; practice social etiquette; and get organized with internal dialogue¹⁸.

Further lexical development was noted with the use of pictograms included in the fringe vocabulary – e.g., the following lexical categories: animals, food, colors, shapes, numbers, the alphabet, feelings, parts of the human body, time, and cartoons. According to the literature, combining core and fringe vocabulary increases the frequency of AAC use¹⁹.

"Forming sentences with four or more words" is an expressive skill in this research highlighting the potential of the robust communication system. Children with ASD may have deficits in syntactic skills as well. However, once the subject better understands language functions and uses, this development helps them acquire syntactic structures of the language. Therefore, it can be noted that the core vocabulary provided the user with a means to create new sentence patterns and to communicate a variety of pragmatic functions²⁰.

Progress in "complying with 'no'", "looking at someone/something", "responding when called", and "understanding and responding to simple commands" indicated a greater comprehension of the meaning of new words and perception of social cues used in communication between interlocutors. Overall, using AAC favored the child's greater responsiveness in interactive situations.

As for behavioral skills, the increase in shared attention, eye contact, and the functional play stood out. Lastly, it must be said that when children understand the idea of playing, they show they know social

rules, have world knowledge, and greater cognitive development.

Using modeling along with physical, visual, and verbal cues and giving access to the communication book led to successful intervention experiences. This corroborates other existing evidence that children exposed to modeling in a natural setting develop pragmatic, semantic, syntactic, and morphological aspects¹¹. Other characteristics also stood out, such as the approach established for the therapeutic process, frequency of sessions, and family engagement. This last one in particular was an extremely relevant component²¹.

The case in question counted on the parents' participation and collaboration throughout the therapeutic process. Accordingly, they adhered to the sessions, the child used the communication book in the sessions, they engaged in the proposed home activities and were interested in the instructions. They presented their questions, such as what activities they could do at home to engage their son and how to use the communication book and certain cues. They also showed interest in broadening his vocabulary when they asked to include other lexical categories to the communication book.

The father's presence and active participation is to be pointed out. It was a differential, as normally only one parent (usually the mother) is the caregiver responsible for most tasks complementary to the treatment. The involvement of both parents helped them share tasks more evenly, ensuring more frequent stimulation outside the therapeutic setting.

A systematic review²² on predictors, moderators, and mediators in intervention in children with ASD using AAC indicated a correlation between language use at home by children with ASD and parental stimulation. Hence, it demonstrates their role as facilitators in the language development process. The development and progress of skills using DHACA, the increase in utterances, and the development of receptive and expressive communication and behavioral skills on the part of the child – not only in the clinic but also in other settings, such as their home – motivated the parents and helped the couple use the communication book at home more consistently.

Some factors suggest the importance of parental self-effectiveness. These include their optimism about the child's progress, their participation as communication partners, stimulating the use of AAC mediated by the communication book in natural interaction settings, and their empowerment from experiences lived in the

outreach program. Such findings add to other studies, emphasizing that parents with a greater perception of parental self-effectiveness tend to be more effective with parenting even when facing challenging child behaviors²¹.

CONCLUSION

The results in this case study showed a positive impact of language intervention with a robust AAC system on communication development. This was demonstrated by the data on the development of receptive and expressive communication and behavioral skills.

Among the main advancements in communication development, the acquisition of new sentence patterns, broader communicative functions, and improved structural and syntactic language stood out. The child also increasingly understood social cues and acquired new words, broadening his vocabulary – which points to a semantic gain.

The robust AAC system proved to be rather advantageous, in contrast to more limited communication systems, which focused on nouns and child preferred items. The robust AAC system provided a faster access to core vocabulary and provided the AAC user with a more complete tool to support his syntactic and morphological development. This allowed him to express a wide range of ideas and communicative functions, while also giving access to the robust grammatical structure of the language.

Since this study addressed a single case, new studies should be conducted with more participants and in different settings, including schools, to better observe the gains found in this study. Likewise, it could be promising to conduct studies assessing family-related factors (such as family engagement and parental self-effectiveness), focusing language development mediated with AAC.

REFERENCES

1. American Psychiatric Association. Manual diagnóstico e estatístico de transtornos mentais: DSM-5. 5th ed. Porto Alegre: Artmed, 2014.
2. Blume J, Wittke K, Naigles L, Mastergeorge AM. Language growth in young children with Autism: interactions between language production and social communication. *J Autism Dev Disord.* 2021;51(2):644-65.
3. Santos SC. Proposta de uma escala de avaliação da comunicação, interação social e linguagem na Perturbação do Espectro do Autismo: contributo para uma melhor intervenção [dissertation]. Viseu: Instituto Politécnico de Viseu; 2020.
4. Eigsti IM, De Marchena AB, Schuh JM, Kelley E. Language acquisition in autism spectrum disorders: a developmental review. *Res Autism Spectr Disord.* 2011;5(2):681-91.
5. Bonotto RCS. Uso da comunicação alternativa no autismo: um estudo sobre a mediação com baixa e alta tecnologia [thesis]. Porto Alegre (RS): Universidade Federal do Rio Grande do Sul; 2016.
6. American Speech-Language-Hearing Association. Augmentative and Alternative Communication (AAC) [homepage on the internet]. [cited 6 April 2021]. Available at: <https://www.asha.org/njc/aac/>
7. Walter C, Togashi C. As contribuições do uso da comunicação alternativa no processo de inclusão escolar de um aluno com transtorno do espectro do autismo. *Rev Bras Edu Espec.* 2016;22(3):351-66.
8. Nunes D, Walter C. AAC and autism in Brazil; a descriptive review. *Int J Disabil Dev Educ.* 2018;67(3):263-79.
9. Montenegro ACA, Lima RASC, Xavier IALN. Desenvolvimento das habilidades comunicativas no autismo. In: Araújo ANB, Lucena JA PL, editors. *Relatos de experiências em fonoaudiologia.* Recife: Editora UFPE; 2021. p. 19-33.
10. Tomasello M. *Origens culturais da aquisição do conhecimento humano.* São Paulo: Martins Fontes; 2003.
11. Sennott S, Light J, McNaughton D. AAC modeling intervention research review. *Res Pract Pers with Sev Disabil.* 2016;41(2):101-15.
12. Marden J. Teaching with core words: building blocks for communication and curriculum. *Commun Matters.* 2015;29(1):23-4.
13. Hatch P, Geist L, Erickson K. Teaching core vocabulary words and symbols to students with complex communication needs. In: Assistive Technology Industry Association [homepage on the internet]. Chicago; 2015. Available at: https://www.med.unc.edu/ahs/clds/wp-content/uploads/sites/859/2018/09/atia_2015.pdf
14. Drager KDR. Aided modeling interventions for children with Autism Spectrum Disorders who require AAC. *Perspect Augment altern commun.* 2009;18(4):114-20.

15. Montenegro ACA, Leite GA, Franco NM, Santos DS, Pereira JE, Xavier IALN. Contribuições da comunicação alternativa no desenvolvimento da comunicação de criança com transtorno do espectro do autismo. *Audiol Commun Res.* [journal on the internet]. 2021 [cited 6 April 2021]; 26: e2442. Available at: <https://www.scielo.br/j/acr/a/ZpKbgfnP8wH6k73HHHXSKxd/abstract/?lang=pt> doi: 10.1590/ 2317-6431-2020-2442
16. Ganz JB, Earles-Vollrath TL, Heath AK, Parker RI, Rispoli MJ DJ. A meta-analysis of single case research studies on aided augmentative and alternative communication systems with individuals with autism spectrum disorders. *J Autism Dev Disord.* 2012;42(1):60-74.
17. Fialho JPG. Uso de pistas visuais. In: Duarte CP, Silva LC, Velloso R, editores. *Estratégias da Análise do Comportamento Aplicada para pessoas com Transtorno do Espectro do Autismo.* São Paulo: Memnon Edições Científicas; 2018. p. 195-217.
18. Bonotto R, Corrêa Y, Cardoso E, Martins DS. Oportunidades de aprendizagem com apoio da Comunicação Aumentativa e Alternativa em tempos de COVID-19. *Rev Ibero-Americana Estud em Educ.* 2020;15(4):1730-49.
19. Beukelman D, McGinnis J MD. Vocabulary selection in augmentative and alternative communication. *Augment Altern Commun.* 1991;7(3):171-85.
20. Dodd JL, Gorey M. AAC intervention as an immersion model. *Commun Disord Q.* 2014;35(2):103-7.
21. Karst J, Van Hecke A. Parent and family impact of Autism Spectrum Disorders: a review and proposed model for intervention evaluation. *Clin Child Fam Psychol Rev.* 2012;15(3):247-77.
22. Sievers S, Trembath D, Westerveld M. A systematic review of predictors, moderators, and mediators of augmentative and alternative communication (AAC) outcomes for children with autism spectrum disorder. *Augment Altern Commun.* 2018;34(3):219-29.

ANNEX A

DHACA Book

