Review Article

A Systematic Review of Augmentative and Alternative Communication Interventions for Children Aged From 0 to 6 Years

Ohiana Leonet,a Maria Orcasitas-Vicandi,b Argia Langarika-Rocafort,c Nahia Idoiaga Mondragon,d and Gorka Roman Etxebarrietae

a Department of Research and Diagnosis Methods in Education, Faculty of Education, Philosophy and Anthropology, University of the Basque Country, Leioa, Spain b Department of English and German Philology, Translation and Interpretating, Faculty of Letters, University of the Basque Country, Leioa, Spain c Department of Didactics of Musical, Plastic and Body Expression, Faculty of Education of Bilbao, University of the Basque Country, Leioa, Spain d Department of Developmental and Educational Psychology, Faculty of Education of Bilbao, University of the Basque Country, Leioa, Spain e Department of Didactics of Language and Literature, Faculty of Education of Bilbao, University of the Basque Country, Leioa, Spain

A B S T R A C T

Purpose: This systematic review evaluates the latest available evidence regard- ing augmentative and alternative communication (AAC) interventions in children from 0 to 6 years old diagnosed with various disabilities.

Method: A systematic search was conducted in MEDLINE (OVID), PsycINFO (EBSCO), ERIC (ProQuest), SCIELO (WOS), Teacher Reference Center (EBSCO), and Education Database (ProQuest), and studies on AAC interventions in children from 0 to 6 years old diagnosed with various disabilities were selected indepen- dently by two reviewers (A.L.-R. and N.I.M.) according to the purpose of the review. Results: Twenty-nine of 1,709 studies met the inclusion criteria for this review. The methodological quality of the included studies was assessed, and the char- acteristics and results of the studies were extracted by a descriptive analysis (O.L.S. and M.O.-V.).

Conclusion: This analysis revealed that children with different diagnoses show improvements in expressive and receptive communication, functional communi- cation behaviors, communication participation skills, interaction strategies, and symbol and multisymbol production and comprehension by using various AAC systems.

Communication is inherent to the human condition, and it is a human right for children to develop their commu- nication potential even if they have profound speech impair- ments (American Speech-Language-Hearing Association [ASHA], 1992). Most people communicate with others through natural language and writing. However, some peo- ple with complex communication needs (CCNs) employ augmentative and alternative communication (AAC) sys- tems. According to ASHA, "AAC involves attempts to study and, when necessary, temporarily or permanently

Disclosure: The authors have declared that no competing financial or nonfinancial interests existed at the time of publication.

compensate for the impairments, activity limitations, and restricted participation of individuals with severe disorders of speech-language production and/or comprehension" (ASHA, 2004, p. 3). The benefits of AAC for people of different ages with developmental and acquired disorders have been widely documented (Beukelman & Mirenda, 2020; Holyfield et al., 2017; Sennott et al., 2016), and there has been a growing awareness of the importance of supporting young children with CCN who need AAC to address their communicative needs (Binger & Light, 2006).

AAC systems have traditionally been divided into "aided" and "unaided." Unaided AAC such as sign lan- guage or gestures do not require any external resources and rapidly generate an unlimited group of messages. However, this also has some limitations. For example, the production of signs requires certain fine motor skills that can be difficult to implement, particularly for young chil- dren. Thus, the majority of these unaided systems have a restricted set of receivers (Wilkinson & Hennig, 2007).

In contrast, aided AAC systems involve using exter- nal devices and can be categorized into low tech and high tech. Low-tech AAC includes pictures, alphabet, or symbol-based topic boards, displayed in (low-tech) communication books and communication programs

such as the Picture Exchange Communication (Frost, 2002). In contrast, high-tech AAC includes a variety of speech- generating devices and other computer- and tablet-based technologies. The introduction of new computer-based tech- nologies (e.g., Intelligent apps) has significantly increased in recent decades (Light, McNaughton, Beukelman, et al., 2019; Light, McNaughton, & Caron, 2019; McNaughton & Light, 2013) with the development of information and communication technology. Thus nowadays, a vast number of high-tech AAC methods are available (Gilroy et al., 2017) for users of different socioeconomic back- grounds (Kulkarni & Parmar, 2017). It should also be mentioned that some researchers have pointed out that high-tech devices are more attractive to children and teen- agers (Rashid & Nonis, 2015).

However, recent research has provided no evidence that high-tech AAC systems are significantly more effective than low-tech AAC systems for teaching social communication skills (Morin et al., 2017). Similarly, the scientific community points to clear advantages and disadvantages to both aided and unaided AAC systems (Simacek et al., 2017). Therefore, an individualized analysis of these systems is usually recommended, considering intrinsic (disabilities, age, etc.) and extrinsic (partners, context, preferences, availability, and access) variables for each case (Johnston et al., 2012).

Additionally, the age of the participants plays a key role in determining their needs and, thus, the characteristics of the intervention to be applied. Several reviews have ana- lyzed the effectiveness of AAC interventions in children and young people (Biggs et al., 2018; Lynch et al., 2018; O'Neill et al., 2018; Sennott et al., 2016), although none of them have focused specifically on early childhood. For instance, Biggs et al. (2018) focused on children and youths from birth to age 21 years and Lynch et al. (2018) focused on children aged 0–18 years, while O'Neill et al. (2018) ana- lyzed studies that included preschoolers (42%), elementary- age children (40%), toddlers (6%), adolescents (5%), and some adults (8%) and Sennott et al. (2016) analyzed studies focused on children from 2 to 12 years old.

The early period of development from 0 to 6 years old is very diverse, as it is a time of rapid change and includes children from infancy (0–18 months) to toddler- hood (18–36 months) and into the preschool (3–5 years) and early school-age years (5 years+; Inhelder

& Piaget, 2013). Therefore, during the early period of development from 0 to 6 years, children undergo significant develop- mental changes and move through various systems of sup- port (early intervention, preschool, and early school years), all of which are likely to have an impact on the type and amount of AAC intervention received and the objectives of AAC (Barker et al., 2013; Binger & Light, 2006). Thus, even though the nature and complexity of a child's com- municative needs will differ according to their stage of development, studies in the field have confirmed that this stage from 0 to 6 years of age is particularly important because it is the phase in which linguistic competence begins to be acquired (Branson & Demchak, 2009; Solomon-Rice & Soto, 2014).

Moreover, recent studies seem to point to the fact that the early introduction of AAC does not harm the communicative development of children with CCN (Millar et al., 2006; Light & Drager, 2007; Romski & Sevcik, 2005) and that these have positive effects on young children (Muttiah et al., 2019; Romski et al., 2015).

Likewise, the range of characteristics shown by peo- ple with CCN (i.e., age, diseases, diagnoses, and skill levels of participants) makes it difficult to legitimately consider some approaches included here as "best practices" (Allen et al., 2017) for every target population. In addition, while research and systematic reviews conducted strictly with chil- dren diagnosed with autism spectrum disorder (ASD) or cerebral palsy have been plentiful in recent years (Holyfield et al., 2017; Karlsson et al., 2018; Logan et al., 2017; Novak et al., 2013; Pennington et al., 2004, 2005; Schlosser & Wendt, 2008; Sievers et al., 2018), there is a lack of spe- cific knowledge on the characteristics and effects of inter- ventions on children with other diagnoses that are not ASD or cerebral palsy, or those with mixed diagnoses (i.e., children diagnosed with ASD or cerebral palsy together with another diagnosis). The results found at least moder- ate effectiveness of AAC interventions in supporting chil- dren diagnosed with ASD or cerebral palsy to produce a wider range of communicative functions, although they also noted that there was insufficient evidence to demonstrate that the change was sustained, transferable, and meaningful (Logan et al., 2017; Novak et al., 2013; Pennington et al., 2004; Schlosser & Wendt, 2008).

Children with “other” or mixed diagnosis” and pro- fessionals working with them need specific research and reviews on their casuistry, otherwise they remain residual and the abundant literature on ASD or cerebral palsy takes over the nonspecific outcomes. Therefore, in this case, it was decided to analyze the research carried out with “other diagnoses (non-ASD or cerebral palsy) or mixed diagnoses.” Therefore, the main goal of this review is to identify, appraise, and critically synthesize the latest available evidence regarding AAC interventions in chil- dren aged from 0 to 6 years with “other” diagnoses (not ASD or cerebral palsy) or mixed diagnoses and determine which interventions are effective.

Method

The present systematic review was designed and con- ducted according to the guidelines proposed by Cochrane Collaboration to develop systematic reviews of interven- tions (Higgins & Green, 2011). This systematic review used the guidelines set out by Preferred Reporting Items for Systematic Reviews and Meta-Analyses with a descriptive-analytical approach (Liberati et al., 2009).

Criteria for the Inclusion of Studies in This Review

Types of Studies

Single-case, case series, or randomized or non– randomized controlled trials (RCTs) were considered for inclusion in this systematic review. In addition, a reference list of systematic and narrative reviews and relevant stud- ies found through a search of five electronic databases was also examined to detect any other potential study not found through our electronic search.

Types of Participants

The review included studies of participants from 0 to 6 years old who were diagnosed with various disabil- ities and CCN. Research with participants who were exclusively diagnosed with ASD or cerebral palsy were excluded. It was decided to exclude these two groups because, as mentioned in the introduction, there is a large body of research in

these fields (Holyfield et al., 2017; Karlsson et al., 2018; Logan et al., 2017; Novak et al., 2013; Pennington et al., 2004, 2005; Schlosser & Wendt, 2008; Sievers et al., 2018), and thus, we decided to give visibility to research on "other diagnoses" or "mixed diagnoses."

Types of Intervention

The interventions included AAC programs or proto- cols used with children aged 0–6 years that may or may not include high-tech AAC systems solutions, published between 2000 and 2018. The AAC programs could have been delivered by clinicians, teachers, other professionals, or parents. Programs applied to teachers, caregivers, other professionals, or parents were also considered when the outcomes were evaluated in children.

Types of Outcomes

Studies that measured child communication skills or behavior related to communication via any modality were included in this review. Specifically, we included those measuring the number of communicative attempts or turns taken, matching objects of reference (or pictures, photo- graphs) to any AAC system, and grammatical aspects of communicative attempts.

Literature Search

MEDLINE (OVID), PsycINFO (EBSCO), ERIC (ProQuest), SCIELO (WOS), Teacher Reference Center (EBSCO), and Education Database (ProQuest) databases were searched by the same investigator (A.L.-R.) from April 20, 2018 to May 3, 2018. The following concepts, their synonyms, and their pertinent indexed terms were conveniently combined using Booleans, truncations, and other operators including "Augmentative and Alternative Communication," "Children," "Young," and "interven- tion." All searches were adapted to the various features of the databases and are replicable (see the Appendix). Fol- lowing the recommendations of Greenhalgh and Peacock (2005), reference tracking and other search methods (snow- balling, hand search, and expert consulting) were used to ensure the inclusion of all existing literature on the research questions addressed by this review. The authors of this review were responsible for study selection, study quality, and data management.

Study Selection

A reviewer (A.L.-R.) eliminated duplicates (documents indexed in two or more databases), nonoriginal documents (i.e., nonoriginal research such as books, book chapters, and journals), and incorrect documents (i.e., wrongly indexed documents in databases). In addition, those documents that included sufficient information for screening (title and abstract) were included in the selection process. In the first screening phase, two reviewers (A.L.-R. and N.I.M.) inde- pendently reviewed the title and abstract of all documents to identify those of potential relevance. In a second screening process, using full texts, the reviewers independently deter- mined which studies met the inclusion criteria for this review. Disagreements between reviewers were resolved by consen- sus. When consensus was not possible, a third reviewer was consulted (G.R.E.), whose decision was final.

Before initiating this phase, the reviewers took part in a training session in which they independently screened a number of randomly selected abstracts and articles. This training included the evaluation of eight studies per reviewer and lasted for 2 weeks. At the end of this training, the results on the selected articles were compared and dis- cussed to achieve a common understanding on how to pro- ceed in the reviewing period of this study. Finally, inclusion and exclusion criteria were redefined and improved to make them more precise and to unify the criteria.

Assessment of Study Quality

The quality of the studies included in this review was evaluated using two tools according to the research design. For single-case studies, single-case experimental design (SCED) criteria (Tate et al., 2008) were used, which are composed of 11 areas of quality judgment: clinical his- tory (Q1), target behavior (Q2), design (Q3), baseline (Q4), sampling behavior during treatment (Q5), raw data (Q6), interrater reliability (Q7), independence of the raters (Q8), statistical analysis (Q9), replication (Q10), and generaliza- tion (Q11). The percentage quality of the studies was calcu- lated by dividing the number of indicators marked as “yes” over the total number of indicators evaluated (11). The per- centage of “yes” for a specific item across the studies was then calculated.

For clinical trials, we applied the criteria proposed by Cochrane Collaboration (Higgins & Green, 2011): random sequence generation (Q1), allocation con- cealment (Q2), selective reporting (Q3), other sources of bias (Q4), participant and personnel blinding (Q5), outcome blinding (Q6), and incomplete outcome data (Q7).

Two authors (O.L.S. and M.O.-V.) independently assessed quality by answering (a) yes or (b) no to each of the domains on the SCED scale and (a) low, (b) high, or

(c) unclear in response to Cochrane domains for clinical trials. Any disagreement was resolved by consensus, and whenever this was not possible, a third reviewer was consulted (A.L.-R.), whose decision was final. The reviewers responsible for this phase were trained to use the same pro- cedure as the one used in the training of the study selection.

Data Management and Analysis

The main characteristics of the included studies were extracted independently by two researchers (O.L.S. and M.O.-V.) using a previously designed template. In single cases or series case studies, the study authors, year, coun- try, study aim, participant characteristics, study design, setting, AAC method used, baseline, intervention, generalization, maintenance information, and results were extracted. In the case of controlled trials, the study, country, aim of the study, participants (experimental and control), AAC method used, intervention (intensity, length), characteris- tics, type of outcome, outcome measurement, and results were transferred to the previously designed template.

A descriptive analysis of the data mentioned above (characteristics of the studies) was conducted. In addition, regarding qualitative variables, an account of the studies and the number of participants was provided for each vari- able category. To assess the agreement between the reviewers in the screening phases in terms of quality evalua- tion, Cohen's kappa was calculated using the SPPS statisti- cal software package (Version 20.0.0.1, IBM Company).

Results

Study Selection

The electronic search detected 1,709 studies, of which 28 were removed because they were not research studies and 477 were eliminated for being duplicates (see Figure 1). Therefore, 1,204 studies were screened by title F1 and abstract, of which 1,014 were removed because they did not meet the inclusion criteria. At this point, an additional 74 publications were added after reference tracking and other identification methods (Greenhalgh & Peacock, 2005). Thus, 264 were included in the second screening phase using the full text. In this screening phase, studies were discarded because participants (n = 170), type of intervention (n = 48), or the design (n = 14) of the stud- ies did not meet the inclusion criteria for this review. In addition, two studies were discarded because they were unpublished, and it was impossible to obtain the full research report. Finally, one of the documents was dis- carded for including data that were duplicated in one of the other included documents. Thus, 29 studies were selected for inclusion in the review. The agreement between reviewers was substantial in the first screening phase (Cohen's kappa = .67) and moderate in the second screening phase (Cohen's kappa = .46; Landis & Koch, 1977). The third reviewer (G.R.E.) was not consulted in this second screening phase.

Study Quality

The agreement between reviewers regarding quality evaluation using the SCED scale was almost perfect (Cohen's kappa = .84) according to the kappa value used by Landis and Koch (1977). For control trials (n = 2), the agreement (Cohen's kappa = .84) was almost perfect. However, the third reviewer (A.L.-R.) was consulted 3 times on three quality items corresponding to three differ- ent articles since the reviewers (O.L.S. and M.O.-V.) asses- sing quality did not reach a consensus. Of the total 29 studies, 27 (93.10%) were single-case studies, whereas two (6.90%) were RCTs. Table 1 displays an assessment of the methodological quality of the single-case studies included in the systematic review (n = 27).

Single-Case Studies

All studies except one (Harding et al., 2011) provided an adequate definition of the characteristics and impair- ments of the children using their clinical history (Q1). Tar- get

behavior (Q2) was also well defined in all but two stud- ies (88.9%; Brancalioni et al., 2011; Harding et al., 2011).

Of the articles reviewed, 25.9% did not implement an appropriate design (Q3) to determine the effectiveness of the interventions, and nine studies did not include or adequately describe the baseline phase (Q7). Sampling behavior (Q5) was adequately described and measured in 77.8% of the studies. Regarding raw data records (Q6), 85.2% of the studies provided raw data and graphics for baseline, intervention, and other study phases. Intrarater reliability (Q7) was not adequately assessed or described in 22.2% of the studies, 51.8% of the studies ensured the independence of the assessors (Q8), and 44.4% of the stud- ies conducted statistical analysis (Q9) to assess the effec- tiveness of the interventions. Finally, 55.5% of the studies replicated the interventions in different situations (Q10), and 63% of the studies reported using activities designed to generalize their interventions (Q11).

[Figure 1. Flow chart of study selection process.]

RCT

Concerning the two RCT studies, Romski et al. (2011) showed a low risk of bias in random sequence gen- eration, while Romski et al. (2010) were unclear regarding the risk of bias. Allocation concealment was included to ensure a low risk of bias in both studies. Romski et al. (2011) displayed a low risk of bias regarding blinding of participants and personnel. In contrast, Romski et al. (2010) did not describe this in sufficient detail, and thus, the risk of bias was considered unclear in this case. Fur- thermore, neither of the studies provided sufficient details about blinding to assessment outcomes, and thus, in both cases, the risk of bias was unclear in this regard. Incom- plete outcome data were found in the study conducted by Romski et al. (2010) and was thus considered to have a high risk of bias. In the work reported by Romski et al. (2011), the risk of bias was unclear since the authors did not provide sufficient outcome data to permit this judg- ment. Selective reporting made the risk of bias unclear in both studies. Finally, other sources of bias were not detected for Romski et al. (2011). While there might have been

other sources of bias in the study published by Romski et al. (2010), there was insufficient information to evaluate this possibility (see Table 2).

Characteristics of the Studies

Country

Of the 29 studies included in this review, 22 (75.86%) were conducted in the United States. Another six studies (20.68%) were conducted in Australia, Brazil, Canada, Germany, the Netherlands, and the United Kingdom. Finally, one study (3.44%) was conducted by collabora- tion between researchers from the United States and Israel (see Table 3).

Study Design and Setting

Concerning study design, nine articles (31.03%) employed a multiple-probe design, and five (17.24%) used a multiple-baseline design. Three studies (10.34%) used an AB design, and another two studies (6.89%) used an AB design followed by three additional follow-up measure- ments. In addition, four studies (13.79%) used alternating treatments, two (6.89%) used pretest and posttest designs, while another study (3.44%) opted for a qualitative approach. Finally, one study (3.44%) collected the data at four points during the intervention. In addition, two stud- ies (6.89%) were RCT.

With regard to the study settings, the studies were conducted in a school setting (seven out of 29; 24.13%), the participants' homes (three out of 29; 10.34%), clinical settings (three out of 29; 10.34%), and early childhood day care centers (two of 29; 6.89%). A further nine (nine of 29; 31.03%) studies were carried out in more than one setting. Finally, five studies (five of 29; 17.24%) did not specify the setting where the work was carried out.

[Table 1. Quality of the single-case studies included in the review.]

[Table 2. Quality of the randomized controlled trials included in the review.]

Characteristics of the Participants

The children included in the 29 studies of the review were aged between 1 and 6 years (see Table 3). That is, although the review was conducted for children between 0 and 6 years of age, no studies were found for children under 1 year of age. The number of participants varied across studies, with a mean of 3.56 (SD = 2.81) partici- pants in each single-case study (see Table 3). For the RCTs, one research study was conducted with 68 partici- pants and another with 53 participants.

In terms of the characteristics of the participants, the children who took part in the 29 studies included in this review had various diagnoses. Some participants had Prader-Willi syndrome, DiGeorge syndrome, Down syn- drome, and Angelman syndrome, while others had autistic spectrum disorder, speech apraxia, seizure disorder, pro- found phonological process disorder, dysarthria, motor speech disorders, pervasive developmental disorder, speech disorders, language disorder, and mitochondrial disease. Most of the participants also had varying degrees of dis- ability and delays such as cognitive disabilities, intellectual disabilities, speech and language disabilities, physical dis- abilities, multiple learning disabilities, hearing disability, severe language and cognitive delays, developmental delays, communication impairments, speech and language delays, and expressive language delay. Some participants were also diagnosed with athetoid cerebral palsy, velopha- ryngeal insufficiency, subpalatal cleft, cystic hygroma, cerebral palsy, and bilateral schizencephaly (see Table 3).

Characteristics of the Interventions

Length and Frequency

The average length of the interventions was 29.23 weeks. The average frequency of the sessions was 3.54 per week (see Table 4). The highest frequency was 10 sessions per week (Leech & Cress, 2011), while the lowest was one session per week (Thomas-Stonell et al., 2016).

AAC Systems

All studies included in the review utilized aided AAC systems, seven (24.13%) of which also used unaided systems. Ten studies (34.48%) used low-tech AAC systems, 11 studies (37.96%) used high-tech systems, and eight studies (27.58%) combined both low- and high-tech sys- tems. Two of the articles did not specify the AAC systems employed in their interventions.

Intervention Target

In 20 (69%) of the included studies, children were the direct target of the interventions implemented (see Table 5). For example, in Leech and Cress (2011), the child's mother was involved in one part of the interven- tion, and in Therrien and Light (2016), the children's classroom peers were involved. In the other nine studies included (31%), the intervention's main target was parents or caregivers (seven studies) or educators (two studies). In these studies, the adults who received the intervention applied these directly to the children, and the outcomes were measured for both children and adults.

Intervention Situation

The interventions were implemented in various situ- ations (see Table 5). In 12 (41.4%) studies, play situations were used to apply the interventions. In eight (27.6%) of these studies, the interventions were implemented in only playing situations, and Barton-Hulsey et al. (2017) specif- ically used a dramatic play situation. Another four (13.8%) studies included play activities in combination with other situations. Thus, Romski et al. (2010, 2011) included playing, story reading, and other routines in their interventions; Binger, Kent-Walsh, and King (2017) combined playing and matching activities (object–symbol); and Harding et al. (2010) implemented their intervention during music, free play, and lunch situations. Eight (27.6%) studies used storytelling as an intervention environment, two combined with other settings (Romski et al.,) (see Table 4). However, the length of the interventions implemented in the studies varied widely from 2 weeks (Douglas et al., 2013) to 2 years (van der Schuit et al., 2010, 2011), five (17.2%) used only story reading to conduct their programs, while one Binger, Kent-Walsh, King, & Mansfield, (2017) used only the story's characters. Four (13.8%) studies used children's

routines to implement inter- ventions, and another four (13.8%) used matching activities (symbol–object or letter–sound). Two (6.9%) studies used preschool classroom activities, one exclusively (Johnston et al., 2003) and another study in combination with other activities (van der Schuit et al., 2010). One study (Brancalioni et al., 2011) conducted their intervention in the children's natural home setting.

[Table 3. Characteristics of the studies included in the systematic review.]

Multimodal Versus Unimodal

Sixteen (58.6%) of the studies included in this sys- tematic review used only one AAC system in their inter- ventions (see Table 5). Three of these unimodal interven- tions (manual sign language alone) compared outcome acquisition between two AAC systems. Thirteen (44.8%) studies employed a multimodal (manual sign language plus the use of an electronic communication) approach in their interventions. So most communications were multi- modal, although it was proved also that AAC interven- tions may be unimodal (Iacono et al., 1993).

Outcomes and Results

The studies included in this review measured various outcomes to assess their interventions. Overall, all studies reported a positive effect of the interventions, although the skills acquired by each participant differed in some of the studies that included more than one participant. Thir- teen (44.8%) studies measured the number of communica- tion attempts (e.g., turns and frequency) of the partici- pants. In all of these studies, participants increased the number of communicative attempts, finding differences between participants in three studies. Binger and Light (2007) found that four of the five children learned to con- sistently produce multisymbol messages, the use of which were generalized to novel play routines. Additionally, in the study reported by Solomon-Rice and Soto (2014), par- ticipants' expressive vocabulary increased during the inter- vention and was sustained and generalized for two of the three toddlers. Finally, Therrien and

Light (2016) found immediate gains in the frequency of symbolic communica- tive turns in one of the participants. In contrast, the other participant showed some initial gains, but these were not maintained over time.

Six (20.7%) of the studies (see Table 5) measured the matchings between object–symbol, picture/photograph symbol, or sound–letter in the display made by the partici- pant. The interventions in these studies demonstrated an improvement in the outcome measures. Three (10.3%) studies measured both several matching turns or commu- nicative attempts made, showing different acquisition levels between participants. Barton-Hulsey et al. (2017) found that two of their three participants used displays largely for initiation, whereas the third participant showed limited expressive use of the display. Van der Schuit et al. (2010) determined that the group of speaking children with CCN showed greater development in the domains of receptive language and productive syntax than the group of nonspeaking children, while Harris and Reichle (2004) found different levels of skills between participants.

Three (10.3%) studies (see Table 5) measured the grammatical aspects of the expressive language shown by participants, with all interventions being successful. Both Brancalioni et al. (2011) and Harding et al. (2011) mea- sured children's behavior. The latter also measured several communication attempts. Johnston et al. (2003) evaluated the ecological impact of the intervention and perceived effectiveness and found that the three children displayed different developmental abilities and areas of need. Finally, Thomas-Stonell et al. (2016) measured partici- pants' communicative, social, and emotional skills, with six of the eight children showing positive changes in com- municative participation skills.

Discussion

This systematic review identified 29 interventions that assessed the effectiveness of AAC-based interventions on communication skills in infants and toddlers through preschool-age children and beyond with mixed diagnoses. These interventions focused on improving children's matching ability, the number of times they communicated, their grammatical competence, or behavioral issues. In general, the interventions were

considered effective in improving various outcomes even though some aspects of their methodological quality should be considered and dis- cussed. The main methodological limitations of the studies were related to problems with defining the baseline, the lack of independence of assessors, statistical analysis and replication, and generalization issues.

Interventions

One of the most important conclusions that can be drawn from this research is that although participants in the studies varied considerably in age, type, and severity of communication impairment and the interventions were also very heterogeneous (see Tables 2 and 3), all of them reported positive effects in children from 1 to 6 years of age with CCN. However, it is true that no clear patterns of intervention have emerged from the research, though there are interesting factors to be taken into account.

First, regarding the intervention target, it is observ- able that most of the interventions are based on working directly with children. None of the studies included in the review mentioned a minimum age for the introduction of AAC, even though the youngest children identified in the articles reviewed were 20 months old (1 year 8 months). Nevertheless, van der Schuit et al. (2010) indicated that the developmental age of participants affects their recep- tive and expressive vocabulary and language development. They found that the developmental rate of speaking chil- dren was higher than nonspeaking children both before and after the intervention. Having already acquired cer- tain language skills, speaking children obtained a greater benefit from the intervention with AAC systems.

However, in some studies, the intervention was con- ducted with caregivers (parents, educators, etc.). In these studies, it is shown that not only do the caregivers learn to use the systems but that this has led to significant improvements in the children. For example, Romski et al. (2011) concluded that the interventions with caregivers increased their perceptions of success while decreasing per- ceptions of impairments concerning their children's lan- guage development. Previous studies have also emphasized the role of caregivers in a successful intervention and assessment process (McNaughton et al., 2008). Similarly, another study targeted the children's peers, that is, where peers are

taught alongside children with CCN (Therrien & Light, 2016). This type of intervention is interesting because training the children in the use of AAC and their environment broadens the spectrum of users and facilitates the interactions and socialization of these children.

Second, this research also provides a body of evidence suggesting the multimodal nature of AAC (Light & Drager, 2007). The studies included in this review have gathered evidence of the positive impact of various types of AAC on the development of communication in children from 0 to 6 years old. In the 29 studies, a variety of AAC types were used to address the communicative needs of the participants—either simultaneously or sequentially—including unaided systems (manual signs and natural gestures), low-tech aided systems (communication boards and Picture Exchange Communica- tion System [PECS]), and high-tech aided systems (speech- generating devices and VOCs). Similar to the review reported by Blackstone and Hunt-Berg (2003), a major find- ing of the present review concerning AAC mode is that many of the interventions used multiple ways of developing the participants' communication skills. Nineteen of the 29 studies relied on various AAC systems in the interventions. In particular, Taylor and Iacono (2003) analyzed the effect of modeling play and vocabulary across three play contexts on the child's symbolic communication. They found that improvements in communication were more evident when a multimodal AAC approach was used in modeling than when the sign was used alone.

None of the studies included in the review have focused only on unaided systems; seven studies used both aided and unaided systems, and the remaining 22 studies made use of a variety of low-tech and high-tech AAC systems. Therefore, this finding suggests a clear tendency toward using aided AAC in intervention studies with chil- dren from 0 to 6 years old. In a previously published system- atic review, Branson and Demchak (2009) found that the age of the participants influenced the choice of the AAC method, revealing a tendency toward using unaided methods with children under the age of 2 years. However, the findings of the current review are somewhat less conclusive. Out of seven studies that included children aged 2 years and youn- ger, two made use of aided AAC (Barton et al., 2006, Binger et al., 2008), while the other five included aided and unaided

methods. Only one study compared aided and unaided methods (Martin et al., 2013). Similar to other studies that compared aided and unaided AAC methods (Anderson, 2001; Iacono & Duncum, 1995), Martin et al. (2013) found that children with Angelman syndrome produced more accu- rate responses in graphic mode than in gestural mode. In this regard, studies have demonstrated that PECS can be a suc- cessful method in interventions with prekindergarten chil- dren with little to no functional speech (Hart & Banda, 2010), and voice output and picture-based devices can be introduced to young children in their early communication interactions (Cress & Marvin, 2003).

Not only has the current research pointed to the importance of aided AAC systems, but it also highlights the benefits of using high-tech AAC with infants, toddlers, preschool-age children, and beyond. Eleven of the 29 stud- ies employed high-tech systems, and another eight studies combined high-tech and low-tech systems in their interven- tion. The use of high-tech AAC systems is considered criti- cal for developing future interventions based on AAC (Banda & Alzrayer, 2018; Ganz et al., 2017; Gevarter & Zamora, 2018).

The most critical finding of this systematic review is the significant number of studies that report the positive effects of AAC interventions on children from 0 to 6 years old. In practice, the assumption that the early introduction of AAC systems might prevent natural speech develop- ment is still ingrained among parents and some practi- tioners, and its use with young children is often considered a last resort (Romski & Sevcik, 2005). In line with Millar et al. (2006), the results of the studies included in this review run counter to this assumption and instead provide evidence of improvement in communication and language skills following the implementation of AAC interventions. However, a certain degree of caution is needed when assessing the effect of these interventions because it is criti- cal to consider the quality of the study design before drawing any firm conclusions.

Quality of the Interventions

A descriptive analysis was described for several quality indicators based on the SCED scale and Cochrane Collaboration criteria, and methodological quality analysis revealed substantial differences in the overall quality of the studies. In fact, on average, the articles

meet 72.04% of the proposed criteria, although five articles meet less than 50% of the criteria. Among the criteria with the low- est rates, 63% of the articles do not adequately describe the baseline measures. This could have serious implica- tions for the quality of these articles, since a poor descrip- tion (or the absence of such a description) could cast doubt on the improvements found. If the baseline is not stabilized, the improvement could be "natural" and not created by the intervention. Moreover, the lack of inde- pendence is usually found in single-case studies, and this was reported in only 51.8% of the articles (Tate et al., 2008), but it would be ideal for improving research in this regard to ensure the independence of the investigators to reduce bias and improve the quality of single-case studies.

Additionally, only some studies carried out replica- tions or attempted to generalize the interventions (55.5% and 63%). Indeed, researchers should also include replica- tion and generalization of their interventions as these are essential to understanding their effects. This same conclu- sion was also found in other systematic research con- ducted with children diagnosed with ASD or cerebral palsy (Logan et al., 2017; Novak et al., 2013; Pennington et al., 2004; Schlosser & Wendt, 2008).

Moreover, according to SCED scale criteria, authors should conduct a statistical analysis on the raw data to establish more objectively the size of the effect generated by their interventions (Byiers et al., 2012; Tate et al., 2008, 2016), but only 44.4% of the studies conducted such analyses. However, there is a lack of agreement among researchers in the use of statistical analysis in single-case designs (Ledford et al., 2018); for some researchers, statis- tical analysis should be equal to or supersede visual analy- sis, and for others, a visual analysis should be the method of choice when determining whether there is a change between baseline, intervention, and maintenance phases. Therefore, the SCED scale and other quality scales should also consider more precisely when it is necessary to con- duct statistical analyses in single-case studies and not "penalize" the quality of the study for not doing so, at least until there is a consensus between experts. Moreover, criteria for determining the quality of the visual analysis should also be included.

Finally, this systematic review includes single-case, case series, and RCT. However, only two RCT met our criteria. This study design allows for making more accu- rate claims about the findings; however, the implementa- tion of this design is still scarce in early intervention stud- ies (Romski et al., 2015). This could be due to the specific difficulties of working with young children, such as prob- lems with evaluating language comprehension. In this regard, the assessment of language and communication skills in young children constitutes a promising and exten- sive field of future research.

Study Limitations

Despite its strengths, this systematic review also has some weaknesses. In general, the agreement between reviews in the screenings and quality measured by Cohen's kappa, an index that considers the possibility of the agree- ment occurring by chance, ranged from almost perfect to moderate (Landis & Koch, 1977). However, it is essential to mention that the reviewers reached a consensus in both screening and quality phases, and there was no need to consult a third reviewer. This procedure aimed to increase the likelihood that the studies were accurately represented in the review.

Implications for Practice and Future Research

Further research on the use of AAC with infants and toddlers is needed. One promising line of research could be to include caregivers or peers in the assessment and intervention process, reinforcing partnerships between children, families, and medical and educational profes- sionals (Kent-Walsh et al., 2015; Romski et al., 2010).

In terms of study design, future studies would be strengthened by following the recommendations of Tate et al. (2008). The quality of assessment in case studies could be improved by correctly defining the baseline, ensuring the independence of the assessors, and addressing issues of replicability or generalizability. It would be also interesting to broaden available information about these children's vision and hearing status, as this information is critical to decisions made about AAC interventions. How- ever, one of the most important findings to emerge from this review is that, for most young children with CCN, these interventions are the first step in AAC use. There- fore, and in line with what the studies suggest, it is never too early to incorporate AAC into language and commu-

nication intervention for a young child with a significant communication disability (Romski & Sevcik, 2005), as it is extremely important accessing language during this period of rapid development. Interventions that compare different methods (Barton et al., 2006; Barton-Hulsey et al., 2017; Bock et al., 2005) also seem particularly use- ful and will help to build scientific evidence to determine best practices with these young children. Finally, it is nec- essary to remind that interventions found in this study do not represent an exhaustive list of possible interventions deployed by speech-language pathologists during a period of rapid language development. Thus, more research is needed in order to provide a wider variety of interventions based on scientific evidence.

Finally, one of the main limitations of the current study might be that children with a single diagnosis of ASD or cerebral palsy were excluded. Although it was a preplanned and responsibly assumed decision to focus on children with other diagnoses or mixed diagnoses, it is indisputable that these children constitute a large propor- tion of those with CCN. The latter benefit from AAC sys- tems and supports. Thus, by excluding these two clinical populations, we may have overlooked relevant informa- tion in the field.

Conclusions

In conclusion, the research presented here has adopted a rigorous methodology and has been conducted and described following the recommendations of experts in the field (Higgins & Green, 2011; Liberati et al., 2009). Moreover, the findings to emerge from the current research align with those reported previously (Biggs et al., 2018; Ganz et al., 2017; Gevarter & Zamora, 2018; O'Neill et al., 2018; Sennott et al., 2016). In particular, the evidence provided in the 29 studies indicates that vari- ous types of AAC systems can be effective with children aged between 0 and 6 years. The majority of the partici- pants in the studies showed an increase in communication skills following the AAC intervention. Moreover, the improvements occurred across a wide variety of disabil- ities, thus demonstrating the heterogeneous nature of AAC interventions, and reinforcing the idea of using AAC systems to address various communication needs (Lynch et al., 2018). In short, there is a need for medical and educational professionals to be prepared to design and provide AAC-based interventions for children with a broad range of disabilities and CCN.

We consider that this study may benefit practi- tioners, researchers, young children with CCN, and their parents by increasing awareness of benefits of early inter- vention and the relevance of interprofessional collabora- tive teams. It challenges professionals to introduce AAC to children with children who are at risk for the develop- ment of speech and language by providing positive data on intervention studies and also challenges speech- language pathologist practitioners and researchers to more closely evaluate the focus of AAC interventions with young children. Moreover, it reflects on which approaches might be more effective, which ones are not widely used, and so forth. It also encourages further research to docu- ment AAC intervention approaches with young children. In a similar vein, it also encourages parents (and profes- sionals) to be more proactive and not wait for traditional speech-language therapy to fail before providing AAC support and helps speech-language pathologists under- stand that that young children who are at risk for speech-language development that AAC approaches are effica- cious (no tech, low tech, and high tech) independent of their diagnosis.

Acknowledgments

This research was supported by AAC@schools for social inclusion ERAMUS+ project (Reference No. 2017- 1-IT02-KA201-036667) and KideOn Research Group of the Basque Government (Reference No. IT1342-19, A category).

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Figure 1: Flow chart of study selection process

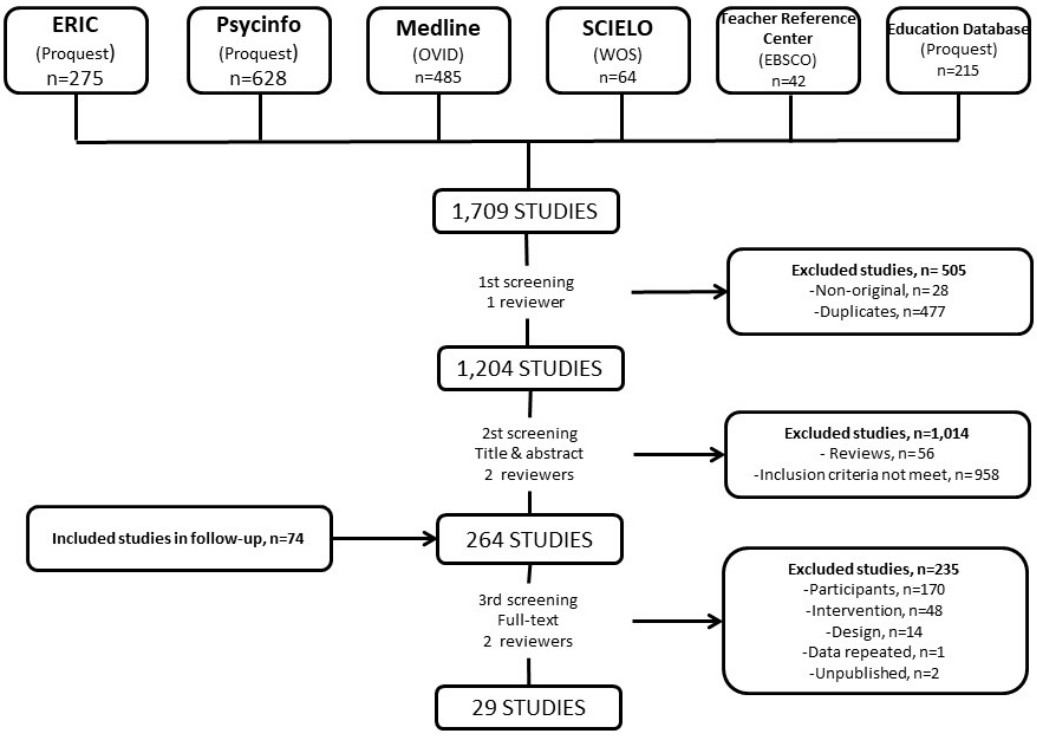

Table 1. *Quality of the single-case studies included in the review*

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Total yes (%)
Brady (2000)	Y	Y	N	N	Y	Y	Y	Y	N	N	N	8/11 (72.7%)
Hetzroni & Belfiore (2000)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	10/11 (90.9%)
Johnston et al. (2003)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	10/11 (90.9%)
Taylor & Iacono (2003)	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	8/11 (72.7%)
Harris & Reichle (2004)	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	8/11 (72.7%)
Sevcik et al. (2004)	Y	Y	N	N	N	N	N	N	N	N	N	2/11 (18.2%)
Bock et al. (2005)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	10/11 (90.9%)
Barton et al. (2006)	Y	Y	N	N	Y	N	N	N	N	N	N	3/11 (27.3%)
Binger & Light (2007).	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	10/11 (90.9%)
Binger et al. (2008)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11/11 (100%)
Rosa-Lugo & Kent-Walsh (2008)	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	10/11 (90.9%)
Johnston et al. (2009)	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	9/11 (81.8%)
Binger et al(2010)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11/11 (100%)
van der Schuit et al. (2010)	Y	Y	N	N	N	Y	N	N	Y	Y	N	5/11 (45.5%)
Brancalioni et al. (2011)	Y	N	N	N	N	N	N	N	N	N	N	1/11 (9.1%)
Harding et al. (2011)	N	N	N	N	N	N	N	N	N	N	N	0/11 (0%)

Leech & Cress (2011)	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	9/11 (81.8%)
Douglas et al. (2013)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	10/11 (90.9%)
Martin et al. (2013)	Y	Y	Y	N	Y	Y	Y	N	Y	N	N	7/11 (63.6%)
Solomon-Rice & Soto (2014)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	10/11 (90.9%)
Kent-Walsh et al. (2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11/11 (100%)
Thomas-Stonell et al. (2016)	Y	Y	Y	N	Y	Y	N	N	Y	N	N	6/11 (54.5%)
Lüke (2016)	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	8/11 (72.7%)
Therrien & Light (2016)	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	10/11 (90.9%)
Barton-Hulsey et al. (2017)	Y	Y	N	N	Y	Y	Y	Y	Y	N	N	7/11 (63.6%)
Binger, Kent-Walsh & King (2017)	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	9/11 (81.8%)
Binger, Kent-Walsh, King & Mansfield (2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11/11 (100%)
yes/total (yes %)	26/27 (96.3%)	24/27 (88.9%)	20/27 (74.1%)	17/27 (63%)	21/27 (77.8%)	23/27 (85.2%)	20/27 (77.8%)	14/27 (51.8%)	12/27 (44.4%)	15/27 (55.5%)	17/27 (63%)	

Notes: Q1, Clinical history; Q2, Target behaviors; Q3, Design; Q4, Baseline; Q5, Sampling behavior during treatment; Q6, Raw data record; Q7, Interrater reliability; Q8, Independence of assessors; Q9, Statistical analysis; Q10, Replication; Q11, Generalization; Y, yes; N, no.

Table 2. *Quality of the randomized controlled trials included in the review*

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Romski et al. (2010)	Uncl.	Low	Uncl.	Uncl.	High	Uncl	Uncl.
Romski et al. (2011)	Low	Low	Low	Uncl.	Uncl.	Uncl.	Low

Notes: Q1, Sequence generation; Q2, Allocation concealment; Q3, Blinding of participants and personnel; Q4, Blinding of outcome assessment; Q5, Incomplete outcome data; Q6, Selective outcome reports; Q7, Other sources of bias

Table 3. *Characteristics of the studies included in the systematic review*

Study	Country	Aim of the study	Participants	Study design	Setting
Brady (2000)	USA	To describe the effects of introducing a VOCA on both expressive and receptive communication	2 chldn. 5- 5;11 yr. Autism, severe language and cognitive delays	AB design (Pre-test & intervention)	classroor

							skills for the names of the objects requests
Hetzroni, & Belfiore (2000)	Israel/USA	To investigate the effectiveness of teaching 24 elements and 24 compound Blissymbols using a multimedia computer software developed for interactive use within a storytelling paradigm	3 chldn. 3;10-4 yr. Severe communication impairments. Apraxia.	A single-subject multiple-probe research design across three sets of symbols	home	Y/Y/Y	The intervention was effective for the three participants across the three sets of symbols. Children reached mastery and retained their knowledge during maintenance probes.
Johnston et al. (2003)	USA	To examine the effectiveness of an intervention strategy for teaching functional communication behaviors using AAC devices in the context of identified classroom activities	3 chldn.3;3-4;6 yr. Dev'l delays, athetoid cerebral palsy & severe multiple disabilities.	A multiple-baseline probe design across participants	classroom	Y/Y/N	The three children displayed different developmental abilities and areas of need, suggesting the procedures might be effective across a range of children.

Taylor & Iacono (2003).	Australia	To investigate the effects of modelling play and vocabulary across three play contexts on the child's (a) spontaneous functional and symbolic pretend play, and (b) symbolic communication	1 chldn.. 3;6 yr. Mild intellectual disability & severe communication impairment	Single-subject multiple baseline design	classroom	Y/N/N	Modelling and scripted play activities increased symbolic play. Improvements in communication were more evident when a multimodal AAC approach was used in modelling than when sign was used alone.
Harris & Reichle (2004)	USA	To determine a) whether aided language stimulation increased symbol comprehension, and b) whether aided language stimulation increased symbol production (object labelling).	3 chldn.. 3;10-5;4 yr. Moderate cognitive disabilities	Single subject, multiple-probe design across symbol sets/activities	School, home & educational day care settings	Y/N/N	A gradual increase in symbol comprehension and symbol production was observed. Yet, the rate of acquisition differed for each participant.
Sevcik et al. (2004)	USA	a) To evaluate the effect System for Augmentative Language (SAL) use had on the child's engagement state and child utterance attempts.	1 child. 4 yr. Severe Dev'l delays & seizure disorder	AB design (Pre-test & intervention)	Home & clinical setting	N/N/N	Child communicative attempts increased following the introduction of the augmented system. Parents reported successful use of the SAL.

		b) To determine parents' perception of SAL use					
Bock et al. (2005)	USA	a) To identify which communication strategy, PECS or VOCA, results in a more rapid rate of acquisition of requesting skills b) To explore to what extent do communication behaviours utilizing PECS and VOCA generalize from a pull-out setting to the classroom setting	6 chldn. 4 yr. Dev'l delay. Nonspeaking	An alternating treatment single subject design	school	Y/Y/N	PECS rate of acquisition was higher in all children. Communication behiviorus did not generalize to classroom settings.
Barton et al. (2006)	USA	To investigate how participants learned symbol-referent relationships across two symbol sets (Blissymbols and lexigrams) using the observational language learning strategy	4 chldn.. 2;4-3;8. Significant speech and language delays	Four data points during the intervention	Not specified	N/N/N	All participants demonstrated symbol-referent relationships, while in comprehension, three of the four participants demonstrated at least emerging symbol-referent relationships

Binger & Light (2007)	USA	To examine the effect of using aided AAC models on the production of multi-symbol messages by pre-schoolers	5 chldn.3;5-4;6 yr. Prader-Willi syndrome, DiGeorge syndrome, Down syndrome & Dev'l delay.	A single subject, multiple-probe across one set of three participants	School & home	Y/Y/Y	Four of the five pre-schoolers learned to consistently produce multi-symbol messages and generalized its use to novel play routines
Binger et al. (2008)	USA	(a) To teach caregivers how to support the production of their children's multi-symbol messages (b) to evaluate the effectiveness of the instructional program on the multi-symbol utterance productions of Latino children	3 Latino caregiver-child dyads. 2;11-4;1 yr. Profound phonological process disorder, profound, velopharyngeal insufficiency & Subpalatal cleft	A single subject, multiple probe design across three participants	Not specified	Y/Y/Y	All caregivers successfully learned to use the instructional strategy. All children increased their use of multi-symbol messages

Rosa-Lugo & Kent-Walsh (2008)	USA	To investigate the effects of a parent instructional program on the use of an evidence-based interaction strategy by Latino parents on the communicative turns of their children during interactive storybook reading	2 parent-child dyads. 6;8-6;10 yr. Cystichygroma. Dev'l delay	Single-subject, multiple-baseline-across subject	home	Y/Y/Y	Both parents reached criterion for implementation of the targeted interaction strategy. Both children demonstrated robust increases in communicative turns and novel semantic concepts expressed
Johnston et al. (2009)	USA	To examine the effectiveness of an intervention strategy to teach sound-letter correspondence and spelling of CVC combinations	2 chldn.4;2-4;5 yrs. cerebral palsy or pervasive Dev'l disorder & severe Dev'l delay	Within-subject, multiple-baseline probe design replicated across participants.	classroom.	Y/Y/Y	The intervention strategy was successful in teaching sound-letter correspondence and spelling of CVC combinations to young children who use AAC.
Binger et al. (2010)	USA	a) To investigate the effectiveness of the communication partner instructional program to teach educational assistants (EA)	3EA-student dyad. 4;6 -6;4 yr. Dev'l1 delay or dysarthria & childhood apraxia of speech	Single-subject multiple-probe-across participants	school	Y/Y/Y	Instruction had a large effect on the EAs' use of the interaction strategy and on students' production of multisymbol messages

		b) To rate the multi-symbol message production of students.					
Romski et al. (2010)	USA	To compare the language performance of young children with developmental delays who were randomly assigned to 1 of 3 parent-coached language interventions	68 toddlers with fewer than 10 spoken words.	RCT	laboratory & home	RCT	Vocabulary size was larger for Augmented Communication-Output (1) and –Input (2) groups than for Spoken Communication (3) group
van der Schuit et al. (2010)	The netherlands	1) to examine the effect of the intervention 2)To compare the development of receptive and expressive language skills of for speaking versus non-speaking children	10 chldn. 2-6 yr. Intellectual disability & severe speech and language disabilities	Pre-test, post-test (4 measure points). 2 groups (speaking and non-speaking)	day care setting	N/N/N	All children improved in receptive and expressive vocabulary. Speaking group showed greater progress
Brancalioni et al. (2011)	Brazil	To analyse the linguistic evolution in relation to understanding and linguistic expression of a subject with	1 child. 6;8 yr. Language disorder	Single case study (qualitative approach, with a retrospective	Not specified	N/N/N	Progress was positive in relation to understanding and linguistic expression. Use of

		motor impairment and speech absence from the introduction of the CAA feature		and documentary approach)			AAC favoured manifestation of speech.
Harding et al. (2011)	UK	To evaluate the processes involved in planning and implementing AAC systems to support the communication of children with profound and multiple learning disabilities.	2 chldn. 6;2- 6;4 yr. physically disabled & profound and multiple learning disabilities	AB design (Baseline & intervention)	classroom	N/N/N	Both children improved their communication skills. Underlines the importance of the level of each child's cognition in relation to their receptive abilities, and collaboration between team members
Leech & Cress (2011)	USA	To investigate the effectiveness of prompted nonspoken language production using two low-tech AAC strategies (i.e., picture symbols and sign language) at indirectly facilitating speech productions (''late talker''& real objects).	1 chldn. 3;4 yr. Expressive language delay.	Single subject, alternating treatment, multiple baseline research design	home	Y/Y/Y	Prompting either sign or picture-symbol production improved the child's speech output for target words without any direct prompts to speak. The two AAC strategies did not differ from one another in effectiveness at indirectly eliciting speech

Romski et al. (2011)	USA	(1) to examine parent perception of children early language development before and after participating in parent-coached early language interventions (2) to relate parent perception to child intervention outcome.	53 parents (*M* = 37 yr) of toddlers with Dev'l delay. Children (20-40 moths)	Randomized clinical trial	laboratory & home	RCT	Parents' perceptions of success became more positive. Their perceptions of the severity of the child's language difficulties decreased for the augmented interventions but increased for the spoken intervention.
Douglas et al. (2013)	USA	To evaluate the impact of instruction to paraeducators in two communication interaction strategies (IPLAN and MORE)	3 paraeducator-child dyads. 2;5-4;11 yr. Down syndrome, Dev'l delay, hearing disability & bilateral schizencephaly	Single-participant multiple baseline probe	Early childhood setting	Y/N/N	Paraeducators increased the number of communication opportunities. Children took a greater number of turns.
Martin et al. (2013)	USA	To identify the most efficiently learned communication mode to emphasize in an initial	1 child. 1;9 yr. Angelman Syndrome	Within-participant, alternating treatment single-subject experimental	home or day care setting.	N/N/N	The participant performed better in graphic mode than in gestural mode. Yet,

		augmentative communication system.					vocalization was very difficult to evoke.
Solomon-Rice & Soto (2014)	USA	To investigate the efficacy of two language intervention techniques, focused on stimulation and augmented input, in increasing the expressive vocabulary of toddlers	3 chldn. 2-3yr.Severe communication difficulties	within subject, adapted alternating treatments design (AATD) replicated across three participants	early intervention centre, home & private speech agency	Y/Y/Y	Participants' expressive vocabulary improved during both conditions and was sustained and generalized for two of the three toddlers
Kent-Walsh et al. (2015)	USA	To investigate the effects of a direct intervention program involving aided modelling and the presentation of contrastive targets on the aided production of inverted yes/no questions and possible generalization to other sentence types	3 chldn.4;9-6;2,yrs. Motor speech disorders	A single-case, multiple-probe, experimental design across participants	University clinic	Y/Y/Y	All 3 participants showed a direct treatment effect, producing a greater number of inverted yes/no questions. All 3 participants evidenced some generalization to novel sentences

Thomas-Stonell et al. (2015)	Canada	To report changes in communicative participation skills in pre-school children receiving AAC interventions	8 chldn.1;4-4;9 yr. Level 4-5 communicators CFCS	A-B-design, with extension through three follow-up measurements	not specified	N/N/N	Six of the eight children showed positive changes in communicative participation skills.
Lüke (2016)	Germany	To evaluate the effectiveness of SGDs on the communication and language development of a child with severe childhood apraxia of speech	1 child. 2;4 yr. Severe childhood apraxia of speech	A-B design, followed by three additional follow-up measurements	not specified	Y/N/N	The use of SGDs lead to an immediate increase in the communicative development of the child
Therrien & Light (2016)	USA	To increase social interaction for preschool-age children with complex communication needs and their peers by providing supports to overcome all three types of barriers to interaction.	2 chldn. 4;2-4;10 yrs. Complex communication needs. Six peers (3-6 yr.) without disabilities	Single-subject, multiple-probe across partner design with one replication	early childcare center	Y/Y/Y	Participant 1 showed immediate gains in the frequency of symbolic communicative turns. Participant 2 showed some initial gains, but they were not maintained over time.
Barton-Hulsey et al. (2017)	USA	To investigate the effect of a traditional grid-based display and a contextually organized	3 chldn. 3;6-5;3 yr. Mitochondrial disease, apraxia of speech &	Pre-test, post-test	Home & university clinic	N/N/N	Comprehension of symbol vocabulary increased on both displays. Participants 1 and 2 used both displays

		visual scene display on a speech-generating device	pervasive Dev'l disorder and delay				largely for initiation and Participant 3 had limited expressive use of either display
Binger, Kent-Walsh, & King (2017)	USA	To evaluate the developmental readiness to produce early sentences with an iPad communication application using graduate prompting dynamic assessment (DA)	10 chldn. 3;0- 4;11 yr. Severe speech disorders	A single-case, multiple-probe, across-targets	private research room at university setting	Y/N/N	Participants produced targets successfully in DA. Some moderate correlations existed between DA scores and performance.
Binger, Kent-Walsh, King & Mansfield (2017)	USA	To investigate the early rule-based sentence productions of 3- and 4-year-old children with severe speech disorders who used single-meaning graphic symbols to communicate	10 chldn. 3;3-4;11 yr. severe speech disorders	Single-case, multiple-probe across-targets	university clinic	Y/Y/Y	Majority of the remaining targets were mastered during intervention. Participants who completed intervention for grammatical markers quickly learned to use the markers accurately.

Notes: B, Baseline; chldn: child, children; DA; dynamic assessment; G, Generalization; M, maintenance; Y, yes; N, no.

Table 4. *Characteristics of the AAC system used in interventions*

Study	AAC system	Length	Sessions week	Session duration	Aided/ unaided	Low/ high tech
Brady (2000)	Graphic symbols, PCS, Jellybean switch, VOCA	no	no	no	Aided	High
Hetzroni, & Belfiore (2000)	57 Blissymbols	no	no	no	Aided	High
Johnston et al. (2003)	Picture Communication Symbols, Voice-output devices	no	no	no	Aided	Both
Taylor & Iacono (2003)	Symbolic communication models provide in manual signs, Dynavox	no	3	30 min	Both	Both
Harris & Reichle (2004)	Picture Communication Symbols.	no	no	no	Aided	Low
Sevcik et al. (2004)	Speech-output device (WOLF)	9 mo	no	no	Aided	High
Bock et al. (2005)	VOCA, PECS	5 ½ wk	3 (A) & 2 (B)	no	Aided	High

Barton et al. (2006)	Blissymbols, lexigrams	no	4	no	Aided	Low
Binger & Light (2007)	Toys, communication board with PCS, photographs printed, displays	no	no	15 min	Aided	Both
Binger et al. (2008)	Pages that followed Fitzgerald Keys containing 30-35 symbols	no	no	10 min	Aided	Low
Rosa-Lugo & Kent-Walsh (2008)	One preferred children's book series with separate communication displays	no	no	no	Aided	Low
Johnston et al. (2009)	12 arrays presented on white paper. Lowercase, 72-point Arial Narrow font.	no	daily	no	Aided	Low
Binger et al. (2010)	SGDs with storybooks organized according to Fitzgerald keys	no	no	10 min	Aided	High
Romski et al. (2010)	SGD using Picture Communication Symbols.	12 wk	2	30 min	Aided	High
van der Schuit et al. (2010)	Manual signs (SSD), graphic symbols, photographs & AAC devices	2 yr.	5	2.5-3 h	Both	Both

Brancalioni et al. (2011)	Communication boards (PCS), photographs, promotional insert figures, drawings and writing	16 mo	no	no	Aided	Low
Harding et al. (2011)	Photographs, natural gestures, specific Makaton signs, hand over hand/physical prompting, verbal prompts and objects.	5wk	daily	30 min	Both	Low
Leech & Cress (2011)	sign language & picture symbols	10wk	1-2	1.5h	Both	Low
Romski et al. (2011)	SGD	no	no	30	Aided	High
Douglas et al. (2013)	Sign, VOCA, picture symbols,	2 wk	no	15	Both	Both
Martin et al. (2013)	Vocal, gestural, and graphic communication modes	5 mo	2	no	Both	Low
Solomon-Rice & Soto (2014)	Manual signs, graphic symbols, pointing and gesturing, single page communication board	no	no	no	Both	Low

Kent-Walsh et al. (2015)	Videos, photographs, SGDs, iPad.	3 wk, 4 wk, 6 wk	2	no	Aided	Both
Thomas-Stonell et al. (2016)	Sign language, assistive technology and PECS	12 mo	1	no	Both	Both
Lüke (2016)	fixed display device, dynamic display device	21 mo	no	no	Aided	Both
Therrien, & Light (2016)	iPad	3 mo	1-3	10	Aided	High
Barton-Hulsey et al. (2017)	Dynavox Systems MT4 SGD, Dynavox Systems SGD and VSD	no	3	30	Aided	High
Binger, Kent-Walsh & King (2017)	iPad, Synthesized speech software	no	no	60 min	Aided	High
Binger, Kent-Walsh, King & Mansfield (2017)	iPad	no	no	no	Aided	High
Average/ frequency		**29.23***	**3.54**	**36.5**	**Aided 22** **Unaided 0**	**High 11** **Low 10**

				Both 7	**Both 8**	

Notes: PE, picture exchange; PECS, Picture Exchange Communication System; PCS, picture communication symbols; SGD, speech generating device; VOCA, Voice Output Communication Aid.

* In order to calculate the average length of the interventions, one month equate to 4 weeks

Table 5. *Characteristics of interventions*

Study	Intervention target	Intervention situation	Multimodal /unimodal	Intervention (IV)	Outcome (DV)	Outcome brief
Brady (2000)	Children	Routines	Unimodal	During routine activity investigator ask for object needed. Incorrect answer "No" + placing particpant hand in the center of the array, wait and place hand in correct symbol.	Recognize the spoken label for target object and correct requests.	Match

Hetzroni & Belfiore (2000)	Children	Storytelling	Unimodal	Multimedia interative computer sofware with interactive story packs to learn Blisssymbols.	Correct identifcation of Blisssymbol after verbal stimulus	Match
Johnston et al. (2003)	Children	Activities of preschool classrom	Unimodal	4 step: 1. Establish communicative opportunities. 2. Peer or teacher modeled desired behaviour using child AAC device. 3. Specific guidance to reach desired behaviour (least-to-most prompintg hierarchy). 4. Consequences and commentary on children behaviour.	Ecological impact: Ecobrehavioral system for Complex Assessment of Preschoolar Enviroments. Acceptability and percieved effectiveness of the staff: 20 items, 7-point Likert.	Ecological impact and perceived effectiveness
Taylor & Iacono (2003)	Children	Play	Multimodal	Scripting and modelling play, with symbolic communication model for target vocabulary proveid by speech-sign and speech, sign and Dynavox.	Spontaneous functional play acts, spontaneous symbolic play acts, spontaneous symbolic communication	Number

Harris & Reichle (2004)	Children	Match object-symbol	Unimodal	Aided language stimulation. Pointing with finger the referenet and sequentialy pointing to a graphich symbol saying the name. During scripted routines	Comprehension of graphic and spoke symbols, production of graphic symbols, comprehension of exclusively graphic symbol.	Match, Number
Sevcik et al. (2004)	Parent	Routines	Unimodal	Introduction to System fro Augmentative Language (SAL). 1. Speech putput device (WOLF),2. Individualized vocabulary display (Mayer-Johnson symbols). 3. Encourgae used of SAL. 4. Taught communication partners to use SAL to augement their own speech. 5. Resource and feedback by the research team	Child engagement state, child communicative events, adult spoken and augmented communcative input	Number
Bock et al. (2005)	Children	Match object-symbol	Unimodal. Comparing	PECS: 1 PECS. Picture exchange, 1. VOCA. Active picture location, 2. persistence of communication. 3.	Correct identification of the item thorugh VOCA or PECS	Match

				Picture discrimination, 4. Classroom intervention.		
Barton et al. (2006)	Children	Match object-symbol	Unimodal. Comparing	Blissymbols, lexigrams and object referent. When children touch symbol corresponding color photograph appeared and digitalized speech heard. 94 experiences per symbol 4 weeks.	Match the symbol to the target photograph.	Match
Binger & Light (2007)	Children	Play	Multimodal	2 play scenarios with a set of toys. Provide an aided AAC model after children took communicative turn or complete action play. 1.touch symbols on device, 2. label each symbol, 3.provide speaking akin. Minimum of 30 model per 15 min session.	Frequency of mutilsymbol production during 15-min play. Diversity of productions	Number

Binger et al. (2008)	Caregivers	Storytelling	Multimodal	caregiver trainign to : 1. Elicitation: read text provide + two-symbol aided AAC model, ask wh- question + provide two-symbol aided AAC model, and (c) answer wh-question + provide two-symbol aided AAC model. 2. Responses: imitations, expansions, and recasts	Caregivers: implementation of the targeted strategy in obligatory contexts. Children: frequency of children's multi-symbol utterance productions (including both spontaneous and imitated messages) within a 10 min book reading activity.	Number
Rosa-Lugo & Kent-Walsh (2008)	Parent	Storytelling	Unimodal	Parents: 3 step intervention (a) introductory,(b) practice, and (c) follow-up based on eight interaction skills (a) aided AAC modeling, (b) use of expectant delay, (c) use of open-ended questions, and (d) increased responsiveness to communicative attempts, sequenced within the	Parents; implementation of targereted interaction (correct, incorrect, omitted), on each book page. Children; appropieate communicative turns taken after page turn or parent´s strategy	Number

				"elicitation" and the "response". Children; novel book reading.		
Johnston et al. (2009)	Children	Match sound-letter	Unimodal	Touch the letter says... or spell. Opportunities or instructional strategies were avaliable. 3 step intevention: 1. 4 activities to choose. 2. Instructional cues followed (0s, 5 s…)by response prompt. 3. material to do activity or game	Sound-letter correspondence and spelling CVC	Match
Binger et al. (2010)	Education assisstant	Storytelling	Multimodal	ImPAACT program. Instructing EA to use interaction activity (for read, ask, answer, and prompt) + evaluate	1. percentage of strategy steps correctly implemented by the EAs on each page of the storybook. 2. the frequency of	Number

				the impact of this instruction on children mutisymbol production	multisymbol messages, number of differente symbol combination, spontaneous symbol combination.	
Romski et al. (2010)	Parent	Play, storytelling, routines	Unimodal	Three interventions: 1. Augmented communication input, 2. Augmented communication output, 3. Spoken communication.	Children: Number of augmented and/or spoken words, mean lenght of utterance morphenes, type/token ratio, total turns, mean lenght of turn in utterances, proportion of intelligible utterances. Parents: mean lenght of utterance morphenes, total turns, mean lenght of turn in utterances.	Number

van der Schuit et al. (2010)	Children	Activities of preschool classrom, other activities	Multimodal	Activities at home and daily care center. KLINc Study interevention: Anchored insttrution of vocabuary (graphic symbols, photographs, and films)	Curriculum-based test. 1. Vocabulary test. 50 words. 2.Expressive vocabulary test. Name a picture of teh anchor word. Standarized tests: 1. Nonverbal intelligence: Revised Snijders-Oomen Nonverbal Intelligence Test (SON-R 2 ½–7). 2. Receptive language: Dutch version of the Reynell Test for Language Comprehension. 3. Expressive language: Schlichting Test for Language Production	Match, Number
Brancalioni et al. (2011)	Parent	Home, natural enviroment	Multimodal	Speech-language intervention through introduction of AAC in a dialogic functioning.	A protocol of behavioral observation that assessed	Behaviour

					children's language and cognitive aspects.	
Harding et al. (2011)	Children	Music, free play, lunch	Multimodal	A child: Verbal prompt, a gesture prompt, (pointing), and a hand over hand prompt for photgraphs.Model an verbal prompt for signing. B child: physically prompt him to touch object with naming, followed by opportunities for him to reach and make a choice. verbal attempts were responded.	Pragmatics Profile of Everyday Communication Skills to assess expression, comprehension, social intereaction and behaviour.	Number, behaiviour
Leech & Cress (2011)	Child, mother involved in experimental	Play	Multimodal	Encourage to use picture symbols and sign to communicate and model speech associated with symbols and signs using least-to-most hierarchy of cueing.	Frequency of use signs, symbols and speech.	Number

Romski et al. (2011)	Parent	Play, storytelling, routines	Unimodal	3 interventions: 1. Augmented communication input, 2. augmented communication output, 3. spoke communication. Targeted voculabulary for each child.	Parent Perception of Language Development. Number of augmented or spoken words	Number
Douglas et al. (2013)	Paraeducators	Play	Multimodal	Importance of communication and IPLAN and MORE programes theory and practice. Apply strategies to children 1-min playing sessions.	Number of communication opportunities prived by paraeducators and number of communication turns taken by children	Number
Martin et al. (2013)	Children	Routines	Multimodal	Instructional procedures to teach requests in gestural, graphic, and vocal communication modes	requesting accuracy for a preferred item	Number
Solomon-Rice & Soto (2014)	Children	Play	Multimodal	Two intervention dugin playing activities: 1. Focused stimulation and 2. Augmented input	Percent of target vocabulary autonomously produced by the child during each 20-min play session, (a) spontaneously, (b) while imitating an adult	Number

					production, (c) with or without adult prompting , (d) with or without the adult pro-viding a choice that includes the target vocabulary , or (e) in response to an adult question	
Kent-Walsh et al. (2015)	Parents	Play	Unimodal	1. Concentrated modelling: 10 aided models of DV1 and DV2 child watching and listening. and 2. Intereactive play: engage child playing 25-min, min 20 aided models for DV1 & DV2, elicited a minimum of 5 children attempt	Percentage of correct productions. DV1: Subject + Aux V (is) + Main Ving. DV 2: Aux V (is) + Subject + Main Ving.	Grammar
Thomas-Stonell et al. (2016)	Children	Routines	Multimodal	Introduction to sing language, assistive technology and PECS. Intervention techniques were consistent with the service delivery practices of each organisation. No	Communication skills: 1. Focus on Communication Outcomes Under Six (FOCUS ©) 2. Ages and Stages	Communication/ Social/emotional /

				attempt was made to control the type of intervention provided.	Questionnaire – Social/Emotional (ASQ-SE)	
Lüke (2016)	Children	Play	Unimodal	A. Introdution to signs/vocabulary work. (17 S). B1. Gotalk 20+ for support (19 S). B2. DynaVox V for supoort (14 S). Speech therapy continued after the completion of B2.	Means of communication, intelligibility of speech productions, consistency of speech productions, lexical development and grammatical development.	Grammar
Therrien, & Light (2016)	Children and their peers	Storytelling	Unimodal	Stroybook reading. Researcher leave and leave children with IPAd for 10 minutes. Training sessions in this study followed the sequence: model, guided practice, independent practice.	Symbolic communicative turns	Number

Barton-Hulsey et al. (2017)	Children	Play, dramatic	Unimodal. Comparing	Dynamic assessment during dramatic play routines. Strategies: Augmented input model, language learning opportunities (target vocabulary and real-life props), modelling, paralell talk. In VSD and grid setting.	Symbol comprehension: "touch ___". Symbol use: exploration, natural speech, imitation, initiation, answering.	Match, number
Binger, Kent-Walsh & King (2017)	Children	Match object-symbol, play	Multimodal	Graduated prompting dynamic assessment	Probe mastery (Percentage of correct productions), DA scoring (4 levels), mean prompting level, measures of modifiability (first 5 DA, vs. last 5 DA), Measure of response to intervention (mean DA Vs. to mean probe mastery)	Match

Binger, Kent-Walsh, King & Mansfield (2017)	Children	Storytelling, characters	Unimodal	Early ruled-based sentence productions	Entity-atributte, possessor entity, locative entity	Grammar

DA, dynamic assessement; DV, dependent varible; IV, Independent variable; PECS, Picture Exchange Communication System; PCS, picture communication symbols; SGD, speech generating device; VOCA, Voice Output Communication Aid; VSD; visual scene display.

Appendix A

Electronic Search Strategies

Medline (OVID). 27th April 2018.

1 - alternative.mp.

2 - augmentative.mp.

3- 1 or 2

4 - communication*.mp.

5 - language*.mp.

6 - 4 or 5

7 - 3 and 6

8 - AAC.mp.

9 - (augmentative and alternative communication).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

10 - Communication Aids for Disabled/

11 - 8 or 9 or 10

12 - model*.mp.

13 - intervention*.mp.

14 - program*.mp.

15 - practice*.mp.

16 - 12 or 13 or 14 or 15

17 - child*.mp.

18 - kid*.mp.

19 - infant*.mp.

20 - minor*.mp.

21 - toddler*.mp.

22 - teen*.mp.

23 - adolescent*.mp.

24 - young*.mp.

25 - 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24

26 - 11 and 16 and 25

27 - limit 26 to yr="2000 - 2018"

ERIC (Proquest). 26th April 2018

S1 - ab(alternative) OR ab(augmentative)

S2 - ab(communication*) OR ab(language*)

S3 - S1 AND S2

S4 - ab(AAC) OR ab(alternative AND augmentative communication)

S5 - S3 OR S4

S6 - ab(model*) OR ab(intervention*) OR ab(program*) OR ab(practice*)

S7 - ab(child*) OR ab(kid*) OR ab(infant*) OR ab(minor*) OR ab(toddler*) OR ab(teen*) OR ab(adolescent*) OR ab(young*)

S8 - S5 AND S6 AND S7

S9 - (S5 AND S6 AND S7) AND yr(2000-2019)

S10 - (S5 AND S6 AND S7) AND (yr(2000-2019) AND PEER(yes))

Psycinfo (EBSC). 5th May 2018.

S1 - ab(alternative) OR ab(augmentative)

S2 - ab(communication*) OR ab(language*)

S3 - S1 AND S2

S4 - aac OR (alternative AND augmentative communication)

S5 - S3 OR S4

S6- AB model* OR AB intervention* OR AB program* OR AB practice*

S7 – AB child* OR AB kid* OR AB infant* OR AB minor* OR AB toddler* OR AB teen* OR AB adolescent*

S8 - S5 AND S6 AND S7

Education Database (Proquest). 26th April 2018

S1 - ab(alternative) OR ab(augmentative)

S2 - ab(communication*) OR ab(language*)

S3 - S1 AND S2

S4 - ab(AAC) OR ab(augmentative and alternative communication)

S5 - S3 OR S4

S6 - ab(model*) OR ab(intervention*) OR ab(program*) OR ab(practice*)

S7 - ab(child*) OR ab(kid*) OR ab(infant*) OR ab(minor*) OR ab(toddler*) OR ab(teen*) OR ab(adolescent*) OR ab(young*)

S8 - S5 AND S6 AND S7

S9 - (S5 AND S6 AND S7) AND yr(2000-2019)

S10 - (S5 AND S6 AND S7) AND (yr(2000-2019) AND PEER(yes))

S11 - (S5 AND S6 AND S7) AND (yr(2000-2019) AND PEER(yes))

Teacher Reference Center (EBSCO).27th April 2018.

S1 - AB alternative OR AB augmentative

S2 - AB communication* OR AB language*

S3 - S1 AND S2

S4 - AB AAC OR AB (augmentative and alternative communication)

S5 - S3 OR S4

S6 - AB model* OR AB intervention* OR AB program* OR AB practice*

S7 - AB child* OR AB kid* OR AB infant* OR AB minor* OR AB toddler* OR AB teen* OR AB adolescent* OR AB young*

S8 - S5 AND S6 AND S7

S9 - S5 AND S6 AND S7. Limiters - Published Date: 2000/01/01-2018/12/31; Peer Reviewed.

SCIELO (Web of Science). 27th April 2018.

1 Tema: (alternative) OR Tema: (augmentative)

2 22.788 Tema: (communication*) OR Tema: (language*)

3 Tema: (AAC) OR Tema: (augmentative and alternative communication)

4 #2 AND #1

5 #4 OR #3

6 Tema: (model*) OR Tema: (intervention*) OR Tema: (program*) OR Tema: (practice*)

7 Tema: (child*) OR Tema: (kid*) OR Tema: (infant*) OR Tema: (minor*) OR Tema: (toddler*) OR Tema: (teen*) OR Tema: (adolescent*) OR Tema: (young*)

8 #6 AND #5

9 #8 AND #7

Appendix (p. 1 of 2) Electronic Search Strategies

Medline (OVID). 27th April 2018.

- alternative.mp.

- augmentative.mp.

or 2

4 - communication*.mp.

5 - language*.mp.

6 - 4 or 5

- 3 and 6

- AAC.mp.

- (augmentative and alternative communication).mp. [mp = title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

- Communication Aids for Disabled/

- 8 or 9 or 10

- model*.mp.

- intervention*.mp.

- program*.mp.

- practice*.mp.

- 12 or 13 or 14 or 15

- child*.mp.

- kid*.mp.

- infant*.mp.

- minor*.mp.

- toddler*.mp.

- teen*.mp.

- adolescent*.mp.

- young*.mp.

- 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24

- 11 and 16 and 25

- limit 26 to yr="2000 - 2018"

ERIC (Proquest). 26th April 2018

S1 - ab(alternative) OR ab(augmentative) S2 - ab(communication*) OR ab(language*) S3 - S1 AND S2

S4 - ab(AAC) OR ab(alternative AND augmentative communication) S5 - S3 OR S4

S6 - ab(model*) OR ab(intervention*) OR ab(program*) OR ab(practice*)

S7 - ab(child*) OR ab(kid*) OR ab(infant*) OR ab(minor*) OR ab(toddler*) OR ab(teen*) OR ab(adolescent*) OR ab(young*) S8 - S5 AND S6 AND S7

S9 - (S5 AND S6 AND S7) AND yr(2000–2019)

S10 - (S5 AND S6 AND S7) AND (yr(2000–2019) AND PEER(yes))

Psycinfo (EBSC). 5th May 2018.

S1 - ab(alternative) OR ab(augmentative) S2 - ab(communication*) OR ab(language*) S3 - S1 AND S2

S4 - aac OR (alternative AND augmentative communication) S5 - S3 OR S4

S6 - AB model* OR AB intervention* OR AB program* OR AB practice*

S7 - AB child* OR AB kid* OR AB infant* OR AB minor* OR AB toddler* OR AB teen* OR AB adolescent* S8 - S5 AND S6 AND S7

Appendix (p. 2 of 2) Electronic Search Strategies

Education Database (Proquest). 26th April 2018

S1 - ab(alternative) OR ab(augmentative) S2 - ab(communication*) OR ab(language*) S3 - S1 AND S2

S4 - ab(AAC) OR ab(augmentative and alternative communication) S5 - S3 OR S4

S6 - ab(model*) OR ab(intervention*) OR ab(program*) OR ab(practice*)

S7 - ab(child*) OR ab(kid*) OR ab(infant*) OR ab(minor*) OR ab(toddler*) OR ab(teen*) OR ab(adolescent*) OR ab(young*) S8 - S5 AND S6 AND S7

S9 - (S5 AND S6 AND S7) AND yr(2000–2019)

S10 - (S5 AND S6 AND S7) AND (yr(2000–2019) AND PEER(yes)) S11 - (S5 AND S6 AND S7) AND (yr(2000–2019) AND PEER(yes))

Teacher Reference Center (EBSCO).27th April 2018.

S1 - AB alternative OR AB augmentative S2 - AB communication* OR AB language* S3 - S1 AND S2

S4 - AB AAC OR AB (augmentative and alternative communication) S5 - S3 OR S4

S6 - AB model* OR AB intervention* OR AB program* OR AB practice*

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1 Tema: (alternative) OR Tema: (augmentative)

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7 Tema: (child*) OR Tema: (kid*) OR Tema: (infant*) OR Tema: (minor*) OR Tema: (toddler*) OR Tema: (teen*) OR Tema: (adolescent*) OR Tema: (young*)

8 #6 AND #5

9 #8 AND #7