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REVIEW PAPER

# Caregiver-Implemented AAC Interventions for Children with Intellectual or Developmental Disabilities: a Systematic Review

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## Abstract

Many children with intellectual and/or developmental disabilities benefit from augmentative and alternative communication strategies (AAC) to increase their communicative competency. Furthermore, caregiver-implemented AAC interventions are an effective and efficient strategy to improve communication outcomes. We reviewed the caregiver-implemented AAC intervention literature to assess child and caregiver characteristics, what kind of interventions caregivers were taught, how caregivers were trained, and how studies evaluated caregiver implementation. We found that families from marginalized backgrounds were underrepresented. Most studies used functional behavioral interventions and various teaching strategies, and few included caregiver-dependent variables. We discuss our results in the context of improving future caregiver-implemented AAC interventions and, in turn, child communication outcomes.

**Keywords** Autism · Development disability · Intellectual disability · Augmentative and alternative communication · Caregiver-implemented communication interventions · Complex communication needs

Communication is integral to our ability to build and maintain relationships, influence our environment, and participate fully in our society. Many children diagnosed with an intellectual or developmental disability (I/DD; e.g., autism, Down syndrome, fragile X syndrome) experience complex communication needs (CCN), impacting their ability to use speech to meet their daily communication needs. In 2013, individuals with CCN comprised approximately 1.3% of the US population (Beukelman & Mirenda, 2013); however, this figure has likely increased along with the increasing incidence rates of autism and other disabilities impacting communication and language skills. The Center for Disease Control and Prevention's (CDC) update on autism prevalence rates has demonstrated an increase in the number of children diagnosed since 2000 with the latest estimating that 1 in 54 children are diagnosed with autism (Maenner et al., 2020). Furthermore, the current estimate of children aged 3–17 years with developmental disabilities (DD) is 1 in 6, as reported by parents to the CDC via the National Health Interview Survey (Zablotsky & Black, 2020).

## AAC Interventions to Improve Communicative Competency

Augmentative and alternative communication (AAC) interventions are an established and effective practice for increasing opportunities for communication and, in turn, social participation for individuals with CCN (Beukelman &

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Light, 2021; Biggs et al., 2018; Therrien et al., 2016). AAC strategies can be classified as unaided and aided. Unaided strategies include systems using gestures, movements, facial expressions, or manual signs. In contrast, aided systems use tools external to the body, such as abstract symbols, pictures, or digitized speech. Specific examples include the Picture Exchange Communication System (PECS; Bondy & Frost, 1994) and speech-generating devices (SGD). SGDs are mobile technology such as iPod™, iPad™, and iPhone™ applications installed on tablets and smartphones or dedicated devices made solely for communication. Aided communication systems are increasingly available, affordable, and portable, but intervention research is struggling to keep up with technological advances (Still et al., 2014). There are advantages to using high-tech AAC strategies, including conveying messages both visually and verbally, gaining attention through audible speech, using synthesized or digitized speech, and, in turn, enhancing intelligibility (Schlosser et al., 2009), especially to unfamiliar listeners.

Given that communication impairments are prevalent and hallmark features of many I/DD, AAC interventions are often critical in promoting communication. Specifically, AAC interventions for individuals with I/DD can increase functional communication skills (Beukelman & Light, 2021; Drager et al., 2010; Johnston et al., 2012), improve language and social competence (Kent-Walsh et al., 2015), and increase vocal-verbal speech in some individuals (Millar et al., 2006; Schlosser & Wendt, 2008). The ability to effectively and efficiently communicate wants and needs and actively participate in social exchanges can improve quality of life and independence (Chan & Zoellick, 2011; McNaughton & Bryen, 2007). Ultimately, communication allows us social closeness and is a crucial part of engaging in reciprocal exchanges to develop and maintain relationships, interact with family members, and increase participation (Mei et al., 2015; Therrien et al., 2016).

## Caregivers as Interventionists

Caregivers are natural change agents who play a critical role in their children's social-communicative development across contexts, with new people, and over time (Roberts & Kaiser, 2011). Caregiver training on AAC has successfully resulted in primary caregivers implementing various AAC strategies with high intervention fidelity. This training, in turn, has resulted in increased communication by children, including manual sign (e.g., Casey, 1978), PECS (e.g., Park et al., 2010), and other low-tech strategies (Benson et al., 2017; Mancil et al., 2006), and mid-to-high-tech strategies (Dimian et al., 2018; Olive et al., 2008). AAC has been incorporated into developmental interventions (i.e., heavily child-led approaches, follow typical developmental sequences, and are motivated by constructivist theories of learning, e.g., Pennington et al., 2009), as well as naturalistic developmental behavioral interventions (NDBIs), such as enhanced milieu teaching (EMT; e.g., Wright & Kaiser, 2017). Behavioral interventions (i.e., approaches heavily situated in operant theories of learning) are another common approach in which AAC has been embedded; one popular example is functional communication training (FCT; Reichle & Wacker, 2017). Caregivers have been taught to successfully implement FCT with their children resulting in socially significant reductions in the rates and frequencies of child challenging and idiosyncratic behaviors as a result of increases in the emission of more socially acceptable functional communication acts (Gerow et al., 2017; Simacek et al., 2017). Including caregivers in intervention research offers the potential advantage of increasing the likelihood of generalizing new skills to natural environments, increasing the number of responsive communication partners, and providing more opportunities for children to acquire and maintain communication skills. Ensuring that effective interventions are mastered by all communication partners creates skilled interventionists and the potential for communication partners across the lifespan.

### Implementation and Intervention Fidelity

Intervention fidelity, also known as procedural or treatment fidelity, refers to the degree to which a caregiver delivers the target AAC intervention as intended to their child (Barton & Fettig, 2013). Within the last decade, intervention fidelity has seen an uptick in reporting and systematic evaluation of intervention fidelity on child outcomes (e.g., Barton & Fettig, 2013; Biel et al., 2020: Rispoli et al., 2021).

Implementation fidelity, however, refers to the behaviors of the trainers of caregivers and whether the intervention package is delivered as intended with the desired effects of supporting the caregiver's uptake of the intervention procedures (Dunst et al., 2013). Intervention fidelity is intrinsically tied to implementation fidelity; high intervention fidelity requires high implementation fidelity (Fixsen et al., 2005). Compared to intervention fidelity, implementation fidelity has received far less attention in the systematic evaluation *and* reporting of practices in individual studies (Biel et al., 2020), in part likely due to a lack of reporting conventions. Including implementation procedures will benefit future research and practitioners and, in turn, families and children with CCN. It allows practitioners to identify if there is a contextual fit between the intervention and their clients' support needs and provides an opportunity for researchers to synthesize across studies to identify best training practices.

Although fairly established in the educational and mental health field, implementation science is gaining traction in the communication disorders science field (Douglas et al., 2022). Within this area, there is a focus on expanding and

building upon social validity and consumer satisfaction outcomes to develop methods and conventions to quantify implementation fidelity. One such effort is a conceptual framework proposed by Biel et al. (2020). They organized implementation fidelity into four broad teaching functions based on a small set of underlying adult learning principles. The first is *information sharing*, which refers to providing information on the intervention strategies being taught, rationale behind them, and their evidence base. The second function is *modeling*, referring to the methods used to demonstrate the intervention strategies to caregivers. *Prompting*, *guiding*, or *scaffolding* caregivers in the use of the intervention strategies is the third function. Lastly, *feedback* referring to the methods used to provide feedback on the caregiver's accuracy in implementing the intervention strategies. These underlying learning principles can be found in other teaching methods (e.g., behavioral skills training [BST; Miltenberger, 2012] and teaching interaction procedure [TIP; Phillips et al., 1974]). Both BST and TIP have been successfully used to teach new skills to children with ID/D, their caregivers, teachers, and clinicians (e.g., Brock et al., 2017; Dogan et al., 2017). Including explicit descriptions of implementation fidelity components and the systematic evaluation of these components is necessary to improve not just caregiver-implemented AAC interventions but all intervention research.

### Previous Literature Reviews

There have been numerous reviews on AAC interventions for children with I/DD. Some have focused on the effectiveness of AAC interventions for specific populations (e.g., autism [Hong et al., 2017]; Down syndrome [de Barbosa et al., 2018]). Others have examined AAC preferences (e.g., van der Meer et al., 2011), instructional features (e.g., Biggs et al., 2018; Ganz et al., 2022), literacy outcomes (e.g., Barker et al., 2012), and child characteristics that might moderate outcomes (e.g., Ganz et al., 2022; Sievers et al., 2018). However, no published review to date has examined the effects of caregiver implementation of ACC interventions for children with I/DD. The current study addresses this gap by conducting a systematic review to assess the current nature of the caregiver-implemented AAC interventions literature base.

The purpose of the current study was to better understand the nature of studies evaluating caregiver-implemented AAC interventions for children with I/DD, particularly the type of interventions being taught to caregivers and the implementation procedures used to transmit these interventions. By examining the existing research base, we aimed to identify gaps in the research to guide future intervention studies and, in turn, improve child AAC outcomes. The following research questions guided the review:

A) Who has been represented in research focused on caregiver-implemented AAC interventions regarding child and caregiver characteristics?
B) What kind of AAC interventions have caregivers been taught?
C) What implementation procedures have been used to train caregivers to implement AAC interventions?
D) How did studies evaluate caregiver implementation of AAC interventions being taught?

## Methods

The current study used a subset of articles from a comprehensive systematic review and meta-analysis examining the impact of AAC interventions for individuals with I/DD (PROSPERO registration: CRD42018112428). A summary of procedures used in the comprehensive review is described briefly below, and any additional steps conducted for the current study are described in detail below (see Ganz et al., 2020 for detailed information on the methodology for the comprehensive meta-analysis). Figure 1 depicts a PRISMA flow chart for the current review.

### Search Strategy

The comprehensive review followed procedures outlined in the Cochrane guidelines (Higgins et al., 2019). Included studies were identified through database, reference, first author, and forward searches. A research librarian conducted the database searches in the following databases: Academic Search Complete, ERIC, PsycINFO, Conference Proceedings Citation Index – Social Science & Humanities (Web of Science), and Proquest Dissertations & Theses Global. The following search terms were used: [((augmentative or alternative) within one word (w1) communicat*) or "sign language" or manual sign* or speech-generating device* or SGD or "voice output communication aid" or VOCA* or PECS or "picture exchange communication system" or AAC or "visual scene display" or "functional communication training"] AND [(down* w1 syndrome) or ((develop* or intellectual) w1 (delay* or disabil* or impair*)) or autis* or retard*]. Initial database searching occurred between October and December 2018; search results were updated in April 2020 to identify any potential additional articles during the study period.

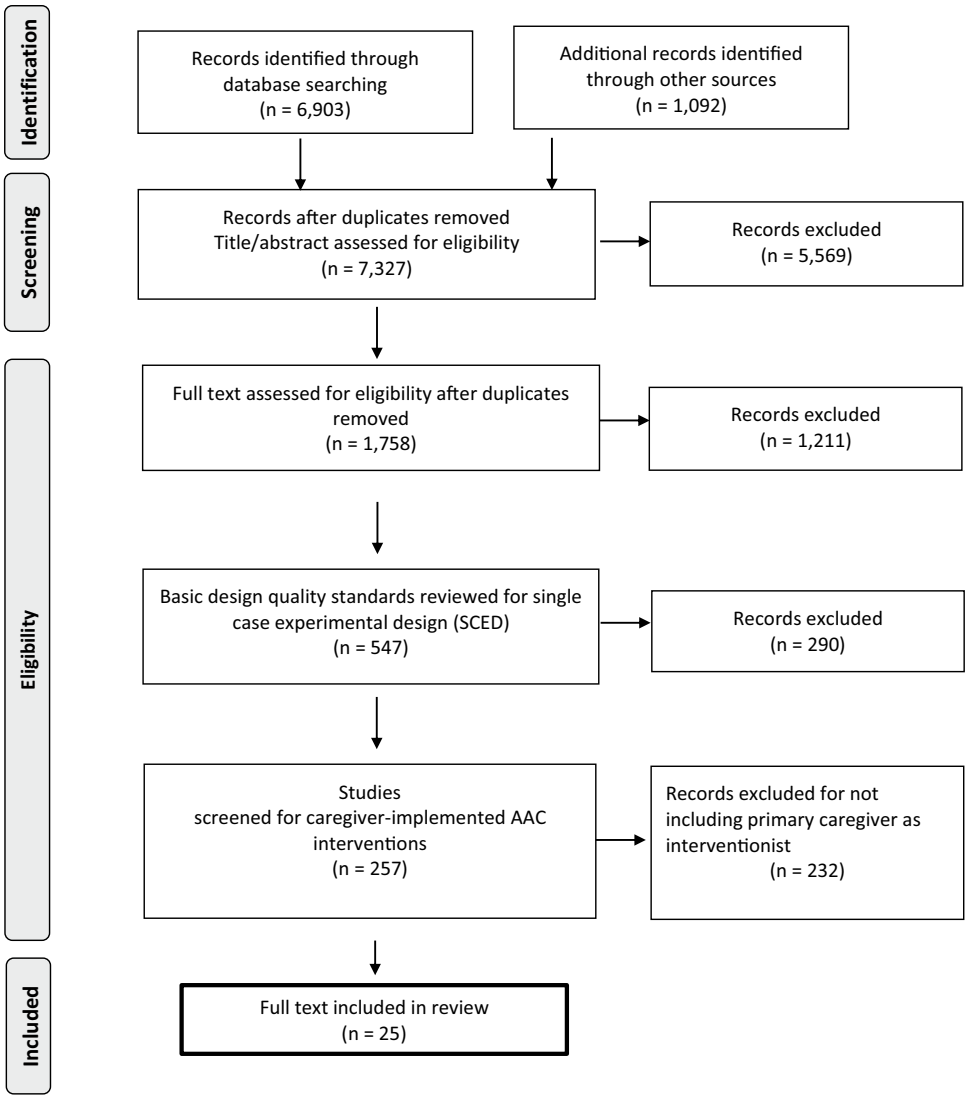


**Fig. 1** PRISMA flow chart depicting search procedures

## Inclusion/Exclusion Criteria

### Comprehensive Review

A total of 7327 titles/abstracts were screened using the Rayyan web platform (Ouzzani et al., 2016). Articles were excluded from the next review step (i.e., the full-text review) if they met any of the following exclusion criteria or there was uncertainty in meeting criteria: (a) did not involve an AAC intervention (including approaches to AAC that have been thoroughly discredited in the literature, e.g., facilitated communication and rapid prompting method, supported typing), (b) did not include at least one participant with I/DD with CCN or reported data on included participant(s) that could not be disaggregated from the excluded participants, (c) did not involve social-communicative or challenging behavior outcomes, (d) did not utilize a single-case experimental design(s) (SCED), and (e) was not available in English.

A total of 1758 articles were reviewed at the full-text level. Studies were included if they met all of the following criteria: (a) the study was in English; (b) included one or more participants with an intellectual disability (ID), developmental disability (DD, e.g., Angelman syndrome, cerebral palsy, autism, Down syndrome), other DD with co-occurring complex communication needs (e.g., minimally or non-verbal), mental retardation, severe and profound cognitive disability, Microcephaly, Apraxia, or dyspraxia who received instruction; (c) reported the results of an AAC intervention (AAC includes both unaided [e.g., sign language, sign system, gesture, manual sign] and aided systems [e.g., from low-, mid-, and high-tech applications] to supplement or

replace conventional speech for people CCN); (d) was a SCED; and (e) measured social-communicative or social-communicative and challenging behavior outcomes.

A total of 547 SCED articles met the full-text inclusion criteria for the comprehensive review and were evaluated for design quality standards. Design quality standards for SCED were based on WWC basic standards (U.S. Department of Education [USDE], 2017). Articles were retained if they met the following criteria: (a) a systematically manipulated independent variable, (b) measured and reported inter-observer agreement (IOA), (c) a minimum of 20% IOA collected across data in baseline and intervention separately, (d) at least 80% or .60 kappa IOA scores, (e) at least three attempted data points by phases changes measured, (f) at least three data points per baseline and intervention phases and at least four data per intervention phase for alternating treatment design. A total of 257 SCED articles met the design quality criteria and were reviewed for the current investigation's eligibility criteria, described below.

#### Current Investigation

After the initial inclusion/exclusion screening process was completed for the comprehensive review, additional screening was completed to identify eligible articles for the current investigation. In addition to the above eligibility criteria, studies needed to include one or more primary caregivers as the interventionist to be included in the present review. We defined primary caregivers as parents, other family members serving a primary caregiver role (e.g., grandparents), and foster parents. A total of 25 articles ($n = 72$ children) met the inclusion criteria for the current investigation.

### Data Extraction

Coding manuals were created prior to the data extraction phase and were used to make all coding decisions. Surveys were developed to extract relevant information from identified articles on (a) study characteristics (e.g., peer-reviewed vs. gray literature), (b) participant characteristics (e.g., age, race/ethnicity, gender, child communication mode prior to intervention), (c) implementation procedures (e.g., information sharing), and (e) dependent variables characteristics (e.g., child communicative function, type of caregiver-dependent variable) (see Table 1 for a description of coding variables and the data extraction source).

### Inter-rater Reliability

#### Comprehensive Review

Inter-rater reliability (IRR) was conducted for the various stages of the review: (a) title/abstract screening, (b) full-text review, and (c) data extraction. Raters were graduate students and PIs of the comprehensive review, all experienced in conducting systematic reviews, meta-analyses, and AAC research. Four raters reviewed 100% of documents for title/abstract and 30% of included documents for full-text and data extraction stages. Practice documents were randomly chosen for training with all raters until 80% agreement for each rater was reached for every stage. Discussion and retraining were conducted when agreement was below 80%. Each rater independently coded and then discussed any disagreements between two raters and arrived at a consensus agreement. Percentage agreement was the IRR metric, derived by dividing agreements by agreements + disagreements multiplied by 100. IRR scores on title/abstract, full-text stage, data extraction stages were 93%, 93%, and 92%, respectively.

#### Current Investigation

For the current review, IRR (percent agreement) was computed for 30% of the studies. All reliability was computed as agreements divided by agreements + disagreements multiplied by 100. Reliability was 96% for the title/abstract stage (across 30% studies), 89% for full-text screening (across 30% studies), and 91% for data extraction (across 30% studies). The first author resolved discrepancies.

## Results

Initial search procedures identified 7327 unique documents (duplicate title/abstracts removed), resulting in 25 studies that met inclusion criteria. From the studies, 72 children were included. Some studies trained more than one primary caregiver, yielding a total of 73 specified caregivers (the number of caregivers was not specified for three included children). All but one study were peer-reviewed (i.e., Chang, 2009 was a dissertation) and all studies were published between 1978 and 2017.

### RQ1: What Populations Have Been Represented in Research Focused on Caregiver-Implemented AAC Interventions Regarding Child and Caregiver Characteristics?

#### Caregiver and Child Characteristics

Table 2 describes caregiver characteristics for the included studies. Most caregivers being trained were mothers ($n = 59$; $k = 22$; note from here on out, $k$ refers to the number of studies, whereas $n$ refers to number of participants), followed by parent ($n = 8$; $k = 2$), father ($n = 6$; $k = 5$), and not specified ($n = 3$; $k = 1$). Caregiver age was not specified for 17

**Table 1** Coding definitions for data extraction process

| Category | Variable | Definition |
|---|---|---|
| Communication mode prior to intervention[a]: Mode of communication(s) for included children prior to AAC intervention. | Manual sign | An unaided system that relies on no equipment and instead rely on the learner's own body to produce communicative acts. An action that includes a specific handshape, location where the sign is produced and movement pattern that adheres to a sign language or sign system. |
| | Natural gestures | Natural gestures that may or may not include a facial expression (e.g., head shake yes or no), but excluding intelligible manual signs or sign approximations. |
| | Verbalizations | Intelligible words or word approximations. |
| | Vocalizations | Production of sound or sound combinations that are not intelligible word approximations (examples: sound- air passing that vibrates the vocal cords that can be heard. This excludes wheezing, snorting, grunting, and whistling.) |
| | Low-tech AAC | An application of a graphic communication mode that does not require electrical power or batteries to operate and do not have the capability to produce synthesized or digitized speech (e.g., graphic symbols housed in a wallet, a laminated card housing graphic symbols, a three-ring binder housing graphic symbols). |
| | Mid-high tech AAC | An application of a graphic communication mode. High tech applications involve the use of electrical or battery power. Typically, they permit the use of digitized and synthesized text to speech, environmental control and may support e-mail and computer access applications. Additionally, they allow unlimited vocabulary, encoding capability, prediction, a variety of access methods, and permit linking any symbol to any other symbol location displayed (e.g., Tobii Dynavox, Prentke Romich). |
| Intervention Fidelity data collection methods[b]: Methods and metrics that were used to collect and report caregiver intervention fidelity | Observation checklist | Intervention fidelity was collected and reported using an observation checklist that included a breakdown of the intervention procedures the caregiver was trained to implement. Caregiver implementation was observed and scored by a person other than the caregiver. |
| | Self-report | Intervention fidelity was collected and reported using a self-report by the caregiver. |
| | Rating scale | Intervention fidelity was collected and reported using a rating scale that captured the overall caregiver implementation performance. |
| | Frequency | Intervention fidelity was reported using a frequency count metric (e.g., percent implemented correctly) |
| | Rate | Intervention fidelity data were reported using a rate metric (e.g., rater per minute of a specific strategy being implemented) |

**Table 1** (continued)

| Category | Variable | Definition |
|---|---|---|
| Child Communicative function[a]: Function of child communication being taught in AAC intervention | Behavior regulation | Communicative act emitted to obtain or maintain access to an object, activity, or person; or to escape or avoid contact with an object, activity, or person (e.g., requesting a hug, asking to go for ice cream, protesting bath time, protesting the offer of a food item; requesting help; requesting a break). |
| | Joint attention | Communicative act emitted to direct a partner's attention to an object or event external to the communicative partners (e.g., providing requested information that is not in the context of an effort to increase turn-taking comment, naming objects in the environment, requesting information) |
| Information sharing[b]: Modalities used to share information about the intervention and deliver the intervention | Telehealth | Caregivers were taught through asynchronous and/or synchronous telehealth formats. |
| | In-person | Caregivers were taught in person. |
| | Print materials | Caregivers were taught through printed resources, such as e-mails and manuals. |
| | Web-based computer lessons or modules | Caregivers were taught via pre-recorded lessons accessed through web-based platforms. |
| Modeling[b]: Modalities used to demonstrate intervention strategies and behaviors | Live modeling | A coach provides the caregiver with a live demonstration of the behavior/strategy being taught. |
| | Video recordings | A coach provides the caregiver with a demonstration of the behavior/strategy being taught using video recordings. |
| Prompts[b]: Modality of cues used to elicit a specific caregiver behavior related to the intervention procedures | Oral prompts | Caregivers receive oral instruction to perform desired behaviors from the coach, in immediate proximity or live via distance through communication technology. |
| | Written prompts | Caregivers receive written instruction to perform desired behaviors from coach. Modalities can include e-mail and text messages. |
| | Graphics/visual prompts | Caregivers receive pictures, cartoons, gestures or other graphic signs that remind them to use the behaviors/strategies being taught. |
| | Audio prompts | Audio messages are delivered via signaling devices that remind learners to use the skill/behavior being taught. |

**Table 1** (continued)

| Category | Variable | Definition |
|---|---|---|
| Feedback[b]: Modality used to provide information on caregiver's implementation of intervention procedures. | Feedback is provided immediately | Caregivers receive feedback while they are performing the behaviors/strategies being taught. |
| | Feedback is delayed | Caregivers receive feedback after they have performed the behaviors/strategies being taught. Often is based on a recorded performance. |
| | Feedback is based on live performance | Feedback is provided by the coach based on a live performance. |
| | Feedback is based on recorded performance | Feedback is provided based on a recorded performance. |
| | Oral feedback | Coach delivers oral feedback to the caregiver. It can be delivered in person or electronically following observation of live or recorded performance; can be immediate or delayed. |
| | Written feedback | Coach delivers written feedback (e.g., graphs, reports) to caregiver in person or electronically following observation of live or recorded performance; can be immediate or delayed. |
| | Self-reflection | Caregiver reflects on their own performance and delivers written or oral evaluative information of the skill/task being taught following the performance of the skill/task. |

[a]Data extracted from the comprehensive review. [b]Data extracted for current investigation. Operational definitions for information sharing, modeling, prompts, and feedback were adapted from Biel et al. (2020)

**Table 2** Descriptive characteristics for caregiver participants

| Study (Child *n*) | Relationship to child (*n*) | Caregiver age | Caregiver race; ethnicity | Parental education; family income |
|---|---|---|---|---|
| Benson et al., 2017 (1) | Mother (1) | NS | NS; NS (1) | NS; NS |
| Casey, 1978 (4) | Mother (4) | NS | NS; NS (4) | NS (4); NS(4) |
| Chaabane et al., 2009 (2) | Mother (2) | 30–45 | NS; NS (2) | HSE (2); NS (4) |
| Chang, 2009 (6) | Parent (6) | NS | NS; NS (6) | NS (6); NS (6) |
| Douglas et al., 2017 (4) | Mother (4) | 34–41 | NS; Latinx/Hispanic/Spanish origin (1)<br>White; NS (2)<br>NS; NS (1) | Some college (2),<br>4-year college (2); NS (4) |
| Douglas et al., 2018 (3) | Mother (3) | 35–40 | African American/Black; NS (1)<br>White; NS (2) | 4-year college (2),<br>2-year college (1); NS (3) |
| Falcomata et al., 2013 (1) | Mother (1) | NS | NS; NS (1) | NS; NS |
| Falcomata et al., 2017 (1) | Mother (1) | NS | NS; NS (1) | NS; NS |
| Gerow et al., 2017 (2) | Mother (1)<br>Father (1) | 23–43 | NS; Latinx/Hispanic/Spanish origin (1)<br>White; NS (1) | Some college (1),<br>HSE (1); NS (2) |
| Kent-Walsh et al., 2010 (3) | Mother (3) | 32–45 | African American/Black; NS (2)<br>White; NS (1) | 4-year college (1),<br>2-year college (1),<br>HSE (1); NS (3) |
| Law et al., 2018 (3) | Mother (3) | NS | NS; NS (3) | 4-year college (1),<br>Post-secondary (2); NS (3) |
| Mancil et al., 2006 (1) | Mother (1) | NS | NS; NS (1) | NS; NS |
| Mancil et al., 2009 (3) | Mother (3) | NS | NS; NS (3) | Trained in ABA (1),<br>4-year college (1),<br>HSE (1); NS (3) |
| Olive et al., 2008 (1) | Mother (1) | NS | NS; NS | 4-year college; NS |
| Park et al., 2010 (3) | Mother (3) | 33–45 | White; NS (2)<br>Indian American; NS (1) | Masters (3); NS (3) |
| Schieltz et al., 2011 (10) | Mother (10) | NS | NS; NS (10) | NS (10); NS (10) |
| Schindler & Horner, 2005 (3) | NS | NS | NS; NS (3) | NS (3); NS (3) |
| Simacek et al., 2017 (3) | Mother (1)<br>Mother and father (2) | NS | NS; NS (3) | NS (3); NS (3) |
| Snodgrass & Meadan, 2018 (1) | Mother and father (1) | 36–45 | White; NS (2) | Bachelor (1), Associate (1); < $100,000 |
| Stiebel, 1999 (3) | Mother and father (1)<br>Mother (2) | NS | NS: NS (2) | NS (3); NS (3) |
| Tsami et al., 2019 (4) | Mother (4) | NS | NS; NS (4) | NS (4); NS (4) |
| Wacker et al., 2013 (3) | Mother (3) | NS | NS; NS (3) | NS (3); NS (3) |
| Waddington et al., 2017 (1) | Mother (1) | NS | NS; NS | NS; NS |
| Winborn-Kemmerer et al., 2010 (2) | Parent (2) | NS | NS; NS (2) | NS (2); NS (2) |
| Wright & Kaiser, 2017 (4) | Mother (3)<br>Father (1) | 30–46 | NS; NS (4) | 4-year college (3), Masters (1);<br>>100,000 (2),<br>70–75,000 (1), NS (1) |

*NS* not specified, *HSE* highschool or equivalent, *ABA* applied behavior analysis

studies ($n = 51$); for the eight included studies that reported caregiver age, the mean was 34.9 years (SD = 14.35, range: 23–46). Caregiver race and ethnicity were not specified for 19 studies. For the studies reporting caregiver race and ethnicity, information was not reported for each participant or only included partial information (e.g., reporting only race). Most caregivers were white ($n = 9$), followed by Black ($n = 3$) and Latinx/Hispanic/Spanish origin ($n = 2$). Data on parental education was reported for 11 studies, and family income information was reported for three studies (see Table 2 for further information).

Table 3 describes child characteristics for the included studies. Of the 72 included children, 58 were boys and 14 girls with a mean of 3.75 years old (45 months; SD = 1.72,

**Table 3** Descriptive characteristics for child participants

| Study (Child *n*) | Age (Boys *n*) | Race; ethnicity (*n*) | Diagnosis (*n*) | Communication mode prior to intervention (*n*) |
|---|---|---|---|---|
| Benson et al., 2017 (1) | 5yrs (1) | White; NS | Autism (1) | NS |
| Casey, 1978 (4) | 6–7yrs (3) | NS; NS (4) | Autism (4) | Manual sign (1); verbalizations (4) |
| Chaabane et al., 2009 (2) | 5–6yrs (2) | White; NS (2) | Autism (2) | Low tech (2) |
| Chang, 2009 (6) | 3–9yrs (6) | NS; NS (6) | Autism (6) | Natural gestures (5); verbalization (1) |
| Douglas et al., 2017 (4) | 3–4yrs (3) | NS; NS (1)<br>NS; Latinx/Hispanic/Spanish origin (1)<br>White; NS (2) | DS (2)<br>NSy (1)<br>CP/FAS (1) | Verbalizations (4); natural gestures (4) |
| Douglas et al., 2018 (3) | 4–5yrs (3) | African American/Black; NS (2)<br>White; NS (1) | Autism (2)<br>DD (1) | Nature gestures (3) |
| Falcomata et al., 2013 (1) | 2yrs (1) | NS | DD (1) | NS |
| Falcomata et al., 2017 (1) | 2yrs (1) | NS | Autism (1) | Vocalizations |
| Gerow et al., 2017 et al., (2) | 2yrs (2) | NS; Latinx/Hispanic/Spanish origin (1)<br>White; NS (1) | Autism (1)<br>NS (1) | Vocalizations (2) |
| Kent-Walsh et al., 2010 (3) | 4–5yrs (3) | African American/Black; NS (2)<br>White; NS (1) | DS (3) | Natural gestures (2); verbalizations (2); vocalizations (1); mid-to-high tech (3); manual signs (1) |
| Law et al., 2018 (3) | 2–4yrs (2) | Asian/Asian American; NS (3) | Autism (3) | Natural gestures (3); verbalizations (1) |
| Mancil et al., 2006 (1) | 4yrs (1) | NS; NS (1) | Autism (1) | Natural gestures |
| Mancil et al., 2009 (3) | 4–7yrs (3) | NS; NS (3) | Autism (3) | Natural gestures (3); verbalizations (3) |
| Olive et al., 2008 (1) | 4yrs (0) | White; NS | Autism (1) | Verbalizations |
| Park et al., 2010 (3) | 2yrs (3) | White; NS (2)<br>Native American; NS (1) | Autism (3) | NS (3) |
| Schieltz et al., 2011 (10) | 1–4yrs (8) | NS; NS (10) | Autism (3)<br>ID (3)<br>DD (3)<br>FS – X (1) | Low tech (1); natural gestures (2); verbalizations (1); manual sign (3); single words (3) |
| Schindler & Horner, 2005 (3) | 4–5yrs (2) | NS; NS (3) | Autism (3) | Natural gestures (1); verbalizations (2) |
| Simacek et al., 2017 (3) | 3–4yrs (0) | NS; NS (3) | Autism (2)<br>Rett (1) | Manual sign (2); vocalizations (2); low tech (1); mid-to-high tech (2) |
| Snodgrass & Meadan, 2018 (1) | 5yrs (1) | NS; NS | AS (1) | Natural gestures |
| Stiebel, 1999 (3) | 4–6yrs (3) | NS; NS (3) | Autism (3) | Natural gestures (3); verbalizations (1) |
| Tsami et al., 2019 (4) | 3–7 (3) | NS; NS (3) | Autism (4) | Verbalizations (1); NS (3) |
| Wacker et al., 2013 (3) | 1–3yrs (2) | NS; NS (3) | DD (1)<br>ID (2) | Verbalizations (3) |
| Waddington et al., 2017 (1) | 8yrs (1) | NS; NS | Autism | Low tech; mid-to-high tech |
| Winborn-Kemmerer et al., 2010 (2) | 3yrs (2) | NS; NS | DD (1)<br>DS (1) | Manual sign (1); verbalization (1) |
| Wright & Kaiser, 2017 (4) | 2yrs (2) | NS; NS | DS (4) | Manual sign (4); verbalizations (4) |

*AS* Angelman syndrome, *CP* cerebral palsy, *DD* developmental delay or developmental disability, *DS* Down syndrome, *FAS* fetal alcohol syndrome, *FS – X* fragile-X syndrome, *ID* intellectual disability, *NS* not specified, *NSy* Noonan's syndrome, *Rett* Rett syndrome

range: 1–9 years). Information on child race/ethnicity was reported for 9 studies ($n = 21$) but often only included partial information. Of those for whom these data were reported, 11 children were white, 4 were Black, 3 were Asian, 2 were of Latinx/Hispanic/Spanish origin, and 1 was Native American. Most children were on the autism spectrum ($n = 45$) and 27 were diagnosed with an I/DD other than autism (see Table 3 for a complete breakdown of child diagnoses).

**Table 4** Intervention characteristics

| Study (Child *n*) | Communication modality targeted in intervention (*n*) | Child communicative function | Instructional features | | |
|---|---|---|---|---|---|
| | | | Teaching opportunities initiated by | Type of teaching opportunities | Teaching opportunities activities |
| Benson et al., 2017 (1) | Low tech | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Casey, 1978 (4) | Manual sign (4) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Chaabane et al., 2009 (2) | Low tech (2) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Chang, 2009 (6) | Low tech (6) | Behavior regulation | Caregiver | Distributed across daily routines | Contrived activities |
| Douglas et al., 2017 (4) | Manual sign; mid-to-high tech (4) | Joint attention; behavior regulation | Child | Massed trial | Contrived activities |
| Douglas et al., 2018 (3) | Natural gestures; manual sign; mid-to-high tech (3) | Joint attention; behavior regulation | Caregiver | Massed trial | Embedded into functional activities |
| Falcomata et al., 2013 (1) | Manual sign; mid-to-high tech | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Falcomata et al., 2017 (1) | Manual sign; low tech; mid-to-high tech | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Gerow et al., 2017 (2) | Low tech (2); manual sign (2); vocalization (2); | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Kent-Walsh et al., 2010 (3) | Low tech; natural gestures; manual sign; verbalizations (3) | Joint attention | Caregiver | Massed trial | Contrived activities |
| Law et al., 2018 (3) | Natural gestures (2); Verbalizations (1) | Behavior regulation | Child | Distributed across daily routines | Embedded into functional activities |
| Mancil et al., 2006 (1) | Low tech | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Mancil et al., 2009 (3) | Low tech (3) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Olive et al., 2008 (1) | Mid-to-high tech | Joint attention | Caregiver | Massed trial | Contrived activities |
| Park et al., 2010 (3) | Low tech (3) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Schieltz et al., 2011 (10) | Low tech; mid-to-high tech (3) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Schindler & Horner, 2005 (3) | Gesture (2); low tech (1) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Simacek et al., 2017 (3) | Low tech (2); vocalizations (3); mid-to-high tech (1) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Snodgrass & Meadan, 2018 (1) | Natural gestures, mid-to-high tech | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Stiebel, 1999 (3) | Low tech (3) | Behavior regulation | Caregiver | Massed trial | Embedded into functional activities |
| Tsami et al., 2019 (4) | Low tech; verbalization (4) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Wacker et al., 2013 (3) | Manual sign; low tech; vocalization (3) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Waddington et al., 2017 (1) | Mid-to-high tech | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Winborn-Kemmerer et al., 2010 (2) | Manual sign; low tech (2) | Behavior regulation | Caregiver | Massed trial | Contrived activities |
| Wright & Kaiser, 2017 (4) | Manual sign; verbalizations (4) | Behavior regulation | Caregiver | Massed trial | Contrived activities |

### Child Communication Modalities

Child communication mode prior to intervention (see Table 3) was reported for 64 children and included the following (note these codes were not mutually exclusive and many children were multimodal communicators): verbalizations ($n = 29$; $k = 14$), natural gestures ($n = 26$; $k = 10$), manual sign ($n = 12$; $k = 6$), vocalizations ($n = 6$; $k = 3$), low-tech AAC ($n = 5$; $k = 3$), mid-to-high-tech AAC ($n = 4$; $k = 3$), and single words ($n = 3$; $k = 1$).

## RQ2: What Kind of AAC Interventions Have Caregivers Been Taught?

### Child Communicative Function and Instructional Features

Two communicative functions were targeted during interventions (see Table 4). Most studies ($k = 21$; $n = 61$) solely focused on behavioral regulation (e.g., requests), two studies ($n = 4$) focused on joint attention (directing a communicative partner's attention to an object or external event), and two studies ($n = 7$) targeted both behavior regulation and joint attention.

The current review examined three instructional features: (a) who initiated the teaching opportunities, (b) the type of teaching opportunities, and (c) the context of the teaching opportunities. The instructional features in most studies were grounded in behavioral approaches compared to developmental or NDBI approaches. Caregivers initiated teaching opportunities in 23 studies ($n = 65$) compared to only two studies in which teaching opportunities were child-initiated ($n = 7$). In these two studies, caregivers were responsive to child communicative overtures that, in turn, were capitalized to create teaching opportunities. In most studies ($k = 23$; $n = 63$), teaching opportunities were delivered through mass trials and were only distributed across the child's daily routines in two studies ($n = 9$). Lastly, teaching opportunities were embedded into contrived activities for 22 studies ($n = 63$), and for the remaining three studies ($n = 9$), teaching opportunities were embedded into functional activities.

### Target Communication Modality

Across the included studies, various AAC strategies were targeted. Sixteen studies included low-tech AAC strategies ($n = 39$), nine studies targeted mid-to-high tech AAC ($n = 16$), manual sign was targeted in nine studies ($n = 23$), and five targeted natural gestures ($n = 11$). Nine studies ($n = 29$) incorporated more than one communication mode into interventions. In addition, seven studies ($n = 20$) incorporated spoken language as a communication modality during the intervention: for 12 children, this included vocalizations and for eight children, this included verbalizations.

## RQ3: What Implementation Procedures Have Been Used to Train Caregivers to Implement AAC Interventions?

### Sharing Information

Various methods were used to share information with caregivers and deliver the AAC intervention (see Table 5). The most common form was in-person ($k = 17$; $n = 52$). Telepractice was used in six studies ($n = 18$). For three of these studies ($n = 8$), information sharing and coaching (specific strategies used are discussed below) were delivered synchronously (i.e., "live" connection between the family and a coach). For the other three studies ($n = 10$), parents completed web-based modules and lessons (i.e., asynchronously, such as store-and-forward feedback delivery) in addition to meeting with trainers synchronously. In addition, 13 studies ($n = 34$) also shared training information via printed materials (e.g., training manuals, instructions about upcoming sessions) Information sharing was unclear in two studies ($n = 2$).

### Modeling, Prompting, and Feedback Strategies

Information was also extracted on modeling, prompts, and feedback strategies used to coach and train parents (see Table 5). Seven studies did not indicate that any modeling was used to teach parents intervention strategies ($n = 41$). There was mention of modeling for five studies, but the mode of modeling used was unclear ($n = 11$). The most common mode was live modeling ($k = 8$; $n = 23$), and video recordings were used in four studies ($n = 17$). In addition, two studies ($n = 7$) used live modeling and video recordings to demonstrate target behaviors to caregivers.

Eight studies ($n = 20$) did not mention using prompts to guide and scaffold caregiver implementation; for two studies ($n = 2$), the prompting strategies used were unclear. Spoken prompts were the most common ($k = 11$; $n = 31$), written prompts were used in five studies ($n = 18$), two used graphic and visual prompts ($n = 7$), and one used audio prompts (i.e., a timer within a video recording system; $n = 10$).

Eight studies ($n = 25$) did not report the use of feedback strategies to train parents, and four studies ($n = 7$) mentioned feedback was used, but the timing of the feedback or what the feedback was based on was unclear. Of the studies that reported feedback timing, feedback delivered to caregivers

**Table 5** Implementation procedures

| Study (Child *n*) | Information sharing and delivery format | Modeling | Prompting | Feedback |
|---|---|---|---|---|
| Benson et al., 2017 (1) | Telehealth | - | Oral prompts | - |
| Casey, 1978 (4) | In-person | - | - | - |
| Chaabane et al., 2009 (2) | In-person; print materials | Modeling (unclear format) | - | Feedback (unclear format) |
| Chang, 2009 (6) | In-person | Live modeling | - | Feedback is provided immediately; feedback is based on live performance; oral feedback |
| Douglas et al., 2017 (4) | In-person; web-based computer lessons or modules (online); print materials | Video recordings | Oral prompts | Feedback is delayed; feedback is based on recorded and live performance; oral feedback; written feedback; self-reflection |
| Douglas et al., 2018 (3) | In-person; web-based computer lessons or modules (online); print materials | Video recordings | Oral prompts | Feedback is delayed; feedback is based on recorded and live performance; oral feedback; written feedback; self-reflection |
| Falcomata et al., 2013 (1) | Unclear | Unclear | Unclear | Unclear |
| Falcomata et al., 2017 (1) | Unclear | Unclear | Unclear | Unclear |
| Gerow et al., 2017 (2) | In-person; print materials | Live modeling | Oral prompts | Feedback is delayed; feedback is based on live performance; oral feedback; self-reflection |
| Kent-Walsh et al., 2010 (3) | In-person | Live modeling | - | - |
| Law et al., 2018 (3) | Telehealth; web-based computer lessons or modules (online) | Live remote modeling | Written prompts | Feedback is delayed; feedback is based on recorded performance; oral feedback |
| Mancil et al., 2006 (1) | In-person | - | - | - |
| Mancil et al., 2009 (3) | In-person; print materials | Video recordings | Written prompts | - |
| Olive et al., 2008 (1) | In-person; print materials | Live modeling | Oral prompts; graphic/visual prompts | Feedback is provided immediately; feedback is based on live performance; written feedback |
| Park et al., 2010 (3) | In-person; print materials | Live modeling; video recordings | Oral prompts; written prompts | Feedback is based on live performance; oral feedback |
| Schieltz et al., 2011 (10) | In-person | - | Audio prompts; | - |
| Schindler & Horner, 2005 (3) | In-person | - | Oral prompts | Feedback is delayed; feedback is based on live performance; oral feedback |
| Simacek et al., 2017 (3) | Telehealth; print materials; e-mails | Live remote modeling | Oral prompts; written prompts; graphic/visual prompts | Feedback is provided immediately; feedback is based on live performance; oral feedback |
| Snodgrass & Meadan, 2018 (1) | In-person | - | - | Feedback is delayed; feedback is based on live performance; oral feedback; self-reflection |
| Stiebel, 1999 (3) | In-person; print materials | Unclear | Oral prompts; written prompts | Unclear |

**Table 5** (continued)

| Study (Child *n*) | Information sharing and delivery format | Modeling | Prompting | Feedback |
|---|---|---|---|---|
| Tsami et al., 2019 (4) | Telehealth; | Unclear | Oral prompts | Feedback is provided immediately; feedback is delayed; feedback is based on live performance; oral feedback |
| Wacker et al., 2013 (3) | In-person; print materials | Live modeling | Written prompts; graphic/visual prompts | Feedback is provided immediately; feedback is based on live performance; oral feedback; feedback is delayed; written/graphic feedback |
| Waddington et al., 2017 (1) | In-person; print materials | Live modeling | - | - |
| Winborn-Kemmerer et al., 2010 (2) | In-person; print materials | - | - | - |
| Wright & Kaiser, 2017 (4) | In-person; print materials | Live modeling; video recordings | Oral prompts | Feedback is delayed; feedback is based on live performance; oral feedback |

was delayed in nine studies ($n = 20$) and immediate in five ($n = 17$). In 12 studies ($n = 37$), feedback was based on live performance; for three it was based on recorded caregiver performance ($n = 10$). The most common mode of feedback was oral ($k = 12$; $n = 21$), followed by self-reflection ($k = 4$; $n = 10$), and written feedback ($k = 3$; $n = 11$).

### RQ4: How Did Studies Evaluate Caregiver Implementation of AAC Interventions Being Taught?

Table 6 presents information on how studies evaluated caregiver implementation of AAC interventions. Most studies ($k = 16$; $n = 43$) did not include a dependent variable related to caregiver behavior. Six studies ($n = 18$) included caregiver behaviors as a primary dependent variable (e.g., frequency of communication opportunities [Douglas et al., 2017, 2018], caregiver use of systematic prompting [Snodgrass & Meadan, 2018], and caregiver use of EMT [Wright & Kaiser, 2017]). Three studies ($n = 12$) included caregiver behaviors as a secondary dependent variable (e.g., caregiver intervention fidelity [Chaabane et al., 2009]; and caregiver provided communication opportunities [Stiebel, 1999]). In addition, to dependent variables, we also examined if studies collected caregiver intervention fidelity. Fourteen studies collected and reported caregiver intervention fidelity ($n = 40$), and one study collected fidelity but did not report results ($n = 3$). Of the studies that did not include a caregiver-dependent variable, seven did not collect and report caregiver implementation fidelity ($n = 22$), and one study collected caregiver implementation fidelity but did not report results ($n = 3$). The most common methods to collect and report implementation fidelity were observation checklists, and results were presented in the percentage of correct implementation ($k = 13$; $n = 34$). Of the included 14 studies that included caregiver coaching, for five of the studies ($n = 18$), coaching was provided during all sessions measuring fidelity; for three ($n = 6$), it was for some sessions, and for the remaining six ($n = 16$), it was unclear. Studies varied in how they reported implementation fidelity results; some presented data individually for each caregiver, others combined across participants, as well as presenting fidelity for each condition, or across conditions (see Table 6 for results for each study). Overall implementation fidelity was high during intervention phases (mean range across studies: 40–99.6%).

## Discussion

This review aimed to better understand the nature of studies evaluating caregiver-implemented AAC interventions for children with I/DD. By examining the existing research base, we aimed to identify gaps in the research to guide future intervention studies and, in turn, improve child

**Table 6** Caregiver outcomes and intervention fidelity

| Study (Child *n*) | Caregiver DVs | Collected and reported caregiver intervention fidelity | Intervention fidelity data collection methods | Coaching during intervention fidelity | Caregiver intervention fidelity results |
|---|---|---|---|---|---|
| Benson et al., 2017 (1) | Neither | Yes | Observation checklist; frequency | Unclear | Individually; across conditions: M =88%, range: 84–92% |
| Casey, 1978 (4) | Neither | No | - | - | - |
| Chaabane et al., 2009 (2) | Secondary DV | Yes | Observation checklist; frequency | Unclear | Combined; across conditions: M = 97%, range: 88–100% |
| Chang, 2009 (6) | Secondary DV | Yes | Self-report & Rating Scale; frequency | Unclear | Individually; unclear |
| Douglas et al., 2017 (4) | Primary DV | No | - | - | - |
| Douglas et al., 2018 (3) | Primary DV | No | - | - | - |
| Falcomata et al., 2013 (1) | Neither | No | - | - | - |
| Falcomata et al., 2017 (1) | Neither | No | - | - | - |
| Gerow et al., 2017 (2) | Primary DV | Yes | Observation checklist; frequency | Some sessions | Individually; BL: 1) M's = 0%, INT: M's 69–70%, range: 0–100% |
| Kent-Walsh et al., 2010 (3) | Neither | No | - | - | - |
| Law et al., 2018 (3) | Primary DV | Yes | Observation checklist; frequency | No | Individually; BL: M's = 35–38.2%. INT: M's = 40–100%. |
| Mancil et al., 2006 (1) | Neither | No | - | - | - |
| Mancil et al., 2009 (3) | Neither | Yes | Observation checklist; frequency | Yes | Combined; BL & INT: M = 92.4%, range: 73–100% |
| Olive et al., 2008 (1) | Neither | Yes | Observation checklist; frequency | Some sessions | Individually; BL and INT; M = 95.9% |
| Park et al., 2010 (3) | Neither | Yes | Observation checklist; frequency | Yes | Individually; INT: M's = 99.6–96.7%, range: 96–100% |
| Schieltz et al., 2011 (10) | Neither | No | - | - | - |
| Schindler & Horner, 2005 (3) | Neither | Collected, did not report | Unclear | Yes | - |
| Simacek et al., 2017 (3) | Neither | Yes | Observation checklist; frequency | Yes | Individually; BL and INT: 93–96%, range: 71–100% |
| Snodgrass & Meadan, 2018 (1) | Primary DV | Yes | Observation checklist; rate (strategy use per min) | Unclear | Individually; unclear |
| Stiebel, 1999 (3) | Secondary DV | No | - | - | - |
| Tsami et al., 2019 (4) | Neither | Yes | Observation checklist; frequency | Yes | Combined; INT: M = 99%, range: 99–100% |
| Wacker et al., 2013 (3) | Neither | Yes | Observation checklist; frequency | Some sessions | Combined: INT: M =99%, range: 94–100% |
| Waddington et al., 2017 (1) | Neither | Yes | Observation checklist; frequency | Unclear | BL & INT: M = 98%, range: 86–100% |
| Winborn-Kemmerer et al., 2010 (2) | Neither | No | - | - | - |
| Wright & Kaiser, 2017 (4) | Primary DV | Yes | Observation checklist; frequency | Unclear | Combined; BL and INT: M = 90%, range: 71–100% |

*DV* dependent variable, *BL* baseline, *INT* intervention

AAC outcomes. Below, we summarize our major findings and provide calls for future research directions related to each research question.

### RQ1: What Populations Have Been Represented in Research Focused on Caregiver-Implemented AAC Interventions Regarding Child and Caregiver Characteristics?

Most studies included mothers as the interventionist; a very small number of the caregivers were identified as fathers or unspecified. Beyond identified caregiver gender, few studies included information related to parental age, education, and family income. While these findings reflect similar findings to other caregiver-implemented communication interventions (e.g., Finestack et al., 2022; Heidlage et al., 2020; Meadan et al., 2009), future AAC research should involve an inclusive range of caregivers. By including multiple caregivers (for those children who have multiple caregivers) in AAC interventions, we are increasing the number of communication partners that have the capacity to foster AAC acquisition.

Like other areas of autism research (e.g., Harris et al., 2020; Steinbrenner et al., 2022), parent-implemented language interventions (e.g., Akamoglu & Meadan, 2018; Finestack et al., 2022), and caregiver intervention research in general (e.g., Barton & Fettig, 2013), we found a prevalent trend of either not reporting participant race/ethnicity and/or underrepresentation of marginalized ethnic and racial populations. Few studies reported caregiver race and ethnicity. When looking at studies that reported race/ethnicity information, most caregivers identified as white, with few participants who were Black, Native American, and/or from Latinx origin. Compared to caregivers, child race/ethnicity was partially reported for a slightly higher number of studies; however, similar findings were revealed. Of the studies that reported child race/ethnicity, most children were white, with a small number of Asian, Black, Native American, and/or Latinx child participants. The underrepresentation of marginalized ethnic and racial populations in caregiver-implemented AAC research are downstream effects of longstanding systemic inequities in the US healthcare and education systems regarding access to equitable and timely diagnoses and services (e.g., Maenner et al., 2020; Magana et al., 2013; Pearson et al., 2020). Some possible strategies to address these inequities in future research include researchers increasing trust within the communities they want to work with through community-based rapport building (Steinbrenner et al., 2022), and include stakeholders in the design, implementation, *and* dissemination of research (e.g., Kerkhoff et al., 2022; McNulty et al., 2019). Researchers must consider access features that may serve as implicit exclusion criteria and work to eliminate them, such as location of research site, native language, availability of translation services, and cultural guides (Steinbrenner et al., 2022).

Most included children were identified as boys, while this reflects the higher prevalence of boys for many disabilities (e.g., autism [Maenner et al., 2020] and Down syndrome [Shin et al., 2009]), and the lack of girls in samples limits the generalizability of study findings on child outcomes. These findings highlight the need to over-recruit girls and others along the gender spectrum in caregiver-implemented AAC research to determine if current research needs to be tailored to the child's gender.

Only three studies did not report information on child communication modality before the intervention, with an additional study only partially providing information for all participants. Verbalizations and natural gestures were the highest reported communication modalities before intervention. These results are promising because they allow researchers to examine if communication modes used prior to intervention moderate child AAC outcomes. Towards that premise, Ganz et al. (2022) conducted a meta-analysis examining differences in outcomes based on prior communication mode for individuals with I/DD. They found larger effect sizes for participants who used manual sign or aided AAC modes compared to verbalizations, vocalizations, or natural gestures before the AAC intervention—suggesting that prior experience may predict future outcomes. Researchers should continue documenting child communication modality so that future synthesis can further evaluate optimal feature matching between children's communicative strengths and AAC strategies.

### RQ2: What Kind of AAC Interventions Have Caregivers Being Taught?

Almost all studies solely targeted behavioral regulation goals (e.g., requests). Of these studies, most were based on FCT procedures. While behavioral regulation is an important intervention target and having the means to communicate wants and needs through requesting affords people with autonomy, it is only one tiny facet of communicative competency. Future research should focus on how best to support caregivers in fostering their child's initiation and maintenance of interactions that involve a range of communicative functions (e.g., commenting, labeling, social greetings).

When considering instructional features, our findings revealed that most interventions used behavioral methods compared to developmental or NDBI approaches to teach AAC strategies to children, specifically, caregiver-initiated teaching opportunities, delivered through massed trials and embedded into contrived activities. Although these methods can be helpful to establish and increase AAC use, there is a need to investigate how to incorporate AAC into NDBIs

and developmental approaches to improve child AAC outcomes in areas that include maintenance and generalization. Naturalistic intervention approaches lend themselves to being blended into daily routines of families. Furthermore, by using daily routines as a teaching context, interventions are aligned with the child's and family's cultural, ethnic, social, and developmental assets, increasing the feasibility and sustainability of interventions.

The last component we examined were the communicative mode(s) targeted during AAC interventions. It was promising that about a third of the studies took a multimodal AAC approach vs. a unimodal one. We are all multimodal communicators, using different modes based on our circumstances and environment. With that premise in mind, children acquiring AAC will likely benefit from learning more than one modality. For example, an SGD may not be a feasible modality during bath time, while gestures and non-verbal communication would. Furthermore, for some children, speech may still be a viable modality in specific settings and with familiar communicative partners. Consequently, incorporating speech as a modality for these children could effectively increase their overall communicative competency. More research is needed to investigate multimodal AAC interventions explicitly (e.g., Liao et al., 2022) to determine if and how they can increase overall communicative competency for children who use AAC, as well as understanding caregiver perspectives on implementing multimodal AAC interventions (e.g., Faldt et al., 2020).

## RQ3: What Implementation Procedures Have Been Used to Train Caregivers to Implement AAC Interventions?

To address research question three, we adapted Biel et al.' (2020) conceptual framework for characterizing the implementation procedures used to train caregivers to implement AAC interventions. We found similar reporting practices to those reported by Biel et al. (2020). The most common teaching function reported was information sharing, followed by modeling. All but two studies reported on how information was shared with parents. Information about feedback and prompting/guiding/scaffolding was included in about two-thirds of studies for both functions. The latter finding was inconsistent with Biel et al. (2020) findings, which found that information regarding prompting/guiding/scaffolding was only used in 18% of included studies. Only about one-third of the studies included components of all four teaching functions and included descriptions of the specific strategies utilized. Incorporating all teaching functions is likely to yield better outcomes, as combining teaching strategies increase mastery and generalization in adult learners (Trivette et al., 2009).

Consistent with other literature syntheses of coaching strategies used in early interventions, there is a need for more detailed descriptions of the implementation procedures, moving beyond broad terms like "coaching" and "feedback" (e.g., Barton & Fettig, 2013; Biel et al., 2020). It is possible that more studies included all four teaching functions but failed to describe implementation procedures in detail. Researchers disseminating caregiver-implemented ACC interventions should describe their implementation procedures in detail, and a possible framework to aid in this is Biel et al. (2020) conceptual framework. An increase in detailed reporting will allow researchers to conduct reviews to identify feasible and effective implementation strategies and increase the reproducibility and replicability of caregiver-implemented AAC intervention studies. In addition, primary research can leverage principles of implementation science and include caregivers in the initial design of interventions (e.g., Quinn et al., 2022) or elicit feedback from established interventions (e.g., Faldt et al., 2020).

## RQ4: How Did Studies Evaluate Caregiver Implementation of AAC Intervention Being Taught?

We found that around two-thirds of studies did not include primary or secondary dependent variables addressing caregiver behaviors, 15 collected caregiver implementation fidelity, and 14 reported implementation fidelity data. However, seven studies did not report collecting any caregiver outcomes. Even though the end goal of caregiver-implemented AAC interventions is improving child communication, it is important to understand the mechanisms driving that change. Therefore, we recommend that all future studies evaluating caregiver-implemented AAC interventions include measures of caregiver implementation. It was encouraging to see that over half of the studies collected information on caregiver intervention fidelity. However, when we examined whether caregivers received coaching during these sessions, we found that coaching was provided in five studies. In some studies, caregivers received coaching during some sessions; however, fidelity data were not disaggregated by interventionist or caregiver. These findings limit our ability to determine whether these interventions are feasible to implement without coaching. To determine if interventions are feasible and sustainable for caregivers, we recommend that researchers incorporate ways to assess caregiver implementation fidelity into their single-case designs when they are not actively receiving coaching. For example, incorporating probe sessions into multiple baseline designs (Ledford, 2018) or utilizing designs such as repeated acquisition design (RAD; Kirby et al., 2021). Furthermore, included studies in this review focused on immediate outcomes, the impact of caregiver-implemented intervention

on distal caregiver and child outcomes remains largely unknown, and warrants future research.

## Study Limitations

This study is not without its limitations. Included studies were identified from a larger comprehensive AAC review that all met specific methodological quality criteria; inclusion of all studies regardless of quality indicators may have provided a more complete description of the current research base on caregiver-implemented AAC interventions. Additionally, only studies published in English were included in the review due to personal resource restraints. Again, including studies in other languages may have provided a more comprehensive overview of the literature base and allowed for examination of potential differences across a diverse set of countries, cultures, and languages. Finally, we did not examine child outcomes; our primary goal was to describe the type of interventions caregivers were being taught to implement, how they were being coached, and how studies evaluated caregiver outcomes. Overall child outcomes in relation to AAC intervention for children with I/DD are reported in the comprehensive meta-analysis from which this review was derived (i.e., Ganz et al., 2022). However, future caregiver-implemented AAC reviews should examine the relation between caregiver and child outcomes and start to identify if there are certain types of interventions that have a greater impact on child outcomes.

## Conclusions

This was the first systematic review that evaluated caregiver-implemented AAC interventions for children with I/DD. Our review highlights important gaps in the current research base that should be addressed, specifically increasing the diversity of included participants, greater detailed reporting of implementation procedures, and measuring caregiver implementation fidelity. This will ultimately allow us to identify the most feasible and sustainable interventions for caregivers to implement while also having the most significant impact on improving child AAC use and overall communication outcomes.

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## Declarations

**Conflict of Interest** The authors declare no competing interests.

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