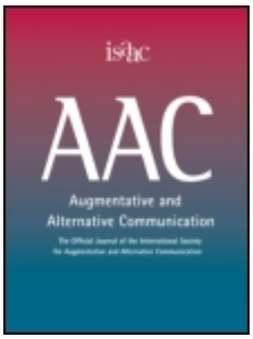

Augmentative and Alternative Communication

ISSN: 0743-4618 (Print) 1477-3848 (Online) Journal homepage: informahealthcare.com/journals/iaac20

The Use of Augmentative and Alternative Communication Methods with Infants and Toddlers with Disabilities: A Research Review

Diane Branson & Maryann Demchak

To cite this article: Diane Branson & Maryann Demchak (2009) The Use of Augmentative and Alternative Communication Methods with Infants and Toddlers with Disabilities: A Research Review, Augmentative and Alternative Communication, 25:4, 274-286, DOI: 10.3109/07434610903384529

To link to this article: https://doi.org/10.3109/07434610903384529

Published online: 03 Nov 2009.

Augmentative and Alternative Communication, December 2009 VOL. 25 (4), pp. 274–286

informa
healthcare

The Use of Augmentative and Alternative Communication Methods with Infants and Toddlers with Disabilities: A Research Review

DIANE BRANSON* and MARYANN DEMCHAK

University of Nevada, Reno; Reno, Nevada, USA

This review sought to determine the evidence base of augmentative and alternative communication (AAC) use with infants and toddlers with disabilities. The review identified 12 studies, involving 190 participants aged 36 months or younger. The majority of the studies investigated unaided AAC methods (e.g., gestures or sign language), with 42% of the studies also including aided AAC methods. Although all studies reported improvement in child communication following AAC intervention, in-depth analyses of study methodology indicated that only 7 out of 12 provided conclusive evidence. Implications for early intervention AAC practice and suggestions for future research are proposed.

Keywords: Augmentative and alternative communication; Developmental disabilities; Intervention; Research synthesis; Effectiveness

INTRODUCTION

Augmentative and alternative communication (AAC) interventions are methods and technology used to compensate for an individual's reduced communicative competence (Light, 1989) and can be temporary or permanent (American Speech-Language-Hearing Association, 1991). According to von Tetzchner and Martinsen (1992), individuals who might benefit from AAC fall into three groups: (a) the expressive language group, in which individuals understand others' spoken language but have difficulty expressing themselves; (b) the supportive language group, comprised of two subgroups that include children who temporarily use AAC in order to facilitate understanding of spoken language as well to express themselves or children who speak but have difficulty being understood; and (c) the alternative language group, in which AAC is a permanent means of receptive and expressive communication. AAC encompasses a variety of communication forms ranging from natural gestures, manual signs, and picture communication boards, to sophisticated voice output or speech generating devices.

Infants and toddlers with developmental delays could fall into any of the three groups described by von Tetzchner and Martinsen (1992). It is important to focus on AAC use with infants and toddlers because there is evidence that a child's early learning experiences during the first 3 years of life lay the foundation for later brain development (National Scientific Council on the Developing Child, 2007). Interactions between a child and his or her caregiver provide those critical experiences (Sameroff & Fiese, 2000), but they may be lacking or insufficient if the caregiver is unable to recognize and respond to the child's subtle communication behaviors. Early access to AAC methods can assist a child in using intentional communication behaviors by making those behaviors recognizable to his or her caregiver who, in turn, can respond to and reinforce those early communication behaviors

*Corresponding author. University of Nevada, Reno; Reno, Nevada 89957, USA. Tel: +1 775 772 3557. Fax: +1 775 688 2984. E-mail: dmbranson@aol.com

ISSN 0743-4618 print/ISSN 1477-3848 online
DOI: 10.3109/07434610903384529

that lead to further development (Cress & Marvin, 2003).

It is clear that AAC use with infants and toddlers can be a critical component in early intervention; however, the majority of AAC research to date has focused on older individuals (Charlop-Christy, Carpenter, Loc, LeBlanc, & Kellet, 2002; Goldstein, 2002), which cannot be seamlessly applied to children under the age of 3 years. Literature specifically addressing AAC use with infants and toddlers is limited and consists primarily of position papers prepared by experts in the field (e.g., Cress & Marvin, 2003; Romski & Sevcik, 2005), rather than empirical research. Evidence-based practice (EBP) has been applied to the field of AAC as a means of ensuring that research evidence is considered by clinical practitioners who make practice-related decisions on a daily basis (Raghavendra, 2000; Schlosser, 2003; Schlosser, Koul, & Costello, 2007; Schlosser & Raghavendra, 2004; Schlosser, Wendt, Angermeier, & Shetty, 2005). The purpose of this paper is to review existing research focusing on use of AAC with infants and toddlers. The review is systematic rather than narrative, emphasizing the rigor of the investigations and the resulting effect sizes, in order to evaluate the current evidence base for the use of AAC with infants and toddlers.

METHOD

Search Strategy

Three techniques were used to locate appropriate articles: (a) computerized searches of abstract databases, (b) hand searches of pertinent journals, and (c) ancestral searches of references cited. Computerized searches of PsychINFO, Education Resources Information Center (ERIC), MEDLINE, Dissertation Abstracts and Cumulative Index of Nursing and Allied Health Literatures (CINAHL) were implemented using the following key words: ''augmentative and alternative communication,'' ''nonvocal,'' ''nonspeaking,'' and ''early intervention.'' Next, hand searches or electronic searches of the tables of contents of 18 journals were performed (see Appendix A). Ancestral search, the use of other authors' references in published articles and books on the topic, was the final technique used to locate pertinent studies (White, 1994).

Inclusion Criteria

Studies met the following inclusion criteria: (a) conducted between 1982 and 2007; (b) involved children birth to 3 years of age and/or the child's communication partner; (c) involved individuals with developmental disabilities with significant communication delays (i.e., speech was not adequate to meet communication needs); and (d) included data on the implementation of either unaided (no external device required, such as the use of natural gestures) or aided (external aid of some sort used, such as pictures or speech generating device) AAC methods because the variable of interest was child AAC use.

Data Extraction

Both authors independently read and analyzed each identified study using a 3-step process described by Sigafoos et al. (2008). First, they determined whether a study met all of the inclusion criteria described above. Next, studies meeting the inclusion criteria were further analyzed for methodological details based on categories used by Schlosser and Lee (2000): (a) study identification; (b) goal of the study; (c) number of participants; (d) participants' age; (e) participants' gender; (f) participants' disability classification (e.g., developmental delay, speech and language delay, autism); (g) target of intervention (i.e., child with disability, communication partner, or both); (h) study design (e.g., alternating-treatments design, multiple-baseline design, randomized control group); (i) setting (e.g., home, childcare, clinic); (j) type of AAC; (k) treatment integrity measure (e.g., 20% of videotaped sessions were coded for adherence to treatment protocol); and (l) percentage of nonoverlapping data (PND) for single-subject experimental designs (Scruggs, Mastropieri, & Casto, 1987; Scruggs, Mastropieri, Cook, & Escobar, 1986) or effect size for group designs. Appendix B lists the operational definitions for the coding categories.

The final step in reviewing the evidence was appraisal of certainty of evidence (Slavin, 1986). This was done by examining the methodological rigor of each included study as indicated by the research design used and other methodological details suggested by Sigafoos and colleagues (2008), including: (a) a convincing demonstration of treatment effects claimed, (b) adequate interobserver reliability data (i.e., 20% of the sessions with 80% agreement or better), (c) operationally defined dependent and independent variables, and (d) study procedures described sufficiently to allow for replication (i.e., measures of treatment integrity provided). Studies were rated as either *conclusive* (i.e., the design provided experimental control, the dependent variable was reliable, and treatment integrity was solid, providing

conclusive evidence that the AAC implementation was effective); or *inconclusive* (i.e., the study did not use a recognized experimental design or there were numerous methodological flaws that reduced the certainty of the evidence presented in the study regarding the effectiveness of the AAC intervention). The initial search yielded 42 papers or studies that focused on AAC use with infants and toddlers; 30 were excluded for the following reasons: (a) studies did not implement AAC methods, such as narrative research reviews (Mirenda, 2003) and survey studies (Dugan, Campbell, & Wilcox, 2006); (b) data were not collected on the AAC method implemented, but rather on the effect on spoken words (Yoder & Stone, 2006); or (c) the study did not include children with developmental disabilities (as per the Drager, Light, Speltz, Fallon, & Jeffries (2003) study of how typically developing 2 ½-year-olds respond to different dynamic display AAC technologies). Methodological rigor of the included studies was of primary interest; however, it should be clarified that lack of rigor was not a factor in exclusion (a list of the excluded studies is available upon request from the first author).

Interrater Agreement

The authors independently screened these 42 papers using an inclusion/exclusion checklist. Interrater agreement for determining papers to be included and excluded was 100% and resulted in 12 studies meeting inclusion criteria. Subsequently, the authors independently coded each article included according to the operational definitions discussed earlier and presented in Appendix B. A point-by-point analysis of interrater agreement showed over 98% agreement. There was only one point of disagreement, in which one author omitted a measure pertaining to treatment integrity. Subsequent review of the original article and discussion of the omitted measure resulted in rectifying the one disagreement and a corrected interrater agreement result of 100%.

Measures of Effect Size and Percentage of Nonoverlapping Data

Quantitative analysis of outcomes reported in the group design studies was based on reported effect size (ES). Effect size is a statistical measure that goes beyond answering the question of the probability of a difference in the means of two or more groups. Effect size gives information about the size of the difference, which can help determine the importance of the findings of a study. Cohen's d is a common statistic for determining effect size (Sprinthall, 2003) of group designs, with effect size interpreted as small (.20), medium (.50), or large (.80) (Cohen, 1969).

The effectiveness measure for single-subject data is the Percentage of Non-overlapping Data (PND), which is calculated by identifying the highest data point in baseline and determining the percentage of data points during intervention that exceed this point (Scruggs et al., 1986). Scruggs et al., (1987) recommend that PND scores be interpreted as follows: (a) PND $< 50\%$ reflect ineffective treatment, (b) PND 50%–70% reflect questionable effectiveness, (c) PND 70%–90% reflect fairly effective, and (d) PND $> 90\%$ reflect a highly effective treatment.

RESULTS

Seven single-subject studies involving a total of 32 participants and five group design studies involving a total of 158 participants met inclusion criteria. Table 1 provides a summary of the dependent variable(s) and effect size, and an appraisal of the study's certainty of evidence. Further information about the studies can found in Appendix C.

Participants

The studies involved a total of 190 participants who were 36 months of age or younger. The number of participants in each individual study varied from 1 to 58. It is important to note that some studies included other participants who were not included in this review because the participant age was over 36 months and/or AAC use was not targeted for the participant (Studies 1, 6, 7, 10).

Most of the participants ($n = 99$, 52%) had either unspecified developmental delays or one of a wide variety of identified etiologies (e.g., agenesis of the corpus callosum, Trisomy 8, mitochondrial disorder), 32 had Down syndrome, 28 had multiple disabilities (e.g., cerebral palsy plus sensory impairments), 26 had an autism spectrum disorder, and 5 had cerebral palsy. Two of the studies also focused on the communication partners of children with complex communication needs: 4 mothers in one case study (Study 7) and 25 caregivers in a pre-experimental study (Study 2).

Overall, participant ages ranged from 8 months to 36 months; however, age information is not

TABLE 1 Summary of Experimental Studies of AAC use in Early Intervention: Study Number, Authors, and Year of Publication; Dependent Variable (DV); Effect Size Statistic (and its Interpretation shown in Parenthesis); Appraisal of the Study (see Appendix C for Details Concerning Study Participants, Method, and Findings).

Study	Dependent variable	Effect size	Appraisal
1. Anderson (2001)	Requesting toys/foods using PECS	PND 60 (Q)	Conclusive
	Requesting toys/food using signs	PND 0 (I)	
2. Chen et al. (2007)	Unaided: Vocalizations and body movements; caregiver use of cues; child use of intentional communication acts	Effect size measure not possible	Inconclusive
3. DiCarlo et al. (2001)	Intervals with sign	PND 33 (I)	Inconclusive
	Frequency of sign	PND 29 (I)	
4. Fey et al. (2006)	Rate of intentional communicative acts (i.e., requesting, commenting, and total rate of intentional acts)	Cohen's $d = 0.40$–0.68 (medium)	Conclusive
5. Iacono & Duncum (1995)	Total number of words produced: sign only	PND 0 (I)	Conclusive
	Total number of words produced: sign + VOCA	PND 66 (Q)	
	Number of different words: sign only	PND 0 (I)	
	Number of different words: sign + VOCA	PND 83 (F)	
6. Kouri (1988)	Frequency of spontaneous signs (label, request, protest, play)	PND 42 (I)	Conclusive
	Frequency responsive signs (e.g., for "What do you want?")	PND 60 (Q)	
	Frequency of informal meaningful gestures or to augment a linguistic form	PND 86 (F)	
7. Pennington & McConachie (1999)	Child's use of different communicative functions and modes for expressive communication in conversational exchanges	Effect size measure not possible	Inconclusive
8. Salmon et al. (1998)	Initiations and responsive requests and comments	PND measure not possible	Inconclusive
9. Stahmer & Ingersoll (2004)	Various measures, including functional communication emphasizing requesting, labeling, and information sharing	Effect size measure not possible	Inconclusive
10. Tait et al. (2004)	Request "more"	PND = 96 (H)	Conclusive
	Choice making	PND = 70 (F)	
	Protest	PND = 94 (H)	
	Request "help"	PND = 100 (H)	
11. Warren, Yoder, Gazdag, Kim, & Jones (1993)	Experiment 1		Conclusive
	Requests	PND = 92 (H)	
	Comments	PND = 100 (H)	
	Experiment 2		
	Requests	PND = 96 (H)	
	Comments	PND = 93 (H)	
12. Yoder & Warren (1998)	Rate of intentional communication acts of requesting and focusing joint attention	Cohen's $d = .5$–$.55$ (Medium)	Conclusive

Note. Percentage of Non-overlapping Data (PND) is interpreted as follows I = ineffective (< 50); Q = questionable (50–70); F = fairly effective (70–90); H = highly effective (> 90) (Scruggs et al., 1986). PECS, Picture Exchange Communication System; PDD, Pervasive Developmental Disorders; VOCA, Voice Output Communication Aid.

available for each individual participant because some studies reported age for groups rather than for individual children (Studies 2, 3, 4, 9, and 12). Age specific data are available only for 24 (13 %) of the 190 participants (12 girls, 12 boys). They ranged from 16–36 months of age, with a mean age of 28.5 months. The majority of the individuals for whom specific ages were available were 31 months of age or older ($n = 11$; 46%), with the second largest group being 25–30 months of age ($n = 6$, 25%), followed by 21% in the 19–24 months old ($n = 5$), and the fewest participants 18 months or less in age ($n = 2$, 8%).

Types of AAC

The types of AAC used included manual signs, line drawings (from Board Builder,[TM1] Picture Communication Symbols[TM2] Blissymbols[3], and Makaton[TM4]); photographs; voice output communication aid (VOCA); gestures (e.g., head nods, head shakes, hand claps, shoulder shrugs); eye gaze shift from referent to communication partner; vocalizations; and body movements. Six studies addressed only unaided AAC strategies (Studies 2, 4, 6, 8, 11, and 12). Two studies focused on comparing an aided AAC method to

an unaided AAC method (Studies 1 and 5); Study 5's recommendation was ultimately for multimodal AAC (i.e., signs plus VOCA). A single study (Study 7) focused on only aided AAC. Those studies that addressed aided AAC most often used line drawings (Studies 1, 7, 9, 10); while only two studies included the use of a VOCA (Studies 3 and 5), with one of those (Study 3) reporting negligible use of the VOCA because it was present but not formally targeted. Only one study reported using photographs as an aided AAC strategy (Study 10). The majority of the 190 participants ($n = 144$, 76%) were involved in studies that targeted unaided AAC (e.g., signs, gestures, vocalizations, body movements, eye gaze shifts).

Intervention procedures

A wide variety of intervention procedures were used across the studies, primarily in the form of intervention packages to teach specific targeted skills. In Studies 1, 3, 4, 5, 6, 8, 10, 11, and 12, the intervention targeted child behavior. Studies 2 and 7 indirectly targeted the children in that the primary focus was on training caregivers and parents to encourage either more intentional communicative acts (Study 2) or different functions and modes within conversational exchanges (Study 7). Study 9 was actually an evaluation of an inclusive preschool program for children with ASD. This study was included in the review because the authors included measures pertaining to functional communication of the participants.

Design

A slight majority of the included studies used some variation of a single subject design ($n = 7$, 58%). Three of these studies used an alternating treatment design (Studies 1, 5, 8); three used a type of the multiple baseline design (Studies 3, 10, 11); and one used an ABAB withdrawal design (Study 6).

Group studies consisted of two pre-experimental designs (Studies 2 and 9) to evaluate the effectiveness of specific curricula on children's communicative behaviors, and two randomized control group studies (Studies 4 and 12) that evaluated the use of Prelinguistic Milieu Treatment on children's rate of intentional communication. One study (Study 7) investigated the effect of a semiscripted elicited conversation intervention on a range of child communicative functions using a case study design.

Targeted skills

A variety of communication skills were targeted within the 12 studies: 4 (Studies 2, 4, 9, and 12) targeted increasing intentional communication acts; with 3 of those (Studies 2, 4, and 12) focusing on prelinguistic, unaided AAC such as vocalizations, body movements, and gestures; and 1 (Study 9) focused on increasing participants' use of symbolic communication through PECS or signs. Four other studies (Studies 5–8 targeted increasing spontaneous and responsive communicative acts in an interactive or "conversational" manner, and all focused on using more symbolic AAC such as conventional gestures, signs, various line drawing symbols, and VOCAs. Two studies (Studies 1 and 3) targeted only requesting, with one of these studies comparing the use of PECS to signs (Study 1) and the other (Study 3), evaluating the use of signs. The remaining two studies (Studies 10 and 11) targeted multiple functions (i.e., requesting, choice making, protesting, and/or commenting).

Outcomes

Column 3 of Table 1 provides the effect size statistic for group designs and the percentage of nonoverlapping data (PND) for single subject designs, along with an interpretation of both effect size and PND. Two of the group design studies provided an effect size measure (Studies 4 and 12), both of which were indicative of a medium effect. Six (Studies 1, 3, 5, 6, 10, and 11) of the seven single subject designs presented data in a manner that allowed PND to be calculated, while one single subject design study did not (Study 8). From these six studies, 19 PND values were calculated due to studies with multiple measures. Studies 10 and 11 were the only two studies to yield PND values (7 PND values, 37%) in the highly effective range (i.e., greater than 90). Three PND values (16%) were classified in the fairly effective range (i.e., 70–90%); 3 PND values (16%) were classified as being in the questionable effectiveness range (i.e., 50–70%), and 6 of the 19 measures (31%) were classified as ineffective (i.e., below 50). These values show that a slight majority of interventions were determined to be highly or fairly effective (i.e., 10 PND values, 53%).

Appraisal of evidence

The appraisal of evidence was determined to be conclusive for seven of the studies (58%) (Studies

1, 4, 5, 6, 10, 11, and 12), including 5 single-subject case designs (Studies 1, 5, 6, 10, and 11) and 2 group designs (Studies 4 and 12). For the remaining 5 studies the appraisal of evidence resulted in ratings of inconclusive. The reasons for inconclusive ratings included pre-experimental design (Study 2), case study (Study 7), and quasi-experimental design (Study 9), lack of treatment integrity measures (Study 3 and 8), and lack of baseline data (Study 8).

Four studies appraised as providing conclusive evidence of a positive intervention effect were linked to 10 of the highly or fairly effective PND values (Studies 5, 6, 10, and 11). One study (Study 1) appraised as conclusive, given sound design, inter-observer agreement and treatment integrity ratings, actually yielded PND values that were ineffective or questionable. The certainty of evidence for Study 3 was inconclusive, with PND values calculated to be in the ineffective range. Two studies (Studies 5 and 6) were rated as being conclusive, with at least one PND value as fairly or highly effective; however, each study also had more than one PND value in the ineffective or questionable range.

DISCUSSION

The purpose of this systematic review was to examine existing research focusing on AAC use with infants and toddlers in order to identify the evidence base and to recognize gaps in the research literature. The reviewed studies reported the following outcomes of AAC use with infants and toddlers: (a) improved communication was reported for 97% of the 190 total participants, but only 71% of those participants were enrolled in a study judged as providing conclusive evidence; (b) communication partners were successfully taught to create more communicative opportunities for their child and to increase their child's use of intentional communication acts by responding contingently; (c) a variety of AAC systems was used successfully with children 36 months of age and younger; and (d) children with various disabilities were taught to use AAC methods to improve communication.

The outcomes reported from the 12 included studies provide support for the use of AAC with infants and toddlers, but the certainty of evidence was inconclusive for 5 out of the 12 studies. Of the 7 studies that were rated as providing conclusive evidence, four used unaided AAC (gestures or manual signs), one used unaided (signs) or aided (pictures, graphic symbols) depending on the age of the participant, one compared manual signs with the PECS, and one compared manual signs alone with manual signs paired with a VOCA. While these studies demonstrate that infants and toddlers can learn to use low-technology (with the exception of the one study using a VOCA) AAC methods to communicate a variety of early developing communication skills (e.g., requesting, commenting, choice making, and protesting), the available research leaves a number of unanswered questions about AAC use with infants and toddlers.

One of the unanswered questions of great interest to clinicians and parents is the comparative effectiveness of various types of AAC methods for children with specific disabilities. Only two of the studies compared AAC methods. Anderson (2001), in her unpublished dissertation, compared an aided and an unaided AAC method (PECS and sign language) with 5 children with autism who were 27 and 36 months old, and found that (a) the children learned to use PECS faster than sign language, and (b) more of the children who used PECS were able to generalize this use to novel items compared to those who used sign language. Iacono and Duncum (1995) compared manual signs alone with manual signs plus a VOCA on the total number of words and the total number of different words produced by a 32-month-old girl with Down syndrome. The child in this study produced both more words and a larger variety of words in the sign plus VOCA condition than in the sign alone condition.

While two studies alone do not provide adequate evidence to draw definitive conclusions about the superiority of aided or unaided AAC, they provide fodder for discussion of the potential benefits of aided systems for young children. The advantage shown by aided (PECS & VOCA) over unaided AAC (gestures, eye gaze, sign language) demonstrated in the studies discussed previously may be related to the relative transparency and concreteness of the symbols used in each study. Pictures may be easier than manual signs to learn for very young children for several reasons. First, pictures more closely resemble their referents than manual signs, making them easier to understand. Second, pointing to or reaching for a picture to make a request involves less physical effort and motor planning than executing a manual sign, and third, pictures are stationary reducing recall memory load (Mirenda, 2003). Additional evidence-based studies comparing AAC methods with children with specific disabilities are needed before any conclusions can be drawn.

Limited use of AAC with infants and toddlers has been attributed to myths about the age at

which AAC should begin with young children (Romski & Sevcik, 2005). It is difficult to predict at a young age whether or not a particular child will be able to use speech as a primary form of communication. Even for children for whom speech is unlikely to be adequate to support their communication needs (e.g., children with significant neuromotor impairments), clinicians are hesitant to label that child as "nonspeaking" prior to age 3 years old (Cress & Marvin, 2003), and thus would not be reported as using AAC. Cress and Marvin recommend that AAC be introduced as soon as it is apparent that a child's communicative signals are difficult to interpret. A common thread through all of the studies reviewed was the focus on improving intentional communication acts in various forms. Chen, Klein, and Haney's (2007) study provided evidence that it is important to assist caregivers in identifying and responding to infants' communicative signals at a very early age. These authors conducted a field study of the Promoting Learning through Active Interaction (PLAI) curriculum, and demonstrated that caregivers could be taught to recognize and encourage infants' preintentional communicative signals as early as 8 months of age. They suggest that it is better to strengthen infants' communicative behaviors as soon as possible, rather than waiting for failure.

None of the studies reviewed supported the idea of a minimum age requirement for introducing AAC; however, age did appear to influence the choice of AAC system implemented. Studies that included children under the age of 2 years old tended to use unaided (e.g., gestures, eye gaze, and sign language) rather than aided methods. Some studies used unaided or aided AAC methods depending on the children's age level. For example, Tait, Sigafoos, Woodyatts, O'Reilly, and Lancioni (2004) targeted a presymbolic communicative act with the youngest child (16 months old) in their study. The goal of the intervention was for the child to use joint attention skills to request "more" (i.e., look at the toy, then look at her mother, and then look back at the toy). In contrast, the goals for the 26- and 31-month-olds in the study were to point at a picture to make a choice, and to produce signs for "help" and "more," respectively.

The conclusive evidence provided in the seven studies indicates that AAC methods can be effective with infants and toddlers. All 135 participants in the conclusive studies demonstrated an improvement in communication skills following the AAC intervention. Improvements in a variety of communication acts occurred across all disabilities (autism, cerebral palsy, Down syndrome, intellectual disability not associated with Down syndrome, and unspecified developmental delays), and across ages of children, beginning at 16 months of age. Improvements were also noted across a range of intervention intensity and frequencies, from three sessions a week for 10 weeks (Study 1) to two sessions a week for 8 months (Study 6).

Summary and Implications for Practice

The current analysis contributes to the evidence that AAC methods can be used effectively with infants and toddlers with disabilities. Although only seven studies provided conclusive evidence to this effect, it does appear that many different types of AAC methods can be used to improve a child's intentional communication, including (a) unaided methods such as signs and gestures (Fey, Warren, Brady, Finestack, Bedin-Oja, Fairchild, et al., 2006; DiCarlo, Stricklin, Banajee, & Reid, 2001; Kouri, 1988; Tait et al., 2004; Yoder & Warren, 1998); and (b) aided methods that are nonelectronic (Anderson, 2001; Pennington & McConachie, 1999; Tait et al., 2004) or electronic technologies (Iacono & Duncum, 1995).

Although PECS was slightly more effective than sign language in one of the studies reviewed (Anderson, 2001), a key finding that has implications for both clinicians and parents is the idea that a variety of AAC methods can be effective when caregivers respond consistently and contingently to their children's communication attempts. If a toddler's natural gestures are difficult to interpret, a clinician should not hesitate to introduce pictures or a VOCA in order to increase the caregiver's ability to recognize and respond to the child's communicative attempts. Furthermore, clinicians should be willing to try a variety of AAC methods – including multi-modal AAC – with a young child before concluding that a particular child is not ready for AAC (Beukelman & Mirenda, 2005).

Future Research Directions

Most of the studies reported here were conducted as part of university early intervention clinics. There is a need to move research from university clinics to homes and childcare centers where functional use of AAC methods during daily routines can be investigated. There is also a need to bridge the gap between research and practice in early intervention. Dugan et al. (2006) conducted a survey study of the assistive technology

practices of multidisciplinary early intervention providers across the United States. The results of their survey indicated that providers did not select AAC or other assistive technology options for children until a child was older than 24 months, and that even then, interveners tended to select a low-tech option (55.2%) over a high-tech communication device (8.4%). It is important to encourage both providers and parents of infants with disabilities to explore the use of AAC methods as early as possible. In the studies reviewed in this paper, children as young as 15 months old were taught to use sign language (DiCarlo et al., 2001) and pictures (Tait et al., 2004), and children as young as 30-months old were taught to use a VOCA (Iacono & Duncum, 1995).

Further research on AAC use with infants and toddlers is needed. Promising research directions include parent-implemented augmented language experiences using speech generating communication devices (Romski, Sevcik, Adamson, Smith, & Cheslock, 2006) and the use of individualized visual scenes displayed on a speech generating device (Light & Drager, 2007) This type of research, investigating the effect of parents modeling AAC use during family routines, may help parents and early intervention providers embed AAC into meaningful activities for infants and toddlers with disabilities in order to facilitate early learning experiences that can promote a child's further development.

Acknowledgements

Preliminary results of this paper were reported at the International Division of Early Childhood (DEC) of the Council of Exceptional Children conference held in Minneapolis, MN October 28, 2008.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

Notes

1 Board Builder (a precursor to Boardmaker) is a registered trademark of Dynavox Mayer-Johnson, 2100 Wharton St., Suite 400, Pittsburgh, PA 15203, USA.
2 Picture Communication Symbols (PCS) is a registered trademark of Dynavox Mayer-Johnson, 2100 Wharton St., Suite 400, Pittsburgh, PA 15203, USA.
3 Blissymbols are available from Blissymbolics Communication International, Suite 104, 1630 Lawrence Ave. West, Toronto, Ontario, Canada.
4 Makaton is a registered trademark of The Makaton Charity, Manor House, 46 London Road, Surrey, UK.

References

American Speech-Language-Hearing Association. (1991). Report: Augmentative and alternative communication. *ASHA*, *33*, 9–12.

Anderson, A. (2001). *Augmentative communication and autism: A comparison of sign language and the Picture Exchange Communication System*. Unpublished doctoral dissertation. University of California, San Diego.

Beukelman, D., & Mirenda (2005). *Augmentative and alternative communication: Supporting children and adults with complex communication needs* (3rd edn). Baltimore, MD: Paul H. Brookes.

Charlop-Christy, M., Carpenter, M., Loc, L., LeBlanc, L., & Kellet, K. (2002). Using the Picture Exchange Communication System (PECS) with children with autism: Assessment of PECS acquisition, speech, social-communicative behavior and problem behavior. *Journal of Applied Behavior Analysis*, *35*, 213–231.

Chen, D., Klein, D., & Haney, M. (2007). Promoting interactions with infants who have complex multiple disabilities: Development and field-testing of the PLAI curriculum. *Infants & Young Children: An Interdisciplinary Journal of Special Care Practices*, *20*, 149–162.

Cohen, J. (1969). *Statistical power analysis for behavioral analysis*. New York: Academic Press.

Cress, C., & Marvin, C. (2003). Common questions about AAC services in early intervention. *Augmentative and Alternative Communication*, *19*, 254–272.

DiCarlo, C., Stricklin, S., Banajee, M., & Reid, D. (2001). Effects of manual signing on communicative verbalizations by toddlers with and without disabilities in inclusive classrooms. *The Journal of the Association for Persons with Severe Handicaps*, *26*, 120–126.

Drager, K. D. R., Light, J. C., Speltz, J. C., Fallon, K. A., & Jeffries, L. Z. (2003). The performance of typically developing 2 1/2-year-olds on dynamic display AAC technologies with different system layouts and language organizations. *Journal of Speech, Language, and Hearing Research*, *46*, 298–312.

Dugan, L., Campbell, P., & Wilcox, M. (2006). Making decisions about assistive technology with infants and toddlers. *Topics in Early Childhood Special Education*, *26*, 25–32.

Fey, M., Warren, S., Brady, N., Finestack, L., Bedin-Oja, S., Fairchild, M., Sokol, S., & Yoder, P. (2006). Early effects of Responsivity Education/Prelinguistic Milieu Teaching for children with developmental delays and their parents. *Journal of Speech, Language, Hearing Research*, *49*, 526–547.

Goldstein, H. (2002). Communication intervention for children with autism: A review of treatment efficacy. *Journal of Autism & Developmental Disorders*, *32*, 373–396.

Iacono, T., & Duncum, J. (1995). Comparison of sign alone and in combination with an electronic communicataion device in early language intervention: Case study. *Augmentative and Alternative Communication*, *11*, 249–259.

Kouri, T. (1988). Effects of simultaneous communication in a child-directed treatment approach with preschoolers with severe disabilities. *Augmentative and Alternative Communication*, *4*, 222–232.

Light, J. (1989). Toward a definition of communicative competence by individuals using augmentative and alternative communication systems. *Augmentative and Alternative Communication*, *5*, 137–144.

Light, J., & Drager, K. (2007). AAC technologies for young children with complex communication needs: State of the

science and future research directions. *Augmentative and Alternative Communication*, *23*, 204–216.
Mirenda, P. (2003). Toward functional augmentative and alternative communication for students with autism: Manual signs, graphic symbols, and voice output communication aids. *Language, Speech and Hearing Services in Schools*, *34*, 203–216.
National Scientific Council on the Developing Child (2007). *The timing and quality of early experiences combine to shape brain architecture: Working Paper #5*. Retrieved 12 February 2009 from: http://www.developingchild.net
Pennington, L., & McConachie, H. (1999). Mother-child interaction revisited: Communication with non-speaking physically disabled children. *International Journal of Language and Communication Disorders*, *34*, 391–416.
Raghavendra, P. (2000). *Evidence-based practice: Where are we in AAC?* Paper presented at the 9th biennial conference of the International Society for Augmentative and Alternative Communication, Washington, DC.
Romski, M., & Sevcik, R. (2005). Augmentative communication and early intervention: Myths and realities. *Infants & Young Children: An Interdisciplinary Journal of Special Care Practices*, *18*, 174–185.
Romski, M., Sevcik, R., Adamson, L., Smith, A., & Cheslock, M. (2006). *Toddlers, parent-implemented augmented language interventions,and communication development*. Paper presented at the 12th biennial conference of the International Society for Augmentative and Alternative Communication, Dusseldorf, Germany.
Sameroff, A., & Fiese, B. (2000). Transactional regulation: The developmental ecology of early intervention. In J. Shonkoff & S. Meisels (Eds.), *Handbook of early childhood intervention* (2nd edn, pp. 135–159). Cambridge: Cambridge University Press.
Schlosser, R. (2003). Roles of speech output in augmentative and alternative communication: Narrative review. *Augmentative & Alternative Communication*, *19*, 5–27.
Schlosser, R., Koul, R., & Costello, J. (2007). Asking well-built questions for evidence-based practice in augmentative and alternative communication. *Journal of Communication Disorders*, *40*, 225–238.
Schlosser, R., & Lee, D. (2000). Promoting generalization and maintenance in augmentative and alternative communication: A meta-analysis of 20 years of effectiveness research. *Augmentative & Alternative Communication*, *16*, 208–226.
Schlosser, R., & Raghavendra, P. (2004). Evidence-based practice in augmentative and alternative communication. *Augmentative & Alternative Communication*, *20*, 1–21.
Schlosser, R., Wendt, O., Angermeier, K., & Shetty, M. (2005). Searching for evidence in augmentative and alternative communication: Navigating a scattered literature. *Augmentative and Alternative Communication*, *21*, 233–255.
Scruggs, T., Mastropieri, M., & Casto, G. (1987). The quantitative analysis of single subject research methodology: Methodology and validation. *Remedial and Special Education*, *8*, 24–33.
Scruggs, T., Mastropieri, M., Cook, S., & Escobar, C. (1986). Early intervention for children with conduct disorders: A quantitative synthesis of single-subject research. *Behavioral Disorders*, Volume 8. 260–270.
Sigafoos, J., Didden, R., Schlosser, R., Green, V., O'Reilly, M., & Lancioni, G. (2008). A review of intervention studies on teaching AAC to individuals who are deaf and blind. *Journal of Physical Disabilities*, *20*, 71–99.
Slavin, R. (1986). Best-evidence synthesis: An alternative to meta-analysis and traditional reviews. *Educational Researcher*, *15*, 5–11.
Sprinthall, R. (2003). *Basic statistical analysis* (7th edn). Boston, MA: Allyn and Bacon.
Tait, K., Sigafoos, J., Woodyatts, G., O'Reilly, M., & Lancioni, G. (2004). Evaluating parent use of functional communication training to replace and enhance prelinguistic behaviours in six children with developmental and physical disabilities. *Disability and Rehabilitation: An International, Multidisciplinary Journal*, *26*, 1241–1254.
von Tetzchner, S., & Martinsen, H. (1992). *Introduction to symbolic and augmentative communication*. San Diego: Singular.
White, H. (1994). Scientific communication and literature retrieval. In H. Cooper & L. Hedges (Eds.), *The handbook of research synthesis* (pp. 42–53). New York: Russell Sage Foundation.
Yoder, P., & Stone, W. (2006). A randomized comparison of the effect of two prelinguistic communication interventions on the acquistion of spoken communication in preschoolers with ASD. *Journal of Speech, Language, Hearing Research*, *49*, 698–711.
Yoder, P., & Warren, S. (1998). Maternal responsivity predicts the prelinguistic communication intervention that facilitates generalized intentional communication. *Journal of Speech, Language & Hearing Research*, *41*, 1207–1219.

APPENDIX A

Hand-Searched Journals

American Association for the Education of the Severely/Profoundly Handicapped
American Journal of Speech-Language Pathology
Assistive Technology
Augmentative and Alternative Communication
Exceptional Children
Exceptionality
Focus on Autism and other Developmental Disorders
Infants & Young Children: An Interdisciplinary Journal of Special Care Practices
Journal of the Association for Persons with Severe Handicaps
Journal of the Association for the Severely Handicapped
Journal of Autism and Developmental Disorders
Journal of Communication Disorders
Journal of Early Intervention
Journal of Special Education Technology
Journal of Speech, Language, Hearing Research
Language, Speech, and Hearing Services in the Schools
Research and Practice for Persons with Severe Disabilities
Topics in Early Childhood Special Education

APPENDIX B

Operational Definitions for Coding the Studies

Coding category	Operational definition
Study identification	Record the names of the authors of the study and the year it was conducted or published.
Goal of the study	List the AAC outcome for the study.
Participants	Record the following for each study: (a) number of participants, (b) each participant's age, (c) each participant's gender, (d) each participant's disability classification.
Target of intervention	Record the primary target of the intervention: (a) child, (b) communication partner (parent, teacher, peer).
Intervention design	For group designs: (a) randomized pre-test/post-test control group, (b) one group pretest/post-test. For single-subject designs: (a) single-participant, alternating treatment design; (b) single-participant, multiple baseline designs (across behaviours or settings); (c) single-participant withdrawal design; (d) multiple participant, multiple baseline.
Setting	Record where the intervention occurred: (a) home, (b) childcare, (c) clinic, (d) pre-school.
AAC system	Record all types of AAC system(s) used in the intervention according to the following categories: (a) unaided AAC (i.e., communication system that only uses the communicator's body, such as manual signs); (b) aided AAC systems without voice output (e.g., communication board, PECS); (c) aided AAC systems with voice output (i.e., electronic AAC systems that produce either digitized or synthetic speech).
Treatment fidelity	Record measures used to ensure treatment fidelity: (a) documentation of training for treatment providers, (b) documentation of observation of treatment sessions by trained observers.
Interrater reliability	Record measures used to ensure reliability of coding treatment data.
Effect of intervention	Calculate the effect of AAC intervention using data provided by the study. For single-subject experimental designs, report the percentage of nonoverlapping data (PND; Scruggs et al., 1987). Calculate the PND by dividing the total number of data points in the intervention that do not overlap the data points in baseline by the total number of data points in the intervention and multiply by 100. For studies with multiple participants, calculate the mean

APPENDIX C

Summary of Experimental Studies of AAC use in Early Intervention

Study 1: Anderson (2001)

Participants. 5 participants (23–35 months): 1 boy (35 months) with PDD; 4 with Autism (2 girls: 34 and 23 months; 2 boys: 27 and 31 months).
Type of AAC. Signs and PECS using pictures from the program Board Builder.
Dependent variables and effect size. Requesting toys and foods using PECS: PND 60 (Q); Requesting toys and food using signs: PND 0 (I)
Method. Compared effectiveness of PECS and manual signs. Treatment sessions, (3 times a week, 90 min each, about 10 weeks) alternated between PECS and sign conditions. Simultaneous modeling of vocal label with AAC system targeted for that session. Child-directed strategies used. Learning trial occurred when the child initiated a communicative attempt.
Findings. All children mastered more items in PECS than in sign condition; rate of acquisition faster in PECS for majority of children.
Design and appraisal. Conclusive: Alternating treatment, multiple baseline probe design ensures experimental control, inter-observer agreement over 80%, and treatment integrity measures and data presented.

Study 2: Chen, Klein, & Haney (2007)

Participants. 25 infants (8–33 months) with multiple disabilities and sensory impairments, and their caregivers.
Type of AAC. Unaided (Vocalizations and body movements).
Dependent variables and effect size. Caregiver use of cues; child use of intentional communication acts; effect size measure not possible based on design.
Method. Five curriculum modules developed and field-tested with two cohorts of early interventionists who then implemented them with families. First cohort: four half-day training sessions (observing video segments; role plays; progress reports; practice explaining concepts and demonstrating strategies; and coaching). Replication cohort: two separate 1-day training sessions. Implementation of the curriculum with families ranged from 6 to 21 months ($M = 13.8$ months).
Findings. Total number of cues and events cued higher following use of PLAI curriculum. 19 of the 24 caregivers reported an increase in child's communication initiations.
Design and appraisal. Inconclusive: Pre-experimental design used; child outcome data limited to anecdotal reports by caregivers.

Study 3: DiCarlo, Stricklin, Banajee, & Reid (2001)

Participants. 12 children with disabilities, 12 children without disabilities (15 to 36 months). Disabilities included autism, Down syndrome, and cerebral palsy.
Type of AAC. Manual signs to request items (free play, art). VOCA present, but not dependent variable.
Dependent variables and effect size. Intervals with sign: PND 33 (I); frequency of sign: PND 29 (I).
Method. Children in both groups attended 2 half-day sessions per week. Treatment occurred over 25 sessions. Baseline and treatment conditions included use of environmental arrangements to facilitate communicative attempts and teacher modeling communicative behaviors (vocal and VOCA models). During treatment the teacher also used simultaneous vocal and sign models of key concepts and words.
Findings. Small increase in frequency of sign use during signing program; use of verbalizations did not decrease for either group of children during signing program.
Design and appraisal. Inconclusive: Multiple baseline design adequate, but treatment integrity measures missing.

Study 4: Fey et al. (2006)

Participants. 51 children (24–33 months); 25 received RE/PMT, 26 in control group. All identified as having mild to moderate mental retardation; 13 within each group with a diagnosis of Down syndrome. Other diagnoses: Trisomy 8, Mitochondrial disorder, Angelman syndrome, Fragile X, cerebrovascular accident at birth; 17 had developmental delays of unknown origin.
Type of AAC. Gestures, vocalization, gaze shifts from referent to communication partner.
Dependent variables and effect size. Rate of intentional communicative acts (i.e., requesting, commenting, and total rate of intentional acts): Cohen's $d = 0.40$–0.68 (medium effect).
Method. Children received both responsive education (RE) and prelinguistic milieu teaching (PMT) over 6 months. RE: Parents taught in eight 1-hr individual sessions by a Hanen-certified therapist who used videos and observation to recognize and respond to real or possible child communicative intents. Parents also read an accompanying book and were assigned tasks to do with their child. PMT: Sessions were 4 days per week for 20 min each (average of 3.32 weekly). Within on-going routines and arranging the setting as needed, therapists waited for, prompted, and responded to nonverbal communicative efforts consistent with perceived intent. Children averaged a total of 80 PMT sessions over 6 months.
Findings. Children in RE/PMT group produced significantly more intentional communicative acts than children in the no-treatment group.
Design and appraisal. Conclusive: Randomized control group treatment design provides experimental control, detailed treatment integrity and interrater observer procedures and data.

Study 5: Iacono and Duncum (1995)

Participants. 1 girl (32 months), Down syndrome.
Type of AAC. Signs and VOCA. Assessing spontaneous and responsive communicative acts.
Dependent variables and effect size. Total number of words produced, sign only: PND 0 (I). Total number of words produced, sign + VOCA: PND 66 (Q). Number of different words, sign only: PND 0 (I); # of different words, sign + VOCA: PND 83 (F).
Method. The effectiveness of sign and sign plus an electronic communication aid was compared using a child-directed approach. Six 30-min treatment sessions alternated between pretend cooking and dressing up activities using scripts. Researcher modeled target vocabulary according to the treatment condition: in the sign condition all models were provided using simultaneous production of sign and speech. In the sign +Dynavox condition, both sign + speech and sign + Dynavox productions were randomly presented.
Findings. Child produced more spontaneous/responsive productions during the sign + DynaVox condition than in the sign-only condition.
Design and appraisal. Conclusive: Alternating treatment design provided evidence that the sign + VOCA condition was more effective; inter-observer reliability 80% or better; treatment integrity data reported.

Study 6: Kouri (1998)

Participants. 2 children (34–36 months), 1 boy (36 months) with Autism; 1 girl (34 months) with Down syndrome.
Type of AAC. Signs, informal gestures (e.g., head nod, hand claps).
Dependent variable and effect size. Frequency spontaneous signs (label, request, protest, play): PND 42 (I); frequency responsive signs (e.g., to the question "What do you want?"): PND 60 (Q); Frequency informal meaningful gestures or to augment a linguistic form: PND 86 (F).

Method. Children received 8 months of intervention, with both individual and group treatment sessions occurring 2 times a week. Treatment sessions were child-directed. The clinician followed the child's attentional lead, modeled a sign-plus-spoken word whenever the child made eye contact, and modified the environment to encourage communication. No response requirements were placed on the child. The only difference between baseline and treatment sessions was the child-directed focus and the use of a simultaneous model.
Findings. Higher levels of interaction and sign use occurred in the sign-plus-speech intervention phase than during the withdrawal phase.
Design and appraisal. Conclusive: Intervention design (ABAB) provided experimental control; treatment protocol followed; inter-observer reliability data over 80%.

Study 7: Pennington and McConachie (1999)

Participants. 4 children (32–36 months) and their mothers: 1 boy (32 months); 3 girls (34, 35, and 36 months) with cerebral palsy.
Type of AAC. PCS, Blissymbols, and Makaton signs.
Dependent Variable and Effect Size. Child's use of different communicative functions and modes for expressive communication in conversational exchanges: Effect size measure not possible based on design.
Method. Conversation Situation: 10-min mother-child interaction with pretend play toys shown to elicit a full range of communicative functions. Mothers asked to "play and talk as you usually do." Script Situation: the researcher played with the child using the same toys, but prompted the children to take an initiating role and attempted to elicit a full range of communicative functions.
Findings. Children produced wider range of communicative functions in the semiscripted elicitation conversation with clinicians than in conversation with their mothers. The 4 children under 3 years old did not use their AAC method in either situation.
Design and appraisal. Inconclusive: Case study design not adequate to provide evidence that communicative script alone accounted for children's use of a greater range of communicative functions.

Study 8: Salmon, Rowan, and Mitchell (1998)

Participants. 3 children (17–30 months): 2 girls (24 and 17 months) with Down syndrome; 1 girl (30 months) with agenesis of the corpus callosum.
Type of AAC. Gestures (i.e., point, nod, shrug), sign, or vocalization.
Dependent variables and effect size. Initiations and responsive requests and comments: PND measure not possible.
Method. Explicit prompts: In random order, trainer used six situations (e.g., bubbles, wind-up toy, desired item in container) designed to stimulate communication and a multi-level system of prompts (joint attention and expectant wait; removal of object or stopping activity + verbal prompt; verbal prompt + visual cue; verbal prompt and visual cue + physical prompt) to elicit intentional requesting and commenting. Minimal prompts: As above but no explicit prompting. Trainer reacted to communicative behaviors by commenting and expanding on each act. Sessions were 20–30 min. Number of sessions for each child was between two and six.
Findings. Compared to minimal prompting, all children used more intentional communication under explicit prompt condition with more responsive acts than initiations.
Design and appraisal. Inconclusive: Alternating treatment design adequate, but baseline data not reported for any children; no graphed data provided; treatment integrity measures not reported.

Study 9: Stahmer and Ingersoll (2004)

Participants. 20 children (22–31 months) with autism spectrum disorders (ASD).
Type of AAC. PECS, sign language.
Dependent variables and effect size. Evaluating the effectiveness of an inclusive preschool program using various measures (functional communication emphasizing requesting, labeling, and sharing information); effect size measure not possible based on study design.
Method. Focus was on evaluating an inclusive preschool program for children with ASD. Children were enrolled in the program 9.5 months on average. Evidenced-based teaching techniques (e.g., discrete trial training, pivotal response training and incidental teaching) used according to individual child's need. Both signs and PECS introduced initially; use of one system intensified once child demonstrated a preference.
Findings. Significant increase in functional communication skills. Upon completion, 90% of children used a functional communication system independently (PECS, signs and/or spoken language). Children who used PECS or sign combinations also acquired spoken words.
Design and appraisal. Inconclusive: The pre-experimental design used does not provide conclusive evidence that children's increase in

functional communication skills resulted from participating in the inclusive preschool program.

Study 10: Tait, Sigafoos, Woodyatts, O'Reilly, and Lancioni (2004)

Participants. 4 children (16–31 months): 1 boy (23 months) with cerebral palsy; 1 girl (16 months) and 2 boys (26 & 31 months) with cerebral palsy and other diagnoses (i.e., sensory impairments and/or epilepsy).
Type of AAC. Manual signs, photos, eye gaze (shift between referent and partner, fix on object), and graphic symbol for "yes."
Dependent variables and effect size. Request "more": PND = 96 (H); choice making: PND = 70 (F); protest: PND = 94 (H); request "help": PND = 100 (H).
Method. Mothers received 30-min training on how to acknowledge, prompt, and react to targeted behaviors. They followed a written plan and received feedback on child progress and on implementation of plan (graphed data; reviewing videos). Each received 27 10-min sessions across situations (toy play, mealtime, social interaction)/ communicative functions, with 2 to 5 monthly follow-up sessions.
Findings. Probes across communicative functions demonstrated higher use of target replacement behaviors following intervention.
Design and appraisal. Conclusive: Multiple baseline design demonstrated targeted behaviors only increased following intervention; inter-observer ratings were over 80%; treatment integrity data reported.

Study 11: Warren, Yoder, Gazdag, Kim, and Jones (1993)

Participants. Experiment 1: 1 boy (20) with Down syndrome. Experiment 2: 1 boy (23 months) with Down syndrome; 1 girl (29 months) and 2 boys (26 months, 30 months) with various etiologies.
Type of AAC. Experiment 1: Gestures, signs. Experiment 2: Gestures, signs.
Dependent variables and effect size. Experiment 1; Requests: PND = 92 (H); comments: PND = 100 (H). Experiment 2; Requests PND = 96 (H) Comments: PND = 93 (H).
Method. Experiment 1: Prelinguistic requesting was targeted using modified milieu teaching approach; training occurred 4 days a week for 25 min each for 60 sessions. Experiment 2: Replicated and extended use of the milieu approach across teachers, setting and materials to investigate generalization. Training: 4 days a week (25 min per session) for between 37 and 61 sessions, due to the multiple baseline design.
Findings. Experiment 1: Requests and comments both increased during intervention. Experiment 2: Requesting increased dramatically for all subjects.
Design and appraisal. Conclusive: Multiple baseline design; targeted behavior only increased during intervention; interobserver rating data averaged above 80%.

Study 12: Yoder and Warren (1998)

Participants. 58 children (17–36 months). Developmental disabilities; etiologies varied with 39 having no identifiable etiology or diagnosis.
Type of AAC. Gestures.
Dependent variables and effect size. Rate of intentional communication acts of requesting and focusing joint attention: Cohen's d = .5–.55 (Medium effect).
Method. Prelinguistic milieu teaching (PMT): Sessions (20 min) 4 times per week for 6 months. Focus on establishing play routines with turn-taking around themes (e.g., peek-a-boo); adult withheld turn, prompted child as needed to produce targeted behavior to request, then moved to increasing child's need to draw trainers' attention to child's focus of interest and attention.
Findings. Children in PMT group used more frequent intentional communication than children in control group (trainer only responded to children's communication without any demands placed on child, no imitation of child's motor or vocal acts).
Design and appraisal. Conclusive: Randomized Control Group Treatment design demonstrated PMT increases the rate of intentional communication acts; treatment integrity procedures in place; inter-observer ratings over 80%.

Note. Percentage of Non-overlapping Data (PND) is interpreted as follows I = ineffective (< 50); Q = questionable (50–70); F = fairly effective (70–90); H = highly effective (> 90) (Scruggs et al., 1986). PECS, Picture Exchange Communication System; PDD, Pervasive Developmental Disorders; VOCA, Voice Output Communication Aid.