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AAC Modeling Intervention Research Review

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Abstract

A systematic review of research on the effects of interventions that include communication partner modeling of aided augmentative and alternative communication (AAC) on the language acquisition of individuals with complex communication needs was conducted. Included studies incorporated AAC modeling as a primary component of the intervention, defined as the communication partners (a) modeling aided AAC as they speak and (b) participating in the context of a naturalistic communication interaction. This review used a best-evidence approach, including nine single-case studies, with 31 participants, and 70 replications, and one quasi-experimental randomized group design study, including 63 participants. The results of the review indicated that AAC modeling intervention packages led to meaningful linguistic gains across four areas including (a) pragmatics, marked by increases in communication turns; (b) semantics, marked by receptive and expressive vocabulary increases; (c) syntax, marked by multi-symbol turn increases; and (d) morphology, marked by increases in target morphology structures.

Keywords

augmentative and alternative communication, aided language stimulation, AAC modeling, communication, complex communication needs

The purpose of this article is to present a systematic review of research documenting the effects of language interventions for people with complex communication needs that include communication partners modeling the use of augmentative and alternative communication (AAC). A review of AAC modeling interventions is important because of a strong theoretical foundation for the significance of language input in the language acquisition process, which is presented in general linguistic literature (Gallway & Richards, 1994; Gerken, 2008; Hart & Risley, 1995; Hirsh-Pasek & Golinkoff, 1996), sign language literature (Bavelier, Newport, & Supalla, 2003; Newport & Supalla, 2000), and AAC-related literature (Goossens', Crain, & Elder, 1992; Light, 1997; Romski & Sevcik, 1996; M. Smith & Grove, 2003).

Language Development for Children Using Speech

For many individuals, speech serves as their primary language tool, and the development of sophisticated speech and language skills occurs in a relatively fluid sequence throughout childhood and early adolescence (Adamson, 1995; Brown, 1973; Hart & Risley, 1995; Tomasello, 2003). This development of communication skills begins in the first years of life, and during this time, children experience rich models of speech (Gallway

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& Richards, 1994). Adults engage children in numerous and rich interactions, which serve to support speech and language development (Hart & Risley, 1995; Tomasello, 2003), evidenced by the strong positive correlation between the number of words a child hears, and the child's language development. Hart and Risley (1995) reported that a typically developing child is surrounded by speech and will hear approximately 26 million words between birth and age 4.

Light (1997) describes this as a "magical" period when children move through using pre-intentional and pre-symbolic communications (e.g., reaching and pointing to objects) to the use of complex syntax and the wide vocabulary available with spoken language (Bates, 1976; Paul, 1997). In summary, during early childhood, typical children learning speech experience a large number of speech models and rich language interactions, and rapidly acquire spoken language ability in response to this quantity and quality of interaction.

Language Development for Children Using AAC

Although most people have the ability to meet their daily communication needs using speech, those with complex communication needs (CCN) resulting from disabilities such as autism, cerebral palsy, and other developmental disabilities require alternative methods for language acquisition and communication (Beukelman & Mirenda, 2013). For children with CCN, language acquisition can be achieved through access to AAC, which involves the use of multiple modalities to communicate, such as speech, vocalizations, signs, gestures, writing, pictures, and speech-generating devices (SGDs; Beukelman & Mirenda, 2013; International Society for Augmentative and Alternative Communication, 2014).

The early experiences of individuals who require AAC differ significantly from those of speaking individuals in at least two important ways. First, unlike speaking children, individuals with CCN rarely observe adults modeling the use of their expressive communication system (i.e., parents or teachers using an SGD or a picture exchange communication system to communicate are rarely observed; Blockberger & Sutton, 2003; Romski & Sevcik, 1996; M. Smith & Grove, 2003). Mostly, these children with CCN receive language input in the form of speech, which differs in modality to the AAC systems they use to express themselves. M. Smith and Grove (2003) characterized this situation as one of an "asymmetry between the modalities of input to output" (p. 163). Second, they are less likely than speaking children to participate in interactions in which they have opportunities to make use of their expressive communication system (i.e., AAC) with others (Blockberger & Sutton, 2003; Calculator, 1997; Light, 2003; Siegel & Cress, 2002). The sparseness of these early language acquisition experiences has serious problematic implications for the development of important early communication and language skills.

AAC Modeling-Based Intervention Approaches

In response to the need to provide greater symmetry between language input and output, the practice of communication partners modeling AAC as an intervention has been proposed as a way to address this asymmetry. A number of similar intervention packages that refer to the interactive modeling of an AAC system by a communication partner have been proposed. These include aided language stimulation (ALgS; Goossens', 1989; Goossens' et al., 1992), augmented input (Romski & Sevcik, 1996), natural aided language (Cafiero, 2001), aided language modeling (Drager et al., 2006), and aided AAC modeling (Binger & Light, 2007).

For the purposes of this review, AAC modeling-based interventions all contain two key features, including communication partners (a) modeling aided AAC as they speak and (b) engaging in the context of a naturalistic communication interaction. The first component involves the modeling of aided AAC. As they are speaking, the communication partner (e.g., a parent, teacher) points to, or in some way draws the learner's attention to, vocabulary items in the child's AAC system (or a copy of the child's system). The goal is that the adult "models" the expressive use of the child's AAC system. AAC modeling is differentiated from instructional modeling, in that in instructional modeling the teacher models an instructional target. With AAC modeling, the teacher uses the AAC system in the context of a naturalistic communication interaction. *A naturalistic communication interaction* is defined as a "dynamic process between at least two people which is highly interactive, bi-directional, and multi-modal" (Kraat, 1985, p. 21) and occurs naturally in the context of the learner's day. Examples of naturally occurring activities are a child participating in a play routine or reading a book with an adult taking place at home, school, in the community, or emulated in a clinic setting.

A simple way to conceptualize the logic and theory supporting the practice of AAC modeling is to think of the analogy of a child learning a spoken or signed language. If you expected a child to learn to speak Spanish, the child should be immersed in environments that use the Spanish language. The same logic is used for a child expected to learn sign language, in that he or she should be immersed in environments where people are using sign. For children who are expected to communicate using AAC, the logic continues that the child would be immersed in an environment "speaking AAC." Language input is important to language acquisition (Bavelier et al., 2003; Gallway & Richards, 1994; Gerken, 2008; Hart & Risley, 1995; Hirsh-Pasek & Golinkoff, 1996; Newport & Supalla, 2000).

The goal of this literature review was to determine the effect of AAC modeling-based interventions on the language development of individuals who use AAC. Determining the nature of the practice of AAC modeling-based interventions and the impact these practices may have on communication performance is important for both practitioners looking to adopt effective practices and for researchers carefully deciding which practices to systematically investigate (Horner et al., 2005).

Method

This review was conducted using a best-evidence analysis approach (Millar, Light, & Schlosser, 2006; Slavin, 1986). In addition, methods were adapted from the Cochrane Collaboration Handbook (Higgins & Greene, 2011), through (a) searching the literature, (b) evaluating the certainty of evidence, (c) extracting relevant data, and (d) performing a qualitative and quantitative analysis of the best evidence.

Search

An electronic search was performed using the PsycInfo, Educational Resources Information Center (ERIC), and Google Scholar databases. The search query phrases used were "aided language stimulation" OR "system for augmenting language" OR "augmented input" OR "aided language modeling" OR "modeling" AND "augmentative and alternative communication" OR "AAC" OR "augmentative." Additional search methods used included a manual search of the journal *Augmentative and Alternative Communication* and an ancestral search of articles that met the study's inclusion criteria. In addition, an email was sent to the first authors of included articles asking whether they were aware of other articles fitting the inclusion criteria, but the correspondence did not yield additional articles.

Inclusion Criteria

A two-part inclusion criterion was used. First, included articles were published in an English language peer-reviewed journal from 1989 to 2013. The initial date of 1989 was chosen based on the case study published by Goossens' (1989), which is generally considered the first study on the subject. Second, articles needed to report a primary intervention variable that included modeling of aided AAC in the context of a naturalistic communication interaction. A total of 17 articles met the study's inclusion criteria.

Certainty of Evidence Analysis

Each article was assessed to determine the certainty of evidence (i.e., the extent to which the treatment used within the study was responsible for the results). The process used was adapted from Millar et al. (2006), Horner et al. (2005), and Gersten et al. (2005). Similar to the process used in Millar et al., an analysis of quality indicators was conducted to determine whether a study should be categorized overall as having

(a) conclusive evidence (i.e., the design demonstrated experimental control, the independent and dependent variables were reliable, and the participants were adequately described, providing convincing evidence that the treatment was responsible for the results), (b) preponderant evidence (i.e., minor flaws were present in the design, reliability of the independent or dependent variable, or description of the participants providing slightly less convincing evidence that the treatment was responsible for the results), (c) suggestive evidence (i.e., multiple minor flaws were present in the design, reliability of the independent or dependent variable, or description of the participants making it plausible the treatment was responsible for the results), or (d) inconclusive evidence (i.e., major flaws were present in the design and the study did not establish experimental control, providing unconfirmed evidence that the treatment was responsible for the results; Simeonsson & Bailey, 1991; Smith, 1981).

Methodological elements of each study were analyzed using a checklist of quality indicators appropriate for the study's design: group design research (Gersten et al., 2005) or single-case research (Horner et al., 2005). The two group design studies were analyzed according to the 38 quality indicators listed in Gersten et al. (2005), which included these general categories: (a) describing participants, (b) implementation of the intervention and description of comparison conditions, (c) outcome measures, and (d) data analysis. The remaining 15 studies were analyzed according to the 20 quality indicators for single-case design research listed in Horner et al. (2005) across the following general categories: (a) description of participants and setting, (b) dependent variable, (c) independent variable, (d) baseline, (e) experimental control/internal validity, (f) external validity, and (g) social validity. For each of the indicators, a yes or no response was recorded. Study evaluators considered whether any no response would prohibit a study from being coded *conclusive*. An inter-rater reliability agreement score for the certainty of evidence estimation was calculated for all of the included studies. The first author and a research associate rated each article independently. The agreement level for the certainty of evidence estimation was 92.9% and the Kappa .85, well above the generally accepted >.7 level (Kazdin, 2011). Following the independent analysis and comparison for inter-rater reliability, a discussion about each disagreement was conducted and consensus was achieved. A total of 10 articles met criteria for conclusive evidence. These included one group and nine single-case design studies.

Of the seven studies that did not present conclusive evidence, three were case studies lacking experimental control (Bruno & Trembath, 2006; Cafiero, 2001; Goossens', 1989), two were longitudinal designs lacking experimental control (Romski, Sevcik, Robinson, & Bakeman, 1994; Wilkinson, Romski, & Sevcik, 1994), one was a single-case design that lacked adequate description of the independent and dependent variables (Beck, Stoner, & Dennis, 2009), and one used a group design that lacked experimental control due to not including any type of control group (Kent-Walsh, Binger, & Malani, 2010).

Best-Evidence Analysis Procedures

A best-evidence analysis approach was used to qualify the nine single-case design studies and one group design study that demonstrated conclusive evidence (Millar et al., 2006; Slavin, 1986). The group design study was analyzed according to the quality indicators from Gersten et al. (2005). Because all single-case design studies did not report effect sizes, data were extracted and entered into a spreadsheet for analysis by the first author, with 100% of the data reviewed for accuracy by a trained research assistant. Data were obtained by evaluating graphs in the published articles or requesting the original data set(s) from the study's authors. Two effect size scores were calculated: percentage of non-overlapping data (PND; Parker, Vannest, & Davis, 2011; Scruggs & Mastropieri, 1998) and mean difference (MD; adapted from Busk & Serlin, 1992).

PND has been both a useful and controversial statistic in the meta-analysis of single-case research. It was used because it is clear, understandable (both in strengths and weaknesses), and relevant when nearly all baselines are low and stable, as in this study. PND can be interpreted through the following general guidelines: >70% for effective interventions, 50% to 70% for questionable effectiveness, and <50% for no observed effect (Scruggs & Mastropieri, 1998). One important weakness of PND occurs when there is a high amount of non-overlapping data, but the intervention condition scores are only slightly above baseline scores. In this case, a high score does not necessarily translate into a meaningful gain from baseline to intervention.

To better estimate the effects participants experienced and account for the limitations of PND, the MD was also reported. MD was calculated by subtracting the mean of the baseline condition from the mean of the intervention condition. This MD score was chosen for clarity over the Busk and Serlin (1992) Standardized Mean Difference because most of the baseline data in the set were low and stable, allowing for clearer estimations of the reported effects as compared with a standardized score. Standardized scores can be difficult to interpret and clinically misleading. The MD score can be interpreted as a rough estimate of gain in performance, but should be interpreted with caution because it is a non-standardized score, which does not account for phase variance. A total of 26% of the single-case design study effect demonstrations were reviewed for accuracy by a second rater. There was 100% agreement for the (a) participant dependent variable data set drawn from the single-case design articles, (b) PND of the dependent variable, and (c) mean difference of the dependent variable.

Results

Ultimately, 10 studies were included in the best-evidence analysis, nine single-case design studies and one group design study. Single-case design studies provide some of the most relevant evidence because of the experimental benefits of these designs with diverse populations such as AAC users (Schlosser, 2003). Group design studies are rare in AAC research.

Due to the nature of the interventions being interactive communication experiences, in all studies, independent variables were package interventions. Authors of seven of the studies explicitly stated that they used specific intervention package components including AAC modeling, question asking, time delay, and responding to child communication attempts. Three of the remaining studies provided more general descriptions of the activities.

Participants

The nine single-case design studies resulted in a data set of 31 participants, including a total of 70 demonstrations of effect (see Tables 1 and 2). The age of the individuals represented ranged from 2 years, 11 months to 12 years, 1 month, with a mean age of 5 years, 9 months, and a median age of 5 years. Most of the participants (*n* = 21) were under 6 years old, while a smaller portion (*n* = 10) were aged 6 through 12 years. The children had a variety of disabilities including nine children with cerebral palsy, seven children with Down syndrome, and 15 children with other disabilities such as autism, developmental disabilities, childhood apraxia of speech, cystic hygroma, velopharyngeal insufficiency, DiGeorge syndrome, and Prader–Willi syndrome. The group design study (Romski et al., 2010) compared 63 participants aged 2 to 3 with developmental delays. In summary, across the 10 studies, the participants were children who were developing early communicative competencies such as turn taking, vocabulary knowledge, morphology knowledge, and use of multi-symbol utterances.

Communication partners across the 10 studies included speech therapists (*n* = 5), parents (*n* = 4), and educational or clinical assistants (*n* = 2; see Table 1). Only Romski et al. (2010) studied two types of communication partners, including both parents and clinical assistants. Five of the studies are considered partner-training interventions where the researchers trained parents (*n* = 4) and educational assistants (*n* = 1) in the intervention procedures and then measured the partner–child dyad's performance during the intervention.

Intervention Outcomes

AAC modeling-based intervention packages provided to children who were beginning communicators consistently produced large and clinically relevant effects on beginning language skills of individuals with CCN using AAC across four primary domains. The four types of skills that were targeted in the interventions included pragmatic, semantic, syntactic, and morphological skills (see Tables 1 and 2). Synthesized across the body of 10 studies, children took increased communication turns, gained vocabulary knowledge, communicated increased multi-symbol utterances, and demonstrated knowledge of early morphological

Table 1. Studies on AAC Modeling-Based Interventions With Conclusive Evidence of Effectiveness.

Study, design	*N* and gender	Age	Disability	Context	Intervention	Results
Harris and Reichle (2004), Multiple baseline across activities	1 f, 2 m	3;10, 4;2, 5;4	DD, DS	Play in preferred activity with teacher in school	Children with less than 30 expressive words, intellectual impairment, and fast mapping skills experienced "aided language stimulation" with 4 scripted AAC models of each target vocabulary word with a paper AAC board.	Increase in receptive and expressive vocabulary
Drager et al. (2006), Multiple baseline across activities	1 f, 1 m	4;0, 4;5	Autism	Play in preferred activity with clinician in child care	Children with less than 30 functional words, intellectual impairment, and matching skills, experienced "aided language modeling," following the child's lead, with 4 AAC models of each target vocabulary word with a paper AAC board.	Increase in receptive and expressive vocabulary
Binger and Light (2007), Multiple baseline across participants	2 f, 3 m	3-5	Prader–Willi, DiGeorge syndrome., DS, dev. delay	Play with clinician in school = 3 + home = 2	Children with at least 25 expressive words and AAC experience, who primarily communicated telegraphically at the one word level, experienced an "aided AAC modeling" intervention with a minimum of 30 multi-symbol AAC models with a SGD, following the child's lead, and time delay.	Increase for 4 out of 5 participants in multi-symbol AAC turns
Binger, Kent-Walsh, Berens, Del Campo, and Rivera (2008), Multiple baseline across participants	2 f, 1 m	2;11, 3;4, 4;1	Motor speech impairments	Story book reading with Latino parents in home; partner instruction	Children with at least 25 expressive words and AAC experience, who primarily communicated telegraphically at the one word level, experienced the Read, Ask, Answer intervention with AAC modeling of up to 3 multi-symbol models per page spread with SGD, plus time delay and contingent responding with multi-symbol AAC models.	Increase in multi-symbol AAC turns
Rosa-Lugo and Kent-Walsh (2008), Multiple baseline across participants	1 f, 1 m	6;8, 6;9	Cystic hygroma, DD	Story book reading with Latino parents in home; partner instruction	Children using at least 10 AAC symbols, have a receptive vocabulary at or above two years and can answer questions about stories participated in the Read, Ask, Answer intervention with AAC modeling of up to 3 models per page spread with SGD, plus time delay and contingent responding with AAC modeling.	Increase in communication turns, expressive vocabulary
Dada and Alant (2009), Multiple baseline across participants	3 f, 1 m	8-12	CP, DS	Arts and crafts, food prep, story time with clinician in school	Children speaking less than 15 intelligible spoken words received an "aided language stimulation" intervention with 3 to 5 AAC models of each target vocabulary word with a paper AAC board.	Increase in receptive vocabulary

(continued)

Table 1. (continued)

Study, design	*N* and gender	Age	Disability	Context	Intervention	Results
Romski et al. (2010), Group	19 f, 43 m	2;0-3;0	Dev. delays	Play, book reading, snack with clinicians, parent in clinic + home; partner instruction	Children with fewer than 10 spoken words randomly assigned to (1) AAC modeling condition with SGD, (2) AAC prompting condition with SGD (3) Speech only condition.	Increase in AAC target word use and vocabulary knowledge for both AAC conditions
Binger, Kent-Walsh, Ewing, and Taylor (2010), Multiple baseline across participants	1 f, 2 m	4;6, 5;8, 6;4	Dev. delay, dysarthria, CP	Story book reading with educational assistant in school; partner instruction	Children with at least 25 expressive words, AAC experience, who primarily communicated telegraphically at the one word level engaged in the Read, Ask, Answer, Prompt intervention with AAC modeling of up to 3 multi-symbol models per page spread with SGD, plus time delay and contingent responding with multi-symbol AAC models.	Increase in multi-symbol AAC turns
Kent-Walsh, Binger, and Hasham (2010), Multiple baseline across participants	2 f, 4 m	4;7-8	DS, CP	Story book reading with parent in home; partner instruction	Children using at least 10 AAC symbols, with a receptive vocabulary at or above two years and able to answer questions about stories, participated in the Read, Ask, Answer intervention with AAC modeling of up to 3 models per page spread with SGD, plus time delay and contingent responding with AAC models.	Increase in communication turns, expressive vocabulary
Binger, Maguire-Marshall, and Kent-Walsh (2011), Multiple baseline across activities	1f, 2 m	11, 9, 6	CP, CAS	Story book reading with clinician in clinic	Children currently using AAC systems and had a receptive vocabulary above three years engaged in an AAC modeling and AAC recasting intervention with a minimum 10 AAC models of target morphologic structures with a Prentke Romich, Unity based SGD, plus time delay and recasting modeling AAC.	Increase in morphology forms: Aux + main, verb + -ing, poss. 's, 3rd per. sing. -s, reg. past tense -ed, pl. –s

Note. AAC = augmentative and alternative communication; f = female; m = male; DD = developmental disabilities; DS = Down syndrome; SGD = speech generating device; CP = cerebral palsy; CAS = childhood apraxia of speech.

Table 2. Single-Case Design Effect Sizes.

Study	*n*	Dem	PND	Mean difference (*SD*)
Pragmatic skills				
Kent-Walsh, Binger, and Hasham (2010)	6	6	100%	+33.3 turns (14)
Rosa-Lugo and Kent-Walsh (2008)	2	2	100%	+39.6 turns (9.3)
Semantic skills				
Dada and Alant (2009)	4	12	80%	+63.4% probes (15.1)
Drager et al. (2006)	2	12	79%	+51.6% probes (23.4)
Harris and Reichle (2004)	3	18	86%	+54.6% probes (16.2)
Syntax skills				
Binger and Light (2007)	5	5	94%	+11.6 multi-symbol turns (5.4)
Binger, Kent-Walsh, Berens, Del Campo, and Rivera (2008)	3	3	88%	+10.1 multi-symbol turns (0.9)
Binger, Kent-Walsh, Ewing, and Taylor (2010)	3	3	96%	+9.9 multi-symbol turns (1.8)
Morphology skills				
Binger, Maguire-Marshall, and Kent-Walsh (2011)	3	9	92%	+77% probes (16.2)
Total	31	70	90.6%	

Note. n = number of participants; Dem = demonstrations/replications in the multiple baseline designs; PND = percentage of non-overlapping data.

forms. Positive results were obtained across a range of communication partners and contexts such as play, shared reading, art activities, and mealtimes. Altogether, the results were consistently positive with large level changes in communication performance from baseline.

Pragmatic skills. Two studies (Kent-Walsh, Binger, & Hasham, 2010; Rosa-Lugo & Kent-Walsh, 2008) targeted beginning communicators and demonstrated an impact on pragmatic skills through the increase of the frequency of communicative turns using AAC (specifically SGDs). Participants in these studies consistently demonstrated clinically important large- and immediate-level changes in communication turns from baseline. Both studies used nearly identical designs and interventions, and included a total of eight beginning communicators ranging from 4 to 8 years old. In both studies, researchers taught parents to use the cognitive strategy "Read, ask, and answer" with their child participants during 10-min shared reading experiences. Using a time delay approach, the partner read and modeled AAC symbol use for each page spread in the book, and then provided wait time followed by the controlling prompt. Then the partner asked a question and modeled AAC symbol use, followed by an additional period of wait time. Following any child attempt at communication, a contingent response was provided that included an AAC model. The six children in Kent-Walsh et al. (2010) and two children in Rosa-Lugo and Kent Walsh (2008) all had 100% PND. Overall, Kent-Walsh et al. (2010) reported MD = +33.3 turns (*SD* = 14) and Rosa-Lugo and Kent-Walsh (2008) reported MD = +39.6 turns (*SD* = 9.3).

Semantic skills. Three single-case design studies (Dada & Alant, 2009; Drager et al., 2006; Harris & Reichle, 2004) and one group design study (Romski et al., 2010) reported gradual increases in vocabulary knowledge in response to AAC modeling.

Two of the studies used very similar approaches. Drager et al. (2006) worked with two children with autism, and Harris and Reichle (2004) worked with three children with developmental disabilities. In the two studies, the researchers targeted the acquisition of 12 different vocabulary words (mostly nouns) in the context of play-based interventions. Four vocabulary words were targeted per activity. For example, words such as "boy," "girl," "desk," "car," "bed," "apple," and "dishcloth" were modeled by pointing to the object and then the AAC symbol on a paper communication display and saying the word within 2 s. The two studies differed primarily in that Harris and Reichle used a scripted procedure for the modeling in the session, while Drager et al. used a more flexible approach to providing the AAC models. In the other single-case design vocabulary study, Dada and Alant (2009) worked in the context of a group activity with four participants with cerebral palsy and Down syndrome. They targeted a fixed set of vocabulary words (eight per activity). They also emphasized the AAC modeling of other words, in addition to the target vocabulary, during the activities.

All three studies reported relatively similar positive effects using vocabulary probes as a primary dependent variable. Dada and Alant (2009) reported 80% PND and a score of MD = +63.4% (*SD* = 15.1) for receptive vocabulary probes correct. Drager et al. (2006) and Harris and Reichle (2004) both probed for receptive and expressive vocabulary. Overall, Drager et al. reported 79% PND and an MD = +51.6% (*SD* = 23.4) probes correct. Harris and Reichle reported similar results, with an average of 86% PND and an MD of +54.6% (*SD* = 16.2) probes correct.

The group design study by Romski et al. (2010) serves as a rare example of a quasi-experiment with this level of rigor in AAC. The goal of each of the three intervention groups was to coach parents helping their children acquire expressive communication skills, specifically learning to use words from a target vocabulary list. The study incorporated random assignment into three groups. Each of the three groups shared intervention components over 24 intervention sessions of 30-min duration, including using age-appropriate naturalistic routines, using all target vocabulary, environmental arrangement, choice-making opportunities, and time delay. The augmentative communication input (AC-I) group was differentiated by providing access to AAC for the child and the adult providing AAC modeling throughout the session. The augmentative communication output (AC-O) group also incorporated access to AAC but used verbal and physical (hand over hand) prompts to promote AAC use. The speech communication (SC) group differed in that the condition did not include access to AAC and instead focused on speech-only approaches that incorporated verbal and gestural prompts. In summary, the children started with zero words in their target vocabulary, and after intervention, the AC-I and AC-O groups each demonstrated increased augmented word use in the clinic and the increases maintained when the sessions switched to the home at Session 18. Vocabulary size, calculated as a combination of spoken and augmented word use, increased substantially for both the AC-I and AC-O groups, but not for the SC group. Many of the children across all three groups did not use any spoken words, but speech increased modestly for all three groups, reinforcing the idea that AAC intervention does not impede speech development.

Syntax skills. Three studies demonstrated evidence of gains in syntax in the form of increasing multi-symbol utterances across 11 participants, aged 2 to 5 years, with various disabilities in the context of play (Binger & Light, 2007) and shared storybook reading (Binger, Kent-Walsh, Berens, Del Campo, & Rivera, 2008; Binger, Kent-Walsh, Ewing, & Taylor, 2010). Binger and Light (2007) used a play-based intervention where multi-symbol AAC models occurred a minimum of 30 times during the 15-min activity. Binger et al. (2008) and Binger et al. (2010) both used the similar cognitive strategy "Read, ask, and answer," as found in Kent-Walsh, Binger, and Hasham (2010) and Rosa-Lugo and Kent-Walsh (2008). Yet in this version of the approach, the communication partner (a parent in Binger et al., 2008, and an educational assistant in Binger et al., 2010) modeled multi-symbol AAC utterances during each of the three steps for each page spread in the book, incorporated a time delay instructional strategy between each step, and responded to any child attempts at communication, providing multi-symbol AAC models during the response. In addition, Binger et al. (2010) added an optional prompt step at the end of the strategy where a verbal prompt could be provided.

The impact of these syntax interventions was consistently positive with high effect sizes across eight of nine participants. In response to the play-based intervention, Binger and Light (2007) reported 94% PND overall with MD = +11.6 (*SD* = 5.4) for multi-symbol turns. Binger et al. (2008) and Binger et al. (2010), who used similar interventions and designs, produced nearly identical strong effect sizes. Binger et al. (2008) reported 88% PND and MD = +10.1 (*SD* = 0.9) for multi-symbol turns, and Binger et al. (2010) reported 96% PND and MD = +9.9 (*SD* = 1.8) for multi-symbol turns.

Morphology skills. Morphology interventions may target word inflections (Roseberry-McKibbin, 2007). One study (Binger, Maguire-Marshall, & Kent-Walsh, 2011) provided evidence of gains in morphology development with three participants. In the context of book reading, Binger et al. (2011) studied the acquisition of morphemes such as "plural -S," "present progressive -ING," "past tense -ED," and "possessive 'S.'" The intervention included AAC models and recasts with the target forms (e.g., modeling on the SGD: HE IS GO +

ING). All three participants quickly improved their performance in the probes of each of the target forms with overall robust changes in level from baseline to intervention, reporting 92% PND and an MD = +77% (*SD* = 16.2) of probes correct.

Discussion

Overall, the 10 studies included in this best-evidence synthesis investigated the impact of aided AAC modeling-based interventions and reported consistently positive and large main effects for pragmatic, semantic, syntactic, and morphological development for young children who are beginning communicators. These studies provide evidence that when provided with appropriate models of the use of AAC within naturalistic contexts, packaged with various interaction techniques such as time delay and recasting, the learners made observable gains in both expressive and receptive language. These positive findings about the impact of AAC modeling package interventions are well aligned with major language acquisition theories regarding the importance of language input (Gerken, 2008; Hirsh-Pasek & Golinkoff, 1996), and when triangulated with clinical expertise (e.g., Goossens', 1989) make a strong argument for using AAC modeling as a foundation of AAC intervention.

The ultimate goal of a quantitative review is to better determine the meaningfulness of the reported results (Busk & Serlin, 1992). In the case of this review, quantifying participant and study-level data on AAC modeling-based interventions provided a sizable data set in which to attempt to make inferences. In addition, it is essential to review the limitations of potential inferences, as well as what mitigating factors influence the results.

Pragmatic language development, although an important area of development in AAC, has often been underrepresented in the research literature (Iacono, 2003). The evidence suggests that AAC modeling-based interventions can serve to stimulate rapid increase in frequency of communication turns for children with CCN, a fundamental gain in the area of pragmatic language intervention (Fey, 1986; Paul, 2007). When the differences from baseline to intervention are evaluated closely, we see meaningful, immediate-level changes and those gains sustained across generalization and maintenance phases. The mean difference scores across the studies were MD = +33.3 (Kent-Walsh, Binger, & Hasham, 2010) and MD = +39.6 (Rosa-Lugo & Kent-Walsh, 2008). These scores represent meaningful differences in child communication turns, especially considering the immediacy of the gains and that the overall progress was obtained in five to nine sessions within a 10-min duration.

Research indicates that individuals with CCN who use AAC are at risk of semantic-related language delays. They are at risk because of one or more of the following reasons: (a) being talked to less, (b) relying on others for lexicon development in their AAC system, (c) experiencing the asymmetry between input and output, and (d) experiencing difficulties surrounding the use of graphic symbol sets (Beukelman & Mirenda, 2013). The evidence presented here demonstrates that AAC modeling-based interventions affected vocabulary knowledge for small sets of target vocabulary words, which were mostly nouns. Across the three single-case design studies and one group design study in this area (Dada & Alant, 2009; Drager et al., 2006; Harris & Reichle, 2004; Romski et al., 2010), vocabulary knowledge increased steadily from baseline to intervention, showing consistent acquisition of the target words by the end of the studies, which ranged from three sessions to much longer, especially in Harris and Reichle (2004).

Individuals who use AAC have been reported to be at risk of experiencing deficits in syntax and morphology skills (Binger & Light, 2008; Blockberger & Sutton, 2003). The impact of being able to combine words and parts of words is important, as it provides access to the generative, flexible, and combinatorial power of language. Research suggests that individuals with CCN, especially beginning communicators, often produce short telegraphic utterances (Binger & Light, 2008; Blockberger & Sutton, 2003). The evidence found in this review indicates that in response to AAC modeling-based interventions, children with CCN who require AAC were able to increase their use of multi-symbol utterances in a meaningful way within the contexts of play (Binger & Light, 2007) and shared storybook reading (Binger et al., 2008; Binger et al., 2010). Also, although only across three participants and nine demonstrations, Binger et al. (2011) demonstrated children acquiring the use of morphology structures in response to AAC modeling and AAC recasts during shared storybook reading. Taken together, this emerging evidence in the syntax and morphology domains is an encouraging sign that when provided the right interventions, children with CCN can develop these generative, flexible, and combinatorial skills.

Limitations

It is important to review the limitations of this systematic review to help interpret the results, which were consistently positive and included a relatively large number of demonstrations of the phenomena, including 70 single-case design replications and a large randomized comparison study. Limitations related to the population and packaged nature of the interventions are discussed.

An important limitation is that the data set represented a restricted population. Most notably, there are limited participant profiles related to age range, disability, and language ability. This limitation is an important gap because we do not have conclusive data documenting the impact of AAC modeling interventions on adolescents and adults with CCN. Another significant gap lies in the disability groups represented, because the population of individuals with CCN is very diverse. For instance, there is a lack of data on individuals with complex motor needs. The currently available data are also missing a focus on advanced language skills, which limits our understanding of the impact of AAC modeling interventions across the different domains of language. In addition, connected to expanding the context for intervention, there is a need for further study of maintenance and generalization of language skills, which is an important limitation because we lack knowledge of how AAC modeling works throughout individuals' entire days. Another limitation is that non-responders are most likely less represented in the literature, which is a common limitation found in reviews of intervention research. This is important because it limits our understanding of the profile of non-responders to treatment.

An additional key limitation in the data set is that all of the studies included package interventions. The intervention packages included AAC modeling as a primary component, but also included various other related components. This limitation is important because we cannot know for certain how each part of the intervention package affected the results. Romski et al. (2010) attempted to address this concern through the comparison of intervention packages, but because that comparison was non-conclusive, future research is still needed to further understand each component's role in the language development process.

Implications for Research and Practice

In summary, AAC modeling-based intervention packages had a positive impact across a range of language domains for young children who are beginning communicators. Future research is needed expanding the population studied, the context of intervention, and the intervention dosage level.

Future research is needed to determine whether AAC modeling is an effective intervention across the life span. This research should explore the impact of the intervention at different ages, and the development of the optimal match between the skills of the individual who requires AAC and the type of AAC modeling provided. Further investigation of matching individual needs in early intervention with targeted AAC modeling interventions is a high priority due to the broad impact that the successful development of communication skills has on individuals (Light, 2003). Light (2003) also described the importance of individuals with CCN developing communicative competence, including linguistic, operational, social, and strategic competencies. Although the evidence presented in this review shows positive results, it is with relatively beginning communicators working on early skills in limited contexts. Future research is needed to determine the roles of participant profile aspects such as language level, intellectual functioning, fast mapping ability (Mervis & Bertrand, 1994), and joint attention (Adamson, Bakeman, Deckner, & Romski, 2009).

It is also important to study older individuals. Future research is needed on the effects of providing AAC modeling-based interventions to adults as related to a number of contexts: (a) adults with a history of using AAC, targeting various skills and levels of skills; (b) adults who have not been provided adequate AAC, despite having CCN; and (c) other adults such as those who may have acquired disabilities later in life.

A range of disability groups are represented in the research reviewed including those with autism, childhood apraxia of speech, cerebral palsy, and various developmental disabilities. To better understand the effects of AAC modeling-based interventions on individuals with CCN, there is a need to extend the research with currently studied populations, and to include a greater range of populations. For instance, Drager et al. (2006) focused on individuals with autism. The large number of individuals with autism who have difficulty speaking makes this population a high research priority. There were no experimentally controlled studies with individuals with CCN who use alternate access (e.g., switch access, eye-control access, brain–computer interfaces). This indicates a clear need for future research to assess participants incorporating various alternate access strategies and tools, and to explore AAC modeling-based interventions with other individuals with disabilities associated with CCN, such as traumatic brain injury, aphasia, and amyotrophic lateral sclerosis.

Future research is needed across pragmatic, semantic, syntactic, and morphologic domains. For instance, research is needed to determine how AAC modeling-based interventions would work to affect the broad range of skills in the pragmatic domain beyond the initial positive finding represented in this review describing increases in communication turns. In addition to the pragmatic domain, it is essential to investigate exactly how AAC modeling-based interventions affect a broader range of semantic word categories. We need to explore not just children early in the vocabulary acquisition process, but individuals with CCN who have more robust vocabularies who are expanding into various content-specific vocabulary. In addition, mitigating factors could be explored, such as the role of fast mapping (Mervis & Bertrand, 1994), joint attention (Adamson et al., 2009), and overall scope and sequence of vocabulary learning for individuals. With the broad array of skills represented in both the syntax and morphology domains, it is important for future research to further discern how these skills are affected by AAC modeling interventions.

For speaking children, parents and caregivers typically provide language input naturally (Tomasello, 2003), although at a range of frequencies (from 620 to 2,150 words heard per hour; Hart & Risley, 1995). For individuals with CCN, the situation is more complicated. We know that typical interactions rarely include AAC models (M. Smith & Grove, 2003) and infrequently provide opportunities for expressive communication (Blockberger & Sutton, 2003). The amount and frequency of AAC modeling described across the interventions seem extraordinarily small in comparison with the input speaking children at age 3 are hearing, which is an average of 1,250 words per hour and 125,000 words of language experience per week (Hart & Risley, 1995). The AAC modeling research reports numbers such as 30 AAC models in 15 min (Binger & Light, 2007), or four models of each target vocabulary word per 15-min session (Drager et al., 2006; Harris & Reichle, 2004). The equivalent is 16 to 240 words per hour or only 1,600 to 24,000 words per week, standing in stark contrast to the massive 125,000 words per week for speaking children. Even the largest dosage of AAC modeling reported pales in comparison with the input that speaking children hear. Despite the relatively small dosage of input, as compared with speaking children, the results of AAC modeling-based interventions were consistently positive across pragmatic, semantic, syntactic, and morphological domains. In the future, with the advent of near ubiquitous new mobile technologies such as the iPhone, iPod touch, and iPad serving as AAC systems, it is practically more feasible that communication partners could be able to provide a greater degree of AAC modeling throughout the day (Sennott & Bowker, 2009). The review of literature on AAC modeling interventions reveals promising results and points to the need for further intervention development and research on an AAC language immersion approach at the level of intensity that Hart and Risley (1995) described.

Authors' Note

Contact the author for detailed information about the results of each study including single-case design data.

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References

References marked with an asterisk indicate studies included in the literature review.

Adamson, L. (1995). *Communication development during infancy*. Madison, WI: Brown & Benchmark.

Adamson, L., Bakeman, R., Deckner, D. F., & Romski, M. A. (2009). Joint engagement and the emergence of language in children with autism and Down syndrome. *Journal of Autism and Developmental Disorders*, *39*, 84-96. doi:10.1007/s10803-008-0601-7

Bates, E. (1976). *Language and context: The acquisition of pragmatics*. New York, NY: Academic Press.

Bavelier, D., Newport, E. L., & Supalla, T. (2003). Children need natural languages, signed or spoken. *Cerebrum*, *6*(4), 19-32.

Beck, A. R., Stoner, J. B., & Dennis, M. L. (2009). An investigation of aided language stimulation: Does it increase AAC use with adults with developmental disabilities and complex communication needs? *Augmentative and Alternative Communication*, *25*, 42-54. doi:10.1080/07434610802131059

Beukelman, D., & Mirenda, P. (2013). *Augmentative and alternative communication: Supporting children and adults with complex communication needs* (4th ed.). Baltimore, MD: Brookes.

*Binger, C., Kent-Walsh, J., Berens, J., Del Campo, S., & Rivera, D. (2008). Teaching Latino parents to support the multi-symbol message productions of their children who require AAC. *Augmentative and Alternative Communication*, *24*, 323-338. doi:10.1080/07434610802130978

*Binger, C., Kent-Walsh, J., Ewing, C., & Taylor, S. (2010). Teaching educational assistants to facilitate the multi-symbol message productions of young students who require augmentative and alternative communication. *American Journal of Speech-Language Pathology*, *19*, 108-120. doi:10.1044/1058-0360(2009/09-0015)

*Binger, C., & Light, J. (2007). The effect of aided AAC modeling on the expression of multi-symbol messages by preschoolers who use AAC. *Augmentative and Alternative Communication*, *23*, 30-43. doi:10.1080/07434610600807470

Binger, C., & Light, J. (2008). The morphology and syntax of individuals who use AAC: Research review and implications for effective practice. *Augmentative and Alternative Communication*, *24*, 123-138. doi:10.1080/07434610701830587

*Binger, C., Maguire-Marshall, M., & Kent-Walsh, J. (2011). Using aided AAC models, recasts, and contrastive targets to teach grammatical morphemes to children who use AAC. *Journal of Speech, Language, and Hearing Research*, *54*, 160-176. doi:10.1044/1092-4388(2010/09-0163)

Blockberger, S., & Sutton, A. (2003). Toward linguistic competence: Language experiences and knowledge of children with extremely limited speech. In J. Light, D. Beukelman, & J. Reichle (Eds.), *Communicative competence for individuals who use AAC: From research to effective practice* (pp. 63-106). Baltimore, MD: Brookes.

Brown, R. (1973). *A first language: The early stages*. Cambridge, MA: Harvard University Press.

Bruno, J., & Trembath, D. (2006). Use of aided language stimulation to improve syntactic performance during a weeklong intervention program. *Augmentative and Alternative Communication*, *22*, 300-313. doi:10.1080/07434610600768318

Busk, P. L., & Serlin, R. C. (1992). Meta-analysis for single-case research. In T. R. Kratochwill & J. R. Levin (Eds.), *Single-case research design and analysis: New directions for psychology and education* (pp. 187-212). Hillsdale, NJ: Lawrence Erlbaum.

Cafiero, J. M. (2001). The effect of an augmentative communication intervention on the communication, behavior, and academic program of an adolescent with autism. *Focus on Autism and Other Developmental Disabilities*, *16*, 179-189. doi:10.1177/108835760101600306

Calculator, S. (1997). Fostering early language acquisition and AAC use: Exploring reciprocal influences between children and their environments. *Augmentative and Alternative Communication*, *13*, 149-157. doi:10.1080/07434619712331277968

*Dada, S., & Alant, E. (2009). The effect of aided language stimulation on vocabulary acquisition in children with little or no functional speech. *American Journal of Speech-Language Pathology*, *18*, 50-64. doi:10.1044/1058-0360(2008/07-0018)

*Drager, K. D. R., Postal, V. J., Carrolus, L., Castellano, M., Gagliano, C., & Glynn, J. (2006). The effect of aided language modeling on symbol comprehension and production in 2 preschoolers with autism. *American Journal of Speech-Language Pathology*, *5*, 112-125. doi:10.1044/1058-0360(2006/012)

Fey, M. (1986). *Language intervention with young children*. Boston, MA: College Hill Press.

Gallway, C., & Richards, B. J. (1994). *Input and interaction in language acquisition*. Cambridge, UK: Cambridge University Press.

Gerken, L. A. (2008). *Language development*. San Diego, CA: Plural Publishing.

Gersten, R., Fuchs, L. S., Compton, D., Coyne, M., Greenwood, C., & Innocenti, M. S. (2005). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children*, *71*, 149-164. doi:10.1177/001440290507100202

Goossens', C. (1989). Aided communication intervention before assessment: A case study of a child with cerebral palsy. *Augmentative and Alternative Communication*, *5*, 14-26. doi:10.1080/07434618912331274926

Goossens', C., Crain, S., & Elder, P. (1992). *Engineering the classroom environment for interactive symbolic communication: An emphasis on the developmental period 18 months to five years*. Birmingham, AL: Southeast Augmentative Communication Conference Publications.

*Harris, M. D., & Reichle, J. (2004). The impact of aided language stimulation on symbol comprehension and production in children with moderate cognitive disabilities. *American Journal of Speech-Language Pathology*, *13*, 155-167. doi:10.1044/1058-0360(2004/016)

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore, MD: Brookes.

Higgins, J. P. T., & Green, S. (Eds.). (2011). *Cochrane handbook for systematic reviews of interventions version 5.1.0* (Updated, March 2011). London, England: The Cochrane Collaboration. Available from www.cochrane-handbook.org

Hirsh-Pasek, K., & Golinkoff, R. M. (1996). *The origins of grammar: Evidence from early language comprehension*. Cambridge, MA: The MIT Press.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children*, *71*, 165-169. doi:10.1177/001440290507100203

Iacono, T. (2003). Pragmatic development in individuals with developmental disabilities who use AAC. In J. Light, D. Beukelman, & J. Reichle (Eds.), *Communicative competence for individuals who use AAC: From research to effective practice* (pp. 323-360). Baltimore, MD: Brookes.

International Society for Augmentative and Alternative Communication. (2014). *What is AAC?* Retrieved from https://www.isaac-online.org/english/what-is-aac/

Kazdin, A. E. (2011). *Single-case research designs: Methods for clinical and applied settings* (2nd ed.). New York, NY: Oxford University Press.

*Kent-Walsh, J., Binger, C., & Hasham, Z. (2010). Effects of parent instruction on the symbolic communication of children using augmentative and alternative communication during storybook reading. *American Journal of Speech-Language Pathology*, *19*, 97-107. doi:10.1044/1058-0360(2010/09-0014)

Kent-Walsh, J., Binger, C., & Malani, M. (2010). Teaching partners to support the communication skills of young children who use AAC: Lessons from the ImPAACT program. *Early Childhood Services*, *4*, 155-170.

Kraat, A. W. (1985). *Communication interaction between aided and natural speakers: A state of the art report*. Madison, WI: Trace Center Reprint Service. Retrieved from http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED287275

Light, J. (1997). "Let's go star fishing": Reflections on the contexts of language learning for children who use aided AAC. *Augmentative and Alternative Communication*, *13*, 158-171. doi:10.1080/07434619712331277978

Light, J. (2003). "Shattering the silence": The development of communicative competence by individuals who require augmentative and alternative communication. In J. Light, D. Beukelman, & J. Reichle (Eds.), *Communicative competence for individuals who use augmentative and alternative communication* (pp. 3-38). Baltimore, MD: Brookes.

Mervis, C. M., & Bertrand, J. (1994). Acquisition of the novel name-nameless category (N3C) principle. *Child Development*, *65*, 1646-1662. doi:10.2307/1131285

Millar, D. C., Light, J. C., & Schlosser, R. W. (2006). The impact of augmentative and alternative communication intervention on the speech production of individuals with developmental disabilities: A research review. *Journal of Speech, Language, and Hearing Research*, *49*, 248-264. doi:10.1044/1092-4388(2006/021)

Newport, E. L., & Supalla, T. (2000). Sign language research at the millennium. In K. Emmorey & H. Lane (Eds.), *The signs of language revisited: An anthology in honor of Ursula Bellugi and Edward Klima* (pp. 103-114). Mahwah, NJ: Lawrence Erlbaum.

Parker, R. I., Vannest, K. J., & Davis, J. L. (2011). Effect size in single-case research: A review of nine non-overlap techniques. *Behavior Modification*, *35*, 303-322. doi:10.1177/0145445511399147

Paul, R. (1997). Facilitating transitions in language development for children using AAC. *Augmentative and Alternative Communication*, *13*, 141-148. doi:10.1080/07434619712331277958

Paul, R. (2007). *Language disorders from infancy through adolescence: Assessment and intervention* (3rd ed.). St. Louis, MO: Mosby/Elsevier.

Romski, M. A., & Sevcik, R. A. (1996). *Breaking the speech barrier: Language development through augmented means*. Baltimore, MD: Brookes.

*Romski, M. A., Sevcik, R. A., Adamson, L. B., Cheslock, M., Smith, A., Barker, R. M., & Bakeman, R. (2010). Randomized comparison of augmented and nonaugmented language interventions for toddlers with developmental delays and their parents. *Journal of Speech, Language, and Hearing Research*, *53*, 350-364. doi:10.1044/1092-4388(2009/08-0156)

Romski, M. A., Sevcik, R. A., Robinson, B., & Bakeman, R. (1994). Adult-directed communications of youth with mental retardation using the system for augmenting language. *Journal of Speech, Language, and Hearing Research*, *37*, 617-628. doi:10.1044/jshr.3703.617

*Rosa-Lugo, L. I., & Kent-Walsh, J. (2008). Effects of parent instruction on communicative turns of Latino children using augmentative and alternative communication during storybook reading. *Communication Disorders Quarterly*, *30*, 49-61. doi:10.1177/1525740108320353

Roseberry-McKibbin, C. (2007). *Language disorders in children: A multi-cultural perspective*. Boston, MA: Pearson.

Schlosser, R. (2003). *The efficacy of augmentative and alternative communication: Toward evidence-based practice*. San Diego, CA: Academic Press.

Scruggs, T. E., & Mastropieri, M. A. (1998). Synthesizing single subject research: Issues and applications. *Behavior Modification*, *22*, 221-242. doi:10.1177/01454455980223001

Sennott, S., & Bowker, A. (2009). Autism, AAC, and Proloquo2Go. *Perspectives on Augmentative and Alternative Communication*, *18*, 137-145. doi:10.1044/aac18.4.137

Siegel, E., & Cress, C. (2002). Overview of the emergence of early AAC behaviors: Progression from communicative to symbolic skills. In J. Reichle, D. Beukelman, & J. Light (Eds.), *Exemplary practices for beginning communicators: Implications for AAC* (pp. 25-57). Baltimore, MD: Brookes.

Simeonsson, R., & Bailey, D. (1991). Evaluating programme impact: Levels of certainty. In D. Mitchell & R. Brown (Eds.), *Early intervention studies for young children with special needs* (pp. 280-296). London, England: Chapman & Hall.

Slavin, R. E. (1986). Best-evidence synthesis: An alternative to meta-analytic and traditional reviews. *Educational Researcher*, *15*, 5-11. doi:10.3102/0013189X015009005

Smith, M., & Grove, N. (2003). Asymmetry in input and output for individuals who use augmentative and alternative communication. In J. Light, D. Beukelman, & J. Reichle (Eds.), *Communicative competence of individuals who use augmentative and alternative communication* (pp. 163-195). Baltimore, MD: Brookes.

Smith, N. L. (1981). The certainty of judgments in health evaluations. *Evaluation and Program Planning*, *4*, 273-278. doi:10.1016/0149-7189(81)90028-8

Tomasello, M. (2003). *Constructing a language*. Cambridge, MA: Harvard University Press.

Wilkinson, K., Romski, M. A., & Sevcik, R. (1994). Emergence of visual-graphic symbol combinations by youth with moderate or severe mental retardation. *Journal of Speech, Language, and Hearing Research*, *37*, 883-889. doi:10.1044/jshr.3704.883

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