The effects of Augmentative and Alternative Communication interventions on the receptive language skills of children with developmental disabilities: A scoping review

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Abstract

Background: For children with developmental disabilities and little or no functional speech, the effect of augmentative and alternative communication (AAC) interventions on the development of receptive language has been neglected in research.

Purpose: To map and synthesise research evidence of the effects that aided and unaided AAC interventions have on the receptive language of children with developmental disabilities.

Methods: This scoping review used a four-pronged search strategy (electronic databases, dissertations and theses, hand search, ancestry searches) to identify germane studies. A total of 16 studies met the inclusion criteria. These studies were described in terms of the number of participants, participant characteristics, research design, AAC interventions, intervention outcomes, intervention effects, and quality appraisal.

Main contribution: The review revealed positive associations between aided and unaided AAC, vocabulary acquisition and symbol comprehension.

Conclusions: AAC interventions may have merit for the development of receptive language skills in children with developmental disabilities. Specific gaps in relation to unaided AAC, aided augmented input strategies, morphological and syntax development, and discourse comprehension are highlighted.

Keywords: Aided approaches, augmentative and alternative communication, comprehension, developmental disabilities, intervention, receptive language, unaided approaches.

Introduction

For most children, the acquisition of language is a process in which receptive language development precedes expressive language development. For children with developmental disabilities, however, language development may be delayed and differ from that of typically developing peers. Some children with developmental disabilities may also present with little or no functional speech (LNFS) (Romski & Sevcik, 1997). For children with LNFS, augmentative and alternative communication (AAC) may provide a mechanism both for learning language and for expressing themselves (Beukelman & Light, 2020).

AAC is a field of clinical practice that aims to enhance communicative competence for persons with LNFS (Lloyd, Fuller, & Arvidson, 1997) by replacing or augmenting natural speech and/or handwriting. AAC approaches may be unaided or aided. Unaided approaches rely on the use of the body to communicate, such as by using gestures, manual signs, and fingerspelling. Aided approaches include the use of real objects, graphic symbols, traditional orthography, speech-generating devices, and mobile technologies with AAC-specific applications.

Although AAC has been recommended as a support for children with developmental disabilities and LNFS, the use of an AAC system is not without challenges, and does not occur naturally. Children who use AAC may only be exposed to their language system sporadically with most communication remaining verbal (Light, 1997; O'Neill, Light, & Pope, 2018; Smith & Grove, 2003). Hence, intervention is required for children with developmental disabilities who are to use AAC. Modelling, in which the communication partner uses the AAC system to produce words alongside speech, is one intervention that has received some research attention. For example, a review by Sennott, Light and McNaughton (2016) on modelling interventions for AAC highlighted that children using AAC were likely to have significantly fewer words modelled for them than children who use speech, thus

making language learning more difficult for them. The number of words a child is exposed to has an impact not only on language, but also on cognitive development, with fewer words resulting in poorer cognitive development (Rindermann & Baumeister, 2015).

Children who use AAC systems are given much of their language input in the auditory modality using spoken language, yet they are often required to develop and use a language system for expression that uses a visual modality such as graphic symbols or manual signs. Having different modalities for language input and output is termed an "input-output asymmetry" (Light, 1997; Smith, 2015; Sutton, Soto, & Blockberger, 2002). Input-output asymmetry places additional burdens on the child using AAC in terms of joint attention, working and declarative memory, selective and divided attention and cognitive processing (Solomon-Rice, 2010), and breakdowns in language development may occur due to these factors (Dodd & Gorey, 2014).

Despite the complexities of language acquisition in relation to language exposure and/or asymmetry in communication, children with developmental disabilities and LNFS have been shown to be able to develop receptive and expressive language skills using an aided AAC system (Geytenbeek, Heim, Knol, Vermeulen, & Oostrom, 2015; Light, 1997; Romski & Sevcik, 1997) and modelling intervention (Allen, Schlosser, Brock, & Shane, 2017; Biggs, Carter, & Gilson, 2018; O'Neill et al., 2018; Sennott et al., 2016). The review by Sennott and colleagues (2016) on the modelling of aided AAC provided evidence of gains in the number of communication turns taken, receptive and expressive vocabulary, the number of multi-symbol turns taken, and the use of targeted morphology when modelling was used. A different but related review indicated that augmented input (speech simultaneously supplemented by an AAC system) resulted in improvements in single-word vocabulary and the use of multi-symbol expressive utterances, but that developments in comprehension beyond the single-word level had not been explored (Allen et al., 2017). A third review

reported that, despite different procedures, AAC modelling interventions resulted in improvements in several areas of expressive language (Biggs et al., 2018). Finally, a meta-analysis agreed and reported that aided AAC input with expectant delays, direct prompting, contingent responding and open-ended questions was effective in the development of receptive and expressive pragmatics, semantics and syntax (O'Neill et al., 2018).

Although there is a growing body of reviews highlighting the effects that aided AAC have on expressive language, two key areas have been underexplored in these reviews. Firstly, the reviews exclude receptive language beyond the basics of turn taking (Sennott et al., 2016) and the comprehension of single words (Allen et al., 2017; Sennott et al., 2016). Secondly, the reviews excluded unaided AAC systems in their search, despite such systems being an essential part of AAC interventions. The reliance on aided AAC systems is problematic as children do show individual preferences for aided or unaided AAC systems (Meer, Sigafoos, Reilly, & Lancioni, 2011) and for their use across different communication situations (Sigafoos & Drasgow, 2001). In order to meet the communication demands of the differing situations that a child may encounter, multiple modes of AAC may be required (Sigafoos & Drasgow, 2001). For example, a child may not be able to take an aided AAC system along during physical activities such as swimming or running, yet communication is still required. In such situations, unaided AAC may provide a viable communication option. In addition, according to Romski, Sevcik, Barton-Hulsey and Whitmore (2015) and Zangari, Lloyd and Vicker (1994), a majority of early interventions using AAC have preferred the use of unaided AAC systems.

A final gap recognised in the current reviews on AAC interventions requires consideration of the results of the identified studies – not only individually, but also in groups of studies with similar interventions. When the results of studies with similar interventions are considered as a group, the effects of a particular type of intervention can be compared to other

possible intervention types, which can then be used by clinicians as a guide in their daily clinical decision making (Schlosser, Wendt, Angermeier, & Shetty, 2005). The reviews highlighted have provided descriptions of the interventions used, but have not analysed the results from similar studies to identify which interventions could be considered in decision making for evidence-based practice (EBP). EBP is a process that involves the integration of the best and current research evidence with clinical expertise and relevant stakeholder perspectives (Schlosser & Raghavendra, 2004). Interventions that have reached a threshold of scientific backing are considered to be "empirically supported" (Schlosser & Sigafoos, 2008). It would be greatly advantageous for clinicians implementing EBP to know which interventions are empirically supported. Hence there is a need to identify those specific intervention strategies that effectively target the receptive language skills of children who use AAC – across both aided and unaided AAC. Additionally, an assessment of the risk of bias or quality and the identification of empirically supported interventions are part and parcel of EBP (i.e., "*best* evidence"). Therefore, this review will conduct a quality appraisal as well.

This scoping review (Arksey & O'Malley, 2005) aimed to answer the following question: What effect does AAC intervention have on receptive language in children with developmental disabilities? More specifically, the review had the following aims:

- To identify studies on aided and unaided AAC interventions targeting receptive language, for children with developmental disabilities.
- To describe the intervention strategies (independent variable) and assess the quality of each study.
- To describe the effects of the interventions on receptive language (dependent variable).
- To describe the evidence base for practice identified from the studies in this review.

While scoping reviews share some characteristics with systematic reviews, they are broader in scope than systematic reviews, with less focused research questions. As such, they

may identify a larger base of literature, and quality appraisals are optional (Levac, Colquhoun, & O'Brien, 2010; Schlosser & Koul, 2015; Sucharew & Macaluso, 2019). For this scoping review, for example, a host of independent variables are eligible as long as the targeted outcome falls within the broad category of receptive skills. The primary goal of a scoping review is to identify as much research on a given topic as possible in order to highlight gaps in the body of knowledge and provide direction for future research.

A protocol was developed and registered with PROSPERO, an international database of prospectively registered reviews (see https://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42016050159&ID=CRD42016050159).

Search strategy

A multifaceted search strategy that was utilised to avoid a biased yield (Schlosser et al., 2005; Schlosser, Wendt, & Sigafoos, 2007) included the following:

- Electronic database searches for published studies (Academic Search Complete; Cumulative Nursing and Allied Health Literature [CINAHL]; Educational Resources Information Centre [ERIC]; Linguistics and Language Behaviour Abstracts [LLBA], and PsycINFO (for database-specific search strategies see Table 1, supplementary materials)
- A search of *ProQuest Dissertations and Theses*
- A hand search of *Augmentative and Alternative Communication*
- Ancestry searches based on studies that qualified for inclusion (Schlosser & Lee, 2000)

The search terms were selected based on consultations with subject librarians and pilot searches conducted in the various databases. The aim was to determine search terms that were appropriate for each database and would yield the best and most appropriate results.

Selection of studies

Studies were selected according to a protocol drawn up prior to the search (available from

the corresponding author on request). A screening relevance tool was completed independently by two authors using Covidence, a web-based platform devised to facilitate the production of a systematic review (Mavergames, 2013). The *Title and Abstract Screening Relevance Tool* (Table 2 in supplementary material) was developed to assist in the screening of study titles and abstracts, to determine their eligibility for inclusion. The tool was refined to include only relevant questions, following its use in a pilot study. If the researcher answered NO to any of the questions in the screening relevance tool, the article was excluded. If the researcher answered YES to all of the questions, the article was included for full-text screening. If the reviewer answered "can't tell" to any or all of the questions, the article was included for full-text screening. The title, abstract and (as necessary) the full-text of the potential study were evaluated according to the screening relevance tool and based on the inclusion and exclusion criteria. Disagreements during the screening process were resolved by comparing rationales until consensus could be reached. Inter-observer agreement (IOA) before consensus was calculated by dividing the number of agreements by the number of disagreements and multiplying the result by 100. IOA for the title and abstract screening was 93.5% and for full-text review was 92%.

Eligible studies had to include children with developmental disabilities (DD), which included (but was not limited to) children with autism spectrum disorder (ASD), intellectual disability (ID), Down Syndrome (DS), or cerebral palsy (CP).

The interventions included in the review had to fall within the scope of AAC, defined as "compensating for both permanent or temporary impairments and participation and activity restrictions of individuals with little or no functional speech and/or comprehension difficulties across auditory and visual communication" (American Speech-Language-Hearing Association, 2004). An intervention was considered to fall within the scope of AAC intervention if it facilitated a child's use of communication modalities that either augmented

or replaced natural speech and/or handwriting (Schlosser & Wendt, 2008). Studies that involved pseudoscientific interventions (and strove to align themselves with legitimate AAC interventions) such as facilitated communication (Hemsley et al., 2018) or the Rapid Prompting Method (Schlosser et al., 2019) were excluded. Additionally, studies using audio-taped instruction and no spoken input were excluded, as were interventions that involved the reading of word or text. Also, the effects of different display designs and use of colour in AAC interventions were excluded. The Picture Exchange Communication System was excluded, as this intervention typically focuses on expressive language outcomes such as requesting and commenting, and other communication lessons that do not rely on receptive language (Bondy & Frost, 2001).

Outcomes of the studies needed to include receptive language in any format as a dependent variable. Receptive language includes the comprehension of (a) vocabulary (words), (b) morphology (rule-bound organisation of language), (c) discourse (conversation), and (d) symbols (a graphic/form relates to a referent).

The studies that were included needed to employ single-case experimental designs (SCED) or a group of experimental designs. Pre-experimental designs, mixed-method designs, case studies, literature reviews, systematic reviews, meta-analyses and scoping reviews were excluded. The studies had to be published in English between January 1970 and December 2019. The year 1970 was used as a starting year because AAC began to be recognised as an independent field in the 1970s (Zangari et al., 1994). Studies needed to have been published in peer-reviewed journals or approved as a doctoral dissertation, based on their inclusion in ProQuest Dissertations and Theses Global. Conference proceedings, opinion pieces, policy reviews and editorials were excluded. The exact search terms applied to each database are available in Table 1 (Supplementary materials).

Data extraction

A data extraction form (Table 3, supplementary materials) was adapted from Schlosser, Lee, and Wendt (2008) and Schlosser and Koul (2015). This form was used by each author to extract data on (a) author and date; (b) purpose (effects of [independent variable] on [dependent variable(s)]); (c) participants (name/number, age, sex, diagnosis); (d) sampling method; (e) research design; (f) type of AAC intervention (aided, unaided); and (f) outcomes. IOA for data extraction was calculated by dividing the number of agreements by the number of disagreements, and multiplying the result by 100. IOA was 97%. Disagreements were discussed until consensus was reached.

For single-case experimental designs (SCEDs), the outcomes of each study were analysed using the percentage of non-overlapping data (PND) as an effect size indicator (Scruggs & Mastropieri, 2013). PND is a measure of non-overlap of data between baseline and intervention phases (Schlosser et al., 2008). Treatment PND scores were interpreted as highly effective (>90%), fairly effective (70%–90%) and unreliable or ineffective (<50%) (Scruggs & Mastropieri, 2013). The PND is an appropriate metric for scoping reviews that do not statistically aggregate effectiveness of data. Although theoretical shortcomings of the PND have been identified, these are reported to be rare, based on a systematic review of systematic reviews that employed the PND (Schlosser et al., 2008). For group designs, effects were measured using Cohen's *d*. Treatment effects using Cohen's *d* are positive effect sizes for use with small samples. Cohen's *d* can be interpreted as large (≥0.8), medium (0.4–0.7), and small (0.2–0.3) (Durlak, 2009).

Quality appraisal of studies. A certainty framework was used to assess the evidence of each included study (Simeonsson & Bailey, 1991). In this framework, the methodological quality of each study is coded according to the design of the study, the inter-observer agreement (IOA) relating to the dependent variable, and reported treatment integrity. The

ratings of the three categories are combined to determine the quality of the study, which is then classified as either conclusive, preponderant, suggestive, or inconclusive. Conclusive evidence shows that the outcomes were the result of the intervention, based on a design that provided experimental control, reliable IOA and solid treatment integrity (TI). Preponderant evidence suggests that reported outcomes were more than likely a result of the intervention, based on a design with minor flaws, and adequate IOA and TI. Suggestive evidence indicates that it may be plausible but not certain that the outcomes were the result of the intervention, based on a strong design but inadequate IOA and/or TI, or minor design flaws and inadequate IOA and/or TI. Inconclusive quality indicates that it was impossible to determine if the outcomes were associated with the intervention because of significant flaws in the design, regardless of IOA or TI (Millar, Light & Schlosser, 2006; Schlosser & Koul, 2015; Schlosser & Wendt, 2008). The first author extracted data for quality appraisal from all of the studies and the second author independently checked this. IOA for data extraction on the certainty of the research evidence was 96%. Disagreements were discussed until 100% agreement was reached.

According to Horner et al. (2005, p. 176) there are five standards of interventions that ensure that the best and most sound research forms the basis of EBP:

> *"(a) the practice is operationally defined; (b) the context in which the practice is to be used is defined; (c) the practice is implemented with fidelity; (d) results from single-subject research document the practice to be functionally related to change in dependent measures; and (e) the experimental effects are replicated across a sufficient number of studies, researchers, and participants to allow confidence in the findings."*

For this review, interventions in studies that provided conclusive and preponderant evidence of effect were evaluated, using the criteria suggested by Horner et al. (2005) to determine if any cohorts of interventions met the criteria for inclusion in EBP decision

making.

Results

The results of this study are reported according to the aims set. First, the results of the search are reported, after which the participants in and designs of the studies are described. Intervention strategies and an assessment of the quality of designs are followed by a description of the effects that the interventions had on receptive language. The final results pertain to the evaluation of the results to determine if they meet the requirements for evidence-based practice. In all sections, the search results are presented with regard to unaided AAC and aided AAC.

Search results

The results of the search conducted for this study are presented in Figure 1, in the form of a PRISMA diagram (Moher et al., 2009). A total of 5832 studies were identified through database searches and an additional 1498 studies through other sources. Altogether 5686 studies were excluded in the title and abstract screening phase, and 145 during the full-text screening phase.

A total of 16 studies were included for review. Six studies evaluated unaided AAC intervention strategies (Acosta, 1981; Kennedy, 1994; Poulton, 1981; Remington & Clarke, 1993a; Remington & Clarke, 1993b; Romski & Ruder, 1984) and ten studies evaluated aided AAC intervention strategies (Browder, Ahlgrim-Delzell, Courtade, Gibbs, & Flowers, 2008; Dada & Alant, 2009; Drager, Postal, Castellano, Gagliano, & Glynn, 2006; Fujisawa, Inoue, Yamana, & Hayashi, 2011; Harris & Reichle, 2004; Ho, 2000; Mims et al., 2016; Preis, 2006; Romski et al., 2010; Van Der Schuit, Segers, Van Balkom, Stoep, & Verhoeven, 2010).

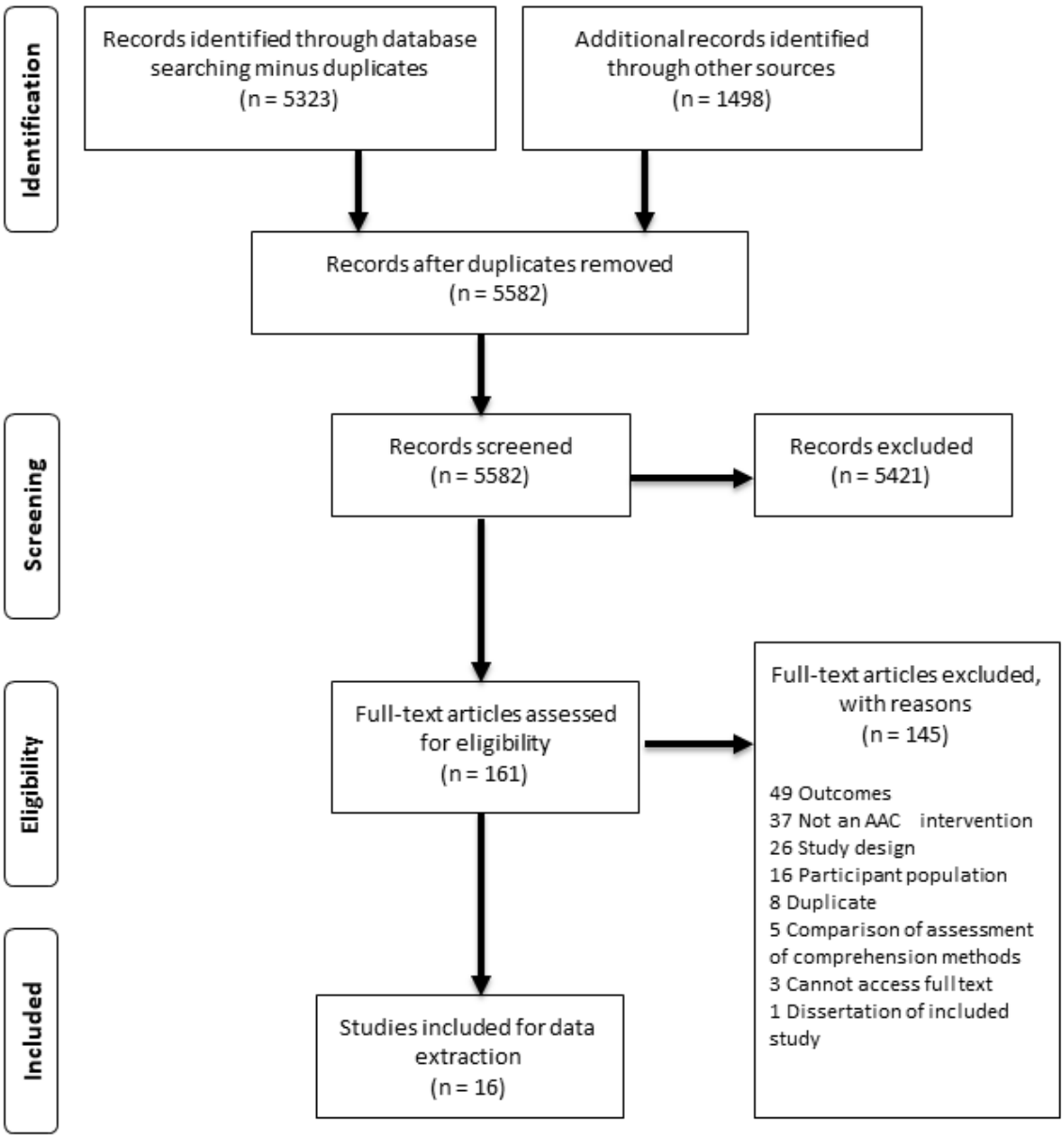

Figure 1: PRISMA flow diagram of the selection process

Participants, date and study design data

Unaided AAC. The studies on unaided AAC were conducted between 1981 and 1996. A total of 55 children, ranging in age from 1 year, 6 months to 14 years, 2 months – with a mean age of five years – were included. The majority of the participants were male (65.9%). The sex of participants was not described in one study (Romski & Ruder, 1984). Children with Down Syndrome were the focus of three studies (Acosta, 1981; Remington & Clarke, 1993a;

Romski & Ruder, 1984) and one study focused on children with autism spectrum disorder (Poulton, 1981). Participants with a variety of disabilities were included in two studies (Kennedy, 1994; Remington & Clarke, 1993b). SCEDs were used for five of the studies and a group design was used for the other study (Kennedy, 1994).

Aided AAC. The studies on aided AAC were conducted between 2000 and 2017. A total of 134 children, ranging in age from 2 years, 3 months to 18 years,11 months with a mean age of 7 years, 8 months, participated in the study. The majority of participants were male (*n* = 82, 63.1%), while 36.9% (*n* = 48) were female. The studies included children with Down Syndrome (n = 3) and intellectual disability (n = 1), followed by cerebral palsy (n = 3), multiple disabilities (n = 1), autism spectrum disorder (n = 2), and developmental disabilities (not specified) (n = 1).

SCEDs were used for the majority of the studies (n = 7). The remaining three studies used a group design (Browder et al., 2008; Romski et al., 2010; Van Der Schuit et al., 2010) of which two were randomised control trials (Browder et al., 2008; Romski et al., 2010).

Intervention strategies and quality of studies included in the review

Unaided AAC. One study comparing extensive sign training with mediated sign training (Remington & Clarke, 1993a) was deemed as conclusive. Extensive sign training involves the use of simultaneous communication during sign training together with intermittent reinforcement, whereas mediated sign training involves training of the comprehension of signs first, followed by expression of these.

One study on total communication was found to provide preponderant evidence (Acosta, 1981). Total communication involves the use of all modes of communication such as speech, manual signs and symbols, alongside non-verbal and paralinguistic communication (Powell & Clibbens, 1994).

Suggestive evidence was provided by three studies. One study compared extensive or

differential sign training (training of signs using an alternating mixture of simultaneous communication) and auditory input only in order to cue signs (Remington & Clarke, 1993b). A second study considered the effect of total communication on comprehension (Kennedy, 1994). The third study compared interventions with components of communication (signs, speech, and simultaneous communication) (Poulton, 1981). A final study comparing interventions using speech and simultaneous communication provided inconclusive evidence (Romski & Ruder, 1984).

Aided AAC. Conclusive effects were reported by seven studies using aided AAC interventions. These included studies on aided language stimulation (Dada & Alant, 2009; Harris & Reichle, 2004) – pointing to pictures while providing verbal language stimulation (Goossens, 1989) – and studies on aided language modelling (pointing to an environmental referent and then, within two seconds, to a graphic symbol of the referent while simultaneously speaking the word for the symbol) (Drager et al., 2006). Additional studies with conclusive evidence focused on (a) a comparison of symbol modelling in a natural context and paired association instruction (Ho, 2000); (b) objects embedded in a storybook (Mims et al., 2009); (c) the presence or absence of pictures (Preis, 2006); and (d) a comparison between speech, Augmented Communication Input (speech from the communication partner is supplemented with a speech-generating device) and Augmented Communication Output (the child is prompted using a prompting hierarchy and hand-over-hand prompts to use the speech-generating device to produce communication) (Romski et al., 2010).

Suggestive effects were provided in a study by Browder et al. (2008) on an early literacy curriculum and in a study by Fujisawa et al. (2011). Inconclusive results were presented in a comparative study on an experiential intervention programme and an anchor-based intervention (Verhoeven & Aarnoutse, 2000). With an “anchored” approach, the core theme is

grounded in the current development and interest of the child, and intended to increase and broaden experiential knowledge and vocabulary associated with the anchor (Van Der Schuit et al., 2010).

The studies included in this review are described in Table 4 (Supplementary materials). The sections of the table are organised in terms of certainty of evidence, beginning with conclusive evidence, followed by preponderant, suggestive and inconclusive evidence. The intervention strategies and their effects are described next.

Effects of the intervention strategies on receptive language

Unaided AAC. For studies that presented preponderant and conclusive evidence, the use of both oral and total communication was fairly effective for vocabulary acquisition, although total communication provided a slightly higher PND (85.71% vs 80.56%) than oral communication (Acosta, 1981). The second study did not provide sufficient data for the calculation of PND for speech comprehension, but did identify that neither extensive nor mediated sign training prevented over selectivity of the visual over the auditory mode (Remington & Clarke, 1993a).

For studies that provided suggestive evidence for the comprehension of words and signs, differential sign training was identified as fairly effective, compared to extensive sign training, which was unreliable (Remington & Clarke, 1993b). Total communication was reported to provide significantly higher comprehension scores than speech only, particularly for a younger intervention group (Kennedy, 1994). Simultaneous communication was highly effective (PND 100%) in comparison to sign-only or speech-only intervention, which were both fairly effective (70.56% and 70% respectively) (Poulton, 1981).

In the study reporting inconclusive evidence for the comprehension of relational meanings in phrases and sentences, seven out of ten children were reported to take fewer trials

to reach the criterion in the simultaneous communication intervention than in the speech-only intervention (Romski & Ruder, 1984).

Aided AAC. For studies that presented conclusive evidence, the efficacy of the augmented input for vocabulary acquisition was questionable for aided language stimulation (PND 66.67%) (Dada & Alant, 2009). A medium effect size was identified for the mode of presentation when spoken communication was compared to augmented communication input and augmented communication output, with augmented communication output showing the greatest effect, followed by augmented communication input and, lastly, spoken communication with the smallest effect (Romski et al., 2010). For studies assessing symbol comprehension, the augmented input techniques of aided language modelling and aided language stimulation were reported to be fairly effective, with PNDs of 74.3% (Drager et al., 2006) and 72.89% (Harris & Reichle, 2004) respectively. The use of paired association was identified as being fairly effective (PND 87.37%) in comparison to modelling in a natural context, which was questionable (PND 60.10%) for symbol identification (Ho, 2000). Another study reported fairly effective results for comprehension by using objects embedded within storybook reading (PND 74.66%) (Mimms et al., 2009), while one more study reported no effect of the inclusion or absence of pictures for sentence comprehension (Preis, 2006).

For studies using aided AAC that provided suggestive evidence, a study on non-verbal literacy showed large effects of an early literacy skills intervention, but medium effects for receptive vocabulary development (Browder et al., 2008). A study by Fujisawa and others (2011) suggested that the use of animation could benefit students in the learning of verbs, but statistical effect was not measured.

In a study that provided inconclusive evidence of receptive vocabulary, reported the use of an anchor-based intervention to be highly effective – in comparison to an experiential learning programme (Van Der Schuit et al., 2010).

Evidence-based practice

Unaided AAC. The cohort of studies on unaided AAC provide insufficient evidence for any specific intervention to be considered empirically supported and included in decision making for EBP. Although the interventions were well defined, treatment integrity (TI) was reported in only one study (Remington & Clarke, 1993a). This challenges the fidelity of the interventions and the assumption of causation reported in the results (Horner et al., 2005). In addition, the minimum recommendation of five supporting studies per intervention proposed by Horner and Kratochwill (2012) has not been met.

Aided AAC. Among the cohort of studies reporting on aided AAC interventions, three studies were judged as fairly effective according to the PND and appraised as providing conclusive evidence for augmented input and comprehension. These studies made use of Aided Language Modelling (Drager et al., 2006), Aided Language Stimulation (Harris & Reichle, 2004), and storybook reading with embedded objects in the book (Mims et al., 2009). Although positive results were suggested by these studies, and each was implemented with adequate or better TI, the operational definition of each modelling technique is slightly different, as were the contexts in which they were used. Due to the differences in operational definitions of each of the interventions and a lack of studies on any specific intervention (minimum of five required), this cohort on the comprehension of symbols or objects does not meet the criteria for inclusion in decision making for EBP (Horner & Kratochwill, 2012).

A further two studies (also providing conclusive evidence) indicated that the teaching of symbols using paired association was fairly effective, in contrast to an augmented input intervention that was questionable (Ho, 2000). Furthermore, the presence or absence of pictures did not influence the follow through of verbal commands (Preis, 2006). Thus, similarly insufficient evidence was provided to suggest that these interventions could be included in decision making for EBP (Horner & Kratochwill, 2012).

Vocabulary acquisition was targeted in a cohort of five studies using augmented input. One presented conclusive evidence of a large effect of augmented communication output and input over speech only (Romski et al., 2010). The remaining studies reported conclusive evidence regarding questionable effects of aided language stimulation (Dada & Alant, 2009), suggestive evidence of a medium effect of an early literacy skills programme (Browder et al., 2008), suggestive effects of the benefit of animation (Fujisawa et al., 2011) and inconclusive evidence of large effect sizes for an anchor-based intervention (Van Der Schuit et al., 2010). Hence, insufficient evidence is provided for any of these interventions on vocabulary acquisition to qualify for decision making for EBP (Horner & Kratochwill, 2012).

Discussion

For children with developmental disabilities who are candidates for AAC, the development of receptive language requires both opportunities and input to acquire skills. All AAC interventions included in this scoping review involved a combination of speech and augmented input, using either aided or unaided AAC systems.

Unaided AAC Intervention

Unaided AAC approaches such as manual signing are reported to be as effective as aided AAC approaches in the acquisition of new communicative behaviours (Mirenda, 2003; Schlosser & Lee, 2000). Yet, despite these reports, this review confirms the findings of Goldbart and Caton (2010), who noted that unaided AAC interventions have not been the subject of recent investigation. The studies of unaided AAC interventions in this review were conducted between 1981 and 1995 and addressed only word-level acquisition and comprehension skills. This is in line with the findings of Mirenda (2003), who noted that almost all of the research studies considering unaided AAC focused on the teaching of receptive or expressive labels. In addition, no studies were found for this review that compared the efficacy of aided and unaided AAC interventions. As such, although unaided

AAC (implemented by using augmented input) shows promise for the development of receptive language, the evidence is insufficient at this time to include it in decision making for EBP. The lack of evidence of effective interventions within unaided AAC is particularly concerning, as it has been reported that early intervention with children who are candidates for AAC is conducted primarily by using unaided AAC (Romski et al., 2015).

A further concern specifically related to unaided AAC studies is the quality of the studies. Only two unaided AAC studies met the requirements for conclusive or preponderant evidence. If the field is to grow, studies with stricter quality control are required.

Aided AAC intervention

The studies on aided AAC interventions identified for this review gave a broad description of the use of aided input and included a variety of different strategies. A similar pattern was described in reviews by Sennott et al. (2016), Allen et al. (2017), Biggs et al. (2018) and O'Neill et al. (2018). The different augmented input strategies described caused some concern as multiple strategies fragment the data on vocabulary acquisition and symbol comprehension presented in this review. Consequently, there is not sufficient evidence to highlight any single strategy for inclusion in decision making for EBP.

Although the studies on aided AAC were of a higher quality overall than the studies on unaided AAC, limitations in the targeted areas of receptive language studied remain evident, with single-word vocabulary or symbol acquisition being the focus of both groups of studies. Single-word vocabulary acquisition does not suggest morphological or syntactic learning and as such is a relatively weak representation of receptive language learning. In order to ensure that children who make use of AAC can do so to their full potential, an understanding is required of how receptive language can be strengthened using AAC.

Gaps in the literature

For both aided and unaided augmented input, a general lack of acknowledgement for augmented input as an intervention strategy is concerning. As highlighted previously, when interventions are described by different names and variations occur in instructional procedures, the information on each intervention is fragmented and cannot be collated. Thus, it is not possible to determine if augmented input as an overarching strategy has merit and should be included in decision making for EBP. This challenge is further complicated by the fact that few studies ventured to compare the various intervention strategies for efficacy. The result is that it is currently unclear which interventions are more effective for benefiting receptive language development.

The lack of clarity on augmented input, as well as the focus on single-word or single-symbol vocabulary learning, points to the prevailing emphasis placed on expressive language for children who are AAC users and not on the development of receptive language. In such cases, the focus tends to be on word learning, as noted during this review, and a gap can be identified in research on the effects of AAC intervention on morphological, syntax and discourse comprehension. This finding is supported by Romski et al. (2015), who suggested that language interventions for young children who rely on AAC should target language skills beyond single-word vocabularies to assist a child through all the stages of language development.

Besides a lack of comparison studies on the interventions used for augmented input, a lack of comparison of aided vs. unaided interventions is evident. Similar findings were reached by Mirenda (2003), who called for focused and systematic research that directly compares unaided and aided AAC approaches. This review highlights that a dearth of comparative studies continues to be an issue in the field.

Furthermore, the literature base consists predominantly of SCEDs. Randomised controlled trials or non-randomised group studies are scant, resulting in greater difficulty to determine the efficacy of intervention strategies. Lastly, there is a significant gap in the literature in terms of limited conclusive data that addresses the impact of AAC interventions on adolescents (not children) with developmental disabilities, as well as in terms of the different disability groups represented, seeing that the population of individuals with developmental disabilities is diverse (Sennott et al., 2016).

Limitations

Most systematic reviews and scoping reviews in AAC do not include unpublished studies. While we systematically searched for unpublished dissertations and theses, the small yield of qualifying papers (n = 4) did not permit a formal analysis of publication bias. Publication bias related to this review implies that studies that report strong evidence of effects are more likely to be published than studies showing little or no effect. As AAC is a relatively new field, and the number of individuals with complex communication needs is small, the number of participants in studies may be low, which decreases the strength of effect that can be reported, and thus the likelihood of publication is reduced.

Finally, language bias must be considered. It has been documented that, for some topics, the inclusion of papers in English only yields different effect sizes, compared to systematic reviews that include articles written in other languages too (e.g., Gregoire, Derderian, & LeLorier, 1995). At this point in time, it is unknown how publication bias in general and language bias in particular play out in the expansion of AAC literature and how prevalent these challenges might be.

Furthermore, this review used a certainty of evidence framework for quality appraisal of the included studies, which entailed an assessment of design, IOA, and TI. However, the results of the quality assessment may not be generalised to the use of other quality appraisal

tools (Schlosser & Koul, 2015). A final limitation of this scoping review was a lack of coding of the dosage and frequency of interventions applied, as this may have an impact on outcomes for language development.

Conclusions and recommendations

The body of research on the use of aided AAC interventions to improve receptive language skills indicates that there are high-quality studies that suggest that aided augmented input may support the receptive language development of children with developmental disabilities. However, a lack of clarity in describing augmented input fractures the field and prevents the inclusion of augmented input as an intervention in decision making for EBP. Further research into the use of unaided AAC interventions is required, as well as research focused on morphological, syntax and discourse intervention. Future studies in these areas should focus on providing clarity on the augmented input strategies used, as well as the dosage and frequency of implementation. Research should also compare augmented input techniques to determine if these can be grouped into a single practice to assist professionals in the decision-making process.

Future research should be designed with sufficient methodological rigour to establish experimental control, ensure the reliability of the dependent measures of receptive language skills, and ensure appropriate treatment integrity. The scoping review in hand provides preliminary evidence and maps the available research evidence on AAC interventions that support the development of receptive language skills of children with developmental disabilities.

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