

Case Study 1: An Evidence-Based Practice Review Report

Theme: School based intervention for children and young people with special educational needs (SEN)

Title: How effective is peer-mediated aided Augmentative and Alternative Communication (AAC) in improving the social interactions of young children with communication difficulties?

Summary

This systematic literature review examined how peer-mediated, aided Augmentative and Alternative Communication (AAC) is implemented by educational settings, in order to evaluate how effective aided AAC is in improving the social interactions of children with communication difficulties.

AAC is an intervention tool that can be used to support children, young people and adults who have communication difficulties, by supporting the functional speech of individuals whose communication would otherwise be limited (Dawson, 2008). Functional speech is often initiated by adults and directed towards children (Dawson, 2008) thus reducing the number of social interactions with peers (Thiemann-Bourque, Brady, McGuff, Stump, & Naylor, 2016). With this in mind, this review evaluates the use of peers as initiators of communication, using aided AAC. The use of peers in this capacity is referred to a peer-mediated throughout the review.

AAC ranges from unaided interventions e.g. manual signs, to aided interventions e.g. Picture Exchange Communication System (PECS) or a Speech Generating Device (SGD) (Light, Roberts, Dimarco, & Greiner, 1998).

Those who use either form of AAC require some exposure to and training with the technique in order to implement its use (Patel & Khamis-Dakwar, 2005). Despite AAC's varied use, the focus of this systematic literature review is to evaluate the effects of peer-mediated, aided AAC that can be used in educational settings with young children who have communication difficulties.

The review found that there were a number of peer-mediated, aided AAC interventions that have been shown to improve the social interactions of young children with communication difficulties. Social interactions were improved between typically developing peers and peers who themselves had communication difficulties, highlighting the benefits of this intervention across mainstream and specialist settings.

Introduction

AAC is an intervention that is used to support children, young people and adults who have communication difficulties (Thiemann-Bourque et al., 2016). Communication difficulties are not specifically defined by the research. Dawson (2008) identifies a spectrum of communication difficulties with which AAC can be used, including children who have limited expressive language and stronger receptive language. Murphy, Markova, Collins and Moodie's (1996) research furthers this by providing AAC to young people with cerebral palsy who have both receptive and expressive language difficulties. Higginbotham, Shane, Russell and Caves (2007) concluded that AAC should be used with all children, young people and adults who have a communication difficulty that affects their ability to express their thoughts and feelings. This includes children, young people and adults with Autism Spectrum Disorder

(ASD), Specific Language Impairment (SLI) and Developmental Language Disorder (DLD) under the umbrella term communication difficulties. This definition is adopted by this review which is why young children with a range of communication difficulties have been included.

Dawson (2008) suggests that the use of AAC is more prominent between the child and the adult who supports them. This is because communication serves a function, which is to express a desire or thought that is often directed towards an adult and initiated by an adult (Dawson, 2008 & Higginbotham et al., 2007). In this instance the use of AAC would be adult-mediated, however this terminology is not used in the literature. This review is focused on peer-mediated, aided AAC, which means that AAC is used by peers to initiate communication and communication is directed towards peers as opposed to adults.

AAC interventions are available in two forms, unaided and aided. Unaided AAC interventions use the body to aid communication, for example Makaton (Light et al., 1998). Whereas aided AACs are external from the body and can include written scripts, Picture Exchange Communication Systems (PECS) and Speech Generating Devices (SGDs) (Light et al., 1998).

The forms of peer-mediated, aided AAC examined in this systematic literature review are; PECS, scripts with pictures and portable SGDs. PECS is a six phase process that uses pictures as a vehicle for communication. PECS begins by introducing the pictures and gaining familiarity with them, gradually moving towards developing the ability to ask and answer questions using pictures (Paden, Kodak, Fisher, Gawley-Bullington, & Bouxsein, 2012;

Thiemann-Borque et al., 2016). Written scripts can be displayed around the classroom. They can be given to a person or can be read to a person and in this way, support communication through supporting the initiation of social interaction (Ganz & Flores, 2007; Ledbetter-Cho et al., 2015; Nelson, McDonnell, Johnston & Crompton, 2007).

The portable SGDs that were explored in this review are available on iPods and iPads in the form of apps such as GoTalk NOW (Therrien & Light, 2016) and Proloquo2go™ (Strasberger & Ferreri, 2013), or handheld SGDs such as the Talara-32 (Trembath et al., 2009). They enable adults to input words and phrases with pictures that can be used by children and young people during social interactions. The devices used in this review were touch screen and enabled the participants to ask or answer questions using pre-programmed requests. This limits social interactions as young children may only interact based on the information already stored on the SGD and may find it difficult to interact outside of what has already been pre-programmed (Blackstone, Williams & Wilkins, 2007).

Training is a necessary requirement for aided AAC to be implemented, with models of delivery drawing on behaviourist principles (Skinner, 1985). Training techniques include; Differential Reinforcement of Alternative Behaviour (DRA) (Thiemann-Borque et al., 2016), Peer Assisted Communication Application (PACA) training (Strasberger & Ferreri, 2013) and hand over hand prompting (Thiemann-Bourque et al., 2016).

The development of peer-mediated, aided AAC has given a 'voice' to young children who may have spent little or no time communicating with adults and

peers (Dawson, 2008). With the increasing strain on resources in educational settings (DfE, 2010), limited spaces in specialist settings (Artiles, 2003) and a drive for inclusive schools (Artiles, 2003; DfES, 1993; Runswick-Cole, 2008), young children who may have traditionally attended specialist settings are in mainstream environments (Vislie, 2003) and need a means of communicating. In addition to other interventions, AAC can also be implemented to support children and young children who face this difficulty.

The principles of AAC are rooted in behavioural psychology and are in line with Skinner's (1953) research on language as learned behaviour. Skinner (1953) suggests that learned behaviour is controlled by environmental variables and acts as a stimulus to which humans respond. This can be seen with the use of PECS which requires the selection of a symbol in order to get a response. This behaviour is reinforced by the response of the interaction.

Communication theory suggests that communication is an essential part of our human functions and facilitates our social interactions (Berger & Calabrese, 1974; Littlejohn, 2010). Having a reduced ability to communicate with those around you may lead to poor social interactions, behavioural difficulties, a lack of motivation and could also be detrimental to one's mental health (MacGregor, Rodger, Cummings & Leschied, 2006). Communication difficulties may also impact a child or young person's ability to access an educational environment, thus potentially leading to further difficulties in their educational career (Ronski & Sevcik, 2005).

This systematic literature review develops the notion that peer-mediated, aided AAC gives a young people a voice, by exploring whether increased

communication skills through using aided AAC will in turn lead to an improvement in social interactions. The literature around AAC focuses on adult mediated interactions which is why this review identifies the need to look at peer-mediated interactions. Inclusion ideology advocates for the necessity of all students to be able to communicate with each other (UNESCO, 2005) and peer-mediated aided AAC supports this.

Educational Psychologists (EPs) can use and support the use of peer-mediated aided AAC as part of developing the social interaction skills for young people with communication difficulties. EPs should endeavour to monitor and assess the effectiveness of the use of any peer-mediated, aided AAC intervention as a means for improving the social interactions of this group. In addition, EPs can use aided AAC to gather the pupil voice in line with the Children and Families Act (2014) which promotes a more person centred approach during the Education Health and Care Plan (EHCP) process. This approach would be more beneficial in settings where peer-mediated, aided AAC is embedded into practice, due to the training element mentioned above.

Review Question

The question that this systematic review aims to address is: How effective is peer-mediated, aided AAC in improving the social interactions of young children with communication difficulties? This review evaluates the effectiveness of peer-mediated, aided AAC that can be implemented in an educational setting, with young children with communication difficulties. Peers are included in this review regardless of communication abilities. Evidence

that explores how effective the intervention is in improving the social interactions of young children with communication difficulties will be evaluated.

Critical review of the Evidence Base

Systematic literature search

A systematic search of the literature was conducted in January 2018. Figure 1 shows the search and exclusion process and Table 1 shows the inclusion and exclusion criteria used to identify the relevant studies. The PsycINFO, Education Resource Information Centre (ERIC) EBSCOHost and MEDLINE databases were searched using the combinations of search terms identified in Figure 1. Database tools were used to search in the following parameters: peer reviewed journals; English Language; Pre-school and primary age (ERIC EBSCO and PsycINFO); Child age (MEDLINE), humans and studies 0-30 years old.

Figure 1 Flow chart of the search and exclusion process

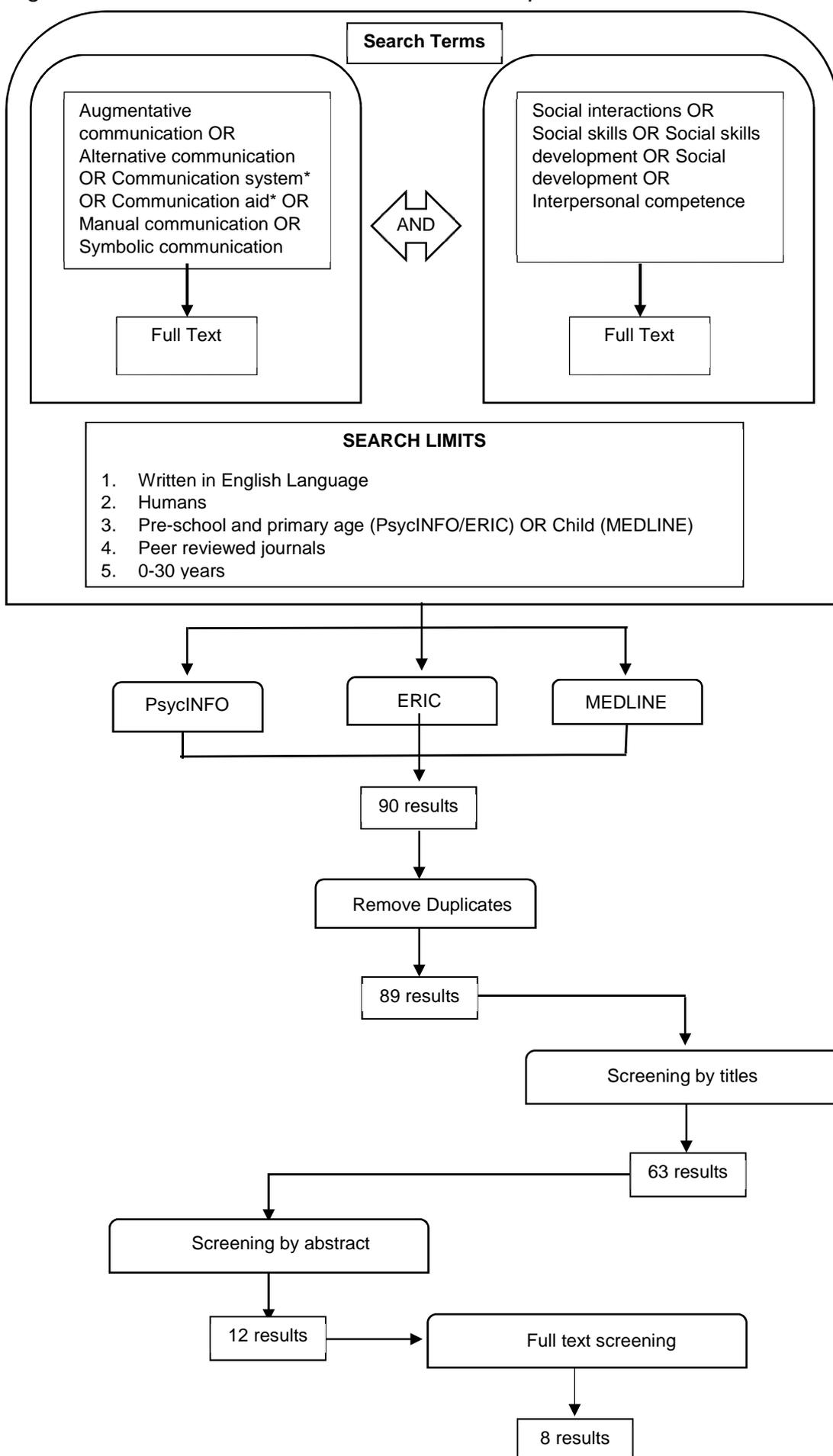


Table 1
Inclusion and Exclusion Criteria

	Features of the Study	Inclusion Criteria	Exclusion Criteria	Rationale
1	Methodological design	Studies that use; Random control trials, Quasi-experimental studies, single case experimental designs or cohort studies	Studies that use; non experimental evaluations, case controls, surveys or qualitative research as their design	Petticrew & Roberts (2003) suggest that this methodological approach is best suited for questions on effectiveness
2	Type of publication	Studies that have been published in peer reviewed journals	Studies that have been published in sources outside of peer reviewed journals	Research published in peer reviewed journals has been rigorously evaluated by expert reviews and have met quality standards
3	Language of the study	Studies should be written entirely in English	Studies where there are sections written in other Languages	This will allow evaluation of the entire study
4	Date of report	Studies between 1988 and 2018	Studies prior to 1988	Research should be published in recent history
5	Language of the participants	Participants first language is English	Participants first language is not English	The study is being conducted in England. For ease of generalisation the language of the participants should reflect this.

	Features of the Study	Inclusion Criteria	Exclusion Criteria	Rationale
6	Age of participants	Studies should include children aged 2 – 12 years old	Any studies where the participants were older or younger than 2 – 12 years old	This review is evaluating young children, who fall into the 2 – 12 year old age bracket
7	Intervention	Studies use AAC	Studies use other interventions that support social interactions	The focus of this review is AAC
8	Type of AAC	a) This review includes studies that use aided AAC	a) Studies that use unaided AAC	a) The studies reviewed aided AAC due to the increased use of these interventions in mainstream school settings
		b) Studies that are peer-mediated	b) Studies that do not use peers at all or use family members	b) This review is evaluating peer-mediated aided AAC, so including peers is essential
9	Outcomes	Studies focused on the development of social interaction	Studies focused on the development of skills that are not social interaction e.g. language or reading	The outcome being evaluated in this review is social interaction so studies should reflect that

Rationale for these limits can be found in Table 1, which states the inclusion and exclusion criteria. Ninety articles were identified from searching the three databases, after removing duplicates there were 89 articles in total. At stage one of the exclusion process the articles were screened by title using the inclusion and exclusion criteria, 63 articles remained. The remaining stages of inclusion and exclusion are represented in Figure 1. After full text screening, using the inclusion and exclusion criteria eight studies remained and are the focus of this review. Table 2 provides full references for the studies included in this review. Appendix A lists all excluded studies with rationale.

Table 2

Eight studies included in this review

Full References
Ganz, J. B., & Flores, M. M. (2008). Effects of the use of visual strategies in play groups for children with autism spectrum disorders and their peers. <i>Journal of Autism and Developmental Disorders</i> , 38(5), 926–940. DOI: 10.1007/s10803-007-0463-4
Ledbetter-Cho, K., Lang, R., Davenport, K., Moore, M., Lee, A., Howell, A., Drew, C., & Dawson D. (2015). Effects of script training on the peer-to-peer communication of children with autism spectrum disorder. <i>Journal of Applied Behavior Analysis</i> , 48(4), 785–799. DOI: 10.1002/jaba.240
Nelson, C., McDonnell, A. P., Johnston, S. S., & Crompton, A. (2007). Keys to Play : A Strategy to Increase the Social Interactions of Young Children with Autism and their Typically Developing. <i>Education and Training in Developmental Disabilities</i> , 42(2), 165–181.
Paden, A. R., Kodak, T., Fisher, W. W., Gawley-Bullington, E. M., & Bouxsein, K. J. (2012). Teaching Children With Autism To Engage in Peer-Directed Mands Using a Picture Exchange Communication System. <i>Journal of Applied Behavior Analysis</i> , 45(2), 425–429. DOI: 10.1901/jaba.2012.45-425

Full References

- Strasberger, S. K., & Ferreri, S. J. (2014). The Effects of Peer Assisted Communication Application Training on the Communicative and Social Behaviors of Children with Autism. *Journal of Developmental and Physical Disabilities, 26*(5), 513–526. DOI: 10.1007/s10882-013-9358-9
- Therrien, M. C. S., & Light, J. (2016). Using the iPad to facilitate interaction between preschool children who use AAC and their peers. *AAC: Augmentative and Alternative Communication, 32*(3), 163–174. DOI: 10.1080/07434618.2016.1205133
- Thiemann-Bourque, K., Brady, N., McGuff, S., Stump, K., & Naylor, A. (2016) Picture Exchange Communication system and Pals: A Peer-Mediated Augmentative and Alternative Communication Intervention for Minimally Verbal Preschoolers with Autism. *Journal of Speech, Language, and Hearing Research, 59*, 1133-1145. DOI: 10.1044/2016_JSLHR-L-15-0313
- Trembath, D., Balandin, S., Togher, L., & Stancliffe, R. J. (2009). Peer-mediated teaching and augmentative and alternative communication for preschool-aged children with autism. *Journal of Intellectual and Developmental Disability, 34*(2), 173–186. DOI: 10.1080/13668250902845210
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Mapping the field

Table 3 shows the key features of the eight studies that have been identified through the systematic literature search. The studies discuss the use of peer-mediated aided AAC and the effects of this on social interactions.

Table 3
Mapping the field

	Sample size	Participant Characteristics	Country	Intervention description	Outcomes	Follow up
Ganz & Flores (2008)	6	1. Male, 4.6 years, high functioning ASD 2. Male, 4.5 years, ASD 3. Male, 4.7 years, PDD-NOS, strabismus and far sightedness <hr/> Two typically developing peers	USA	Written scripts	Increase in scripted verbalisations with peers and an increase in context-related comments across all participants which increased social interactions between peers	No follow up
Ledbetter-Cho et al. (2015)	4	1. Male, 6.3 years, mild to moderate ASD 2. Male, 4.9 years, mild to moderate ASD 3. Male, 6 years, severe ASD <hr/> One Typically developing peer	USA	Written script with pictures	The increase in the use of graphic symbols and verbal language to enter play activities was noteworthy	No follow up

	Sample size	Participant Characteristics	Country	Intervention description	Outcomes	Follow up
Nelson, et al. (2007)	4	1. Male, 4.5 years, ASD 2. Male, 4.1 years, ASD 3. Male, 4.3 years, ASD 4. Enrique, 3.9 years, ASD <hr/> The rest of the setting where used as the typically developing peers	USA	iPad based communication tool	Turn taking during social interactions increased, but this was inconsistent throughout the intervention and during follow up	One participant had follow up three weeks after intervention
Paden et al. (2012)	2	1. Male, 7 years, ASD 2. Male, 9 years ASD	USA	PECS	Improvements in communication which lead to increased social interaction between the participants	No follow up

	Sample size	Participant Characteristics	Country	Intervention description	Outcomes	Follow up
Strasberger & Ferreri (2014)	11	1. Male, 8.4 years, ASD and cognitive impairment 2. Male, 12.11 years, ASD 3. Male, 9.2 years, ASD 4. Male, 5.8 years, ASD <hr/> Seven typically developing peers	USA	SGD	Increase in social interactions when the SGD was introduced, this was not maintained throughout the intervention	No follow up
Therrien & Light (2016)	2	1. Male, 4.2 years, Prada Willi Syndrome 2. Male, 4.10 years, 22q deletion <hr/> Six typically developing peers	USA	iPad based communication tool	Introduction of the aided AAC increased social interactions, responses to initiations were mostly ignored	Follow up conducted after four weeks

	Sample size	Participant Characteristics	Country	Intervention description	Outcomes	Follow up
Thiemann-Bourque et al. (2016)	4	1. Male, 5.1 years, ASD 2. Male, 3.9 years, ASD 3. Male, 4.7 years, ASD 4. Female, 3 years, ASD <hr/> Seven typically developing peers	USA	PECS	Increase in independently created social interactions	No follow up
Trembath et al. (2009)	3	1. Male, 4 years, ASD 2. Male, 4 years, ASD 3. Male, 4 years, ASD <hr/> Three typically developing peers	Australia	SGD	Participants were able to use the device but there was not discussion about the effects of this use on social interactions	Follow up conducted four weeks after intervention

Note. Autistic Spectrum Disorder (ASD), Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS), United States of America (USA), Picture Exchange Communication System (PECS) and Speech Generating Device (SGD).

Critical evaluation

Gough's (2007) weight of evidence framework was used to analyse the evidence discovered through the systematic literature search. The studies were rated using weighted criteria focusing on; the methodological quality of the study – weight of evidence A (WoE A), the relevance of the research design to the review question – weight of evidence B (WoE B) and the relevance of the topic to the review question – weight of evidence C (WoE C). These were then combined to create an overall evaluation rating, weight of evidence D (WoE D).

To calculate WoE A, Horner et al's. (2005) protocol was used to assess the methodological quality of the studies, as all eight are single-case designs. Horner et al. (2005) focuses on seven key areas; description of participants and settings, dependent variable, independent variable, baseline, experimental control/internal validity, external validity and social validity. Each area is given a rating out of three and then an average overall score for the article is calculated. The average rating is then converted into a WoE A weighting, Appendix B provides the criteria and rationale for conversion. Appendix C contains examples of the Horner et al. (2005) protocol used in this review.

To calculate a WoE B weighting, Petticrew and Roberts (2003) typology of evidence criteria was applied. They present criteria to denote how compatible the research design is for answering the research questions e.g. Randomised Control Trials (RCTs) are well-suited to answer questions on effectiveness. See Appendix B for further details.

Review specific criteria was used to evaluate the relevance of the studies in answering the review question (Appendix B). This rating provided a WoE C weighting.

WoE A, B and C weightings range from 1 to 3. An average of the results were taken to create WoE D. Table 4 contains these weightings.

Table 4
Weight of evidence ratings for the studies evaluated in this review

	WoE A	WoE B	WoE C	WoE D
Ganz & Flores (2008)	2.4 (high)	2 (medium)	2 (medium)	2.1 (medium)
Ledbetter-Cho et al. (2015)	2.3 (medium)	2 (medium)	1.75 (medium)	2.0 (medium)
Nelson, et al. (2007)	2.9 (high)	2 (medium)	2.25 (medium)	2.4 (high)
Paden et al. (2012)	1.9 (medium)	2 (medium)	1.75 (medium)	1.9 (medium)
Strasberger & Ferreri (2014)	2.4 (high)	2 (medium)	1.25 (medium)	1.9 (medium)
Therrien & Light (2016)	2.3 (medium)	2 (medium)	2.2 (medium)	2.2 (medium)
Thiemann-Bourque et al. (2016)	2.6 (high)	2 (medium)	2.25 (medium)	2.3 (medium)
Trembath et al. (2009)	2 (medium)	2 (medium)	2.25 (medium)	2.1 (medium)

Note. Ratings between 1 – 1.6 are “low”, 1.7 – 2.3 are “medium” and 2.4 – 3 are “high”

Participants/Population

The age range of the young children discussed in this study is 2-12 years, meaning that the results from this review are applicable to children within this range. Originally this review was aimed at pre-school (age 2-5) participants but the remit of the search was extended to capture more studies on the subject area. It is for this reason that a higher WoE C rating is given to studies whose participants were younger as it was the original aim of the review.

Of the 25 participants with communication difficulties included in the review, 21 had a diagnosis of Autism (ASD). One participant had a diagnosis of ASD and cognitive impairment with the remaining participants presenting other diagnoses that affected their communication e.g. Prada Willi Syndrome, 22q Deletion and Pervasive Development Disorder – Not Otherwise Specified (PDD-NOS) with strabismus and far sightedness. Some of the studies expressed more details about the nature of diagnoses e.g. Mild ASD and the method used to diagnose. For example Thiemann-Bourque et al. (2016) used a combination of the Autism Diagnostic Observation Schedule (ADOS) and the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM IV) to identify that two participants had moderate ASD and two severe. This level of detailed provided in the participants section contributed to the high WoE A rating awarded. In contrast Paden et al. (2012) provided very little detail on this matter which is reflected on their low WoE A rating.

Studies in this review focus on peer-mediated aided AAC. Paden et al. (2007) included peers who also have communication difficulties as mediators whilst the remaining studies included typically developing peers. Weighting was not

give dependent on whether the peer was typically developing or not, but it is important to highlight the variety of peers used in the research as it presents evidence towards peer-mediated, aided AAC's suitability for use in specialist and mainstream settings. Based on the overall weightings (WoE D) provided, this review indicates that peer-mediated, aided AAC is more effective in improving social interactions when typically developing peers mediate and the effect sizes presented in Table 7 corroborate this finding. Although Paden et al. (2007) included peers who themselves have communication difficulties and reports large effects, it would not be possible to generalise these finding based on one study.

Peer-mediated, aided AAC was effective regardless of the communication difficulty faced by the participant. For example, there was a moderate to large effect on the social interactions of participants with ASD, between baseline and intervention and a moderate effect on participants with other communication difficulties e.g. Prada Willi Syndrome. Thus highlighting the range of communication difficulties with which peer-mediated, aided AAC is effective.

Location

This review evaluates studies that were conducted in countries outside of the United Kingdom (UK). The aim of the review was to capture evidence that would allow for generalisation to the UK education system, because of its similarities. The studies were researched in the United States of America (USA) and Australia which, like the UK are members of the Organisation for Economic Co-operation and Development (OECD). Although the foundations of their education systems are similar (OECD, 2018), the presentation varies

e.g. students in the UK attend secondary school at 11 years, whereas at 11 years old students in the USA attend Junior High and move to a High school three years after.

This review acknowledges that being a member of the OECD does not equate to having English as a first language, however this was addressed as part of the inclusion and exclusion criteria (see Table 1 for rationale).

The aim of this review was to include some UK based research, however there was none available for inclusion using the inclusion and exclusion criteria described in table 1. This led to the inclusion of research from countries who are a members of the OECD. For this reason research conducted in countries that are members of the OECD were not awarded the highest WoE C, but given some weighting due to the generalisation that being a member of the OECD allows.

Intervention design

Of the eight studies evaluated, there were three variations in intervention design. Nelson et al. (2007), Thiemann-Bourque et al. (2016) and Trembath et al. (2009) used a fully naturalistic and included all of the young children in the setting as peer-mediators. This was given the highest WoE C rating, as the effects of the intervention are likely to be caused by the design reflecting natural classroom conditions. With all of the peers in the setting able to mediate using aided AAC, it enabled participants with communication difficulties to engage in social interactions with all members and not limit their social interactions to a select few.

The second design presented a partially naturalistic design and was used by Ganz and Flores (2008), Paden et al. (2012) and Therrien and Light (2016). The intervention was conducted in a separate teaching room and only included a few peers who attended the setting. Participants generalised their skills in other areas of the setting e.g. the lunch hall. (Therrien & Light, 2016). This design was not weighted as highly due to the fact that peers who were not present during intervention may not be able to socially interact with participants in a way that is effective for them.

Finally Ledbetter-Cho et al. (2015) and Strasberger and Ferreri (2014) conducted their studies in a laboratory setting. As a result they were given the lowest weighting as generalisation into a natural setting will be challenging.

Methodological design

Petticrew and Rogers (2003) present a typology of evidence for research questions that are designed to assess effectiveness. This is supported by Evans (2003) who suggest that Randomised Control Trials (RCTs) are the epitome of research. For this reason RCTs received the highest rating for WoE B. The remaining designs suggested by Petticrew and Rogers (2003) that relate to questions on effectiveness were given a lower rating and the designs suggested by the authors that do not relate to this type of question were given the lowest rating. All of the studies in this review were small N-case designs and it is for that reason that all of the studies received the same WoE B rating.

Type of aided AAC

The aided AAC interventions evaluated in this review can be divided into those that use technology (iPad/SGDs) and those that do not (PECS/Scripts). Ratings were not assigned to studies based on the use of technology, but this review will present the evidence around this phenomenon as a means of providing a critical discussion of the evidence. Nelson et al. (2007) uses technology and is the only study to be awarded a 'high' WoE D weighting. However, the effect size data presented in Table 7 shows a large effect between baseline and intervention for five of eight studies. The three remaining studies (Strasberger & Ferreri, 2013; Thiemann-Bourque et al., 2016 & Trembath et al., 2009) all show moderate effects between baseline and intervention. Two of which (Strasberger & Ferreri, 2013 & Trembath et al., 2009) use technology. This data presents a mixed view on the use of aided AAC that uses technology and those that do not.

Technology plays an increasingly greater role in the current UK education system with many schools having access iPads and other forms of technology (Li & Kirkup, 2007). Although this review presents evidence to suggest a positive effect of using technologically based, peer-mediated AAC, there is not enough evidence to conclude that this method is more effective than traditional forms to aided AAC e.g. PECS.

Improvement in Social Interactions

Table 5 shows that PND between baseline and intervention ranges from 80-100%. Parker, Vannest and Davis (2011) suggest that PND values within this range denote a moderate to large effect. This provides positive indication that peer-mediated, aided AAC supports the social interactions, of young children with communication difficulties.

Of the eight studies reviewed one conducted a follow up (Ledbetter-Co et al., 2015). This was awarded a higher, WoE C rating due to the benefits of evaluating the effectiveness of the intervention over time (Farrington, 1991). However, the effects of the intervention were not maintained over time, as all of the follow up scores were lower than intervention. Further information on the follow up period would increase the validity of the scores. This data cannot be compared to other studies in this review as no other follow-ups were conducted.

All of the studies included a generalisation element as part of the research process, which allows the participants to use their skills in a variety of locations e.g. the lunch hall. This was given some weighting as it began to address the importance of generalisation when conducting an intervention. Haring et al. (1978) introduced the notion of an instructional learning hierarchy which emphasises the importance of generalising learning as a means of achieving adaptation, the highest level of learning. Where data was available, there is evidence to suggest that there are positive improvements in social interactions

between intervention and generalisation (Table 7). However, the effect sizes range from no effect to a large effect. For this reason it would be difficult to draw conclusions on the extent to which the positive effects on social interactions associated with peer-mediated, aided AAC, can be generalised.

Effect sizes

Treatment As Usual (TAU) effect sizes were reported by Therrien and Light (2016) and Thiemann-Bourque et al. (2016) and effect sizes derived from the Percentage of All Non-Overlapping Data (PAND) were reported by Trembath et al. (2009), however the remaining papers did not provide the data with which to calculate these (TAU and PAND) effect sizes. Therefore, this review will convert the Percentage of Non-Overlapping Data (PND) provided by all of the studies into effect sizes by using Parker, Vanest and Davis (2011) PND to effect size descriptors. Table 5 presents the PND data for all of the studies. Table 6 presents the percentile distributions and descriptors taken from Parker et al., (2011) and Table 7 presents the overall mean effect sizes.

Table 5
PND for interventions using aided AAC

Study	Participant	Baseline vs Intervention	Baseline vs Generalisation	Intervention vs Generalisation	Intervention vs Follow up
Ganz & Flores (2007)	A1	100%	100%	100%	No follow up conducted
	A2	100%	100%	82%	
	A3	100%	100%	100%	
Ledbetter-Cho et al. (2015)	B1	100%	100%	100%	0%
	B2	100%	100%	100%	0%
	B3	100%	100%	100%	0%
Nelson et al. (2007)	C1	100%	0%	No data provided	No follow up conducted
	C2	100%	No data provided	No data provided	
	C3	100%			
	C4	100%			
Paden et al. (2012)	D1	100%	No data provided	No data provided	No follow up conducted
	D2	100%			
Strasberger & Ferreri (2013)	E1	81%	No data provided	No data provided	No follow up conducted
	E2	95%			
	E3	93%			
	E4	80%			
Thiemann-Bourque et al. (2016)	F1	82%	94%	95%	No follow up conducted
	F2	100%	No data available	No data available	
	F3	81%	95%	94%	
	F4	100%	No data available	No data available	

Study	Participant	Baseline vs Intervention	Baseline vs Generalisation	Intervention vs Generalisation	Intervention vs Follow up
Therrien & Light (2016)	G1	100%	100%	0%	No follow up conducted
	G2	100%	100%	0%	
	G3	100%	100%	0%	
Trembath et al. (2009)	H1	69%	100%	0%	No follow up conducted
	H2	100%	100%	63%	
	H3	100%	100%	66%	

Table 6
Percentile distributions and descriptors for PND (Parker et al., 2011)

Percentile Rank	10th	25th	50th	75th	90th
PND	.00	.25	.67	.94	1.00
Effect size	No effect	Small	Moderate	Medium	Large

Table 7
Overall mean PND with effect sizes

	Author							
Effect size	Ganz & Flores (2007)	Ledbetter-Cho et al. (2015)	Nelson et al. (2007)	Paden et al. (2007)	Strasberger & Ferreri (2013)	Thiemann-Bourque et al. (2016)	Therrien & Light (2016)	Trembath et al. (2009)
Baseline vs Intervention	100% (Large)	100% (Large)	100% (Large)	100% (Large)	87.25% (Moderate)	90.75% (Moderate)	100% (Large)	89.67% (Moderate)
Baseline vs Generalisation	100% (Large)	100% (Large)	0% (No effect)	No data	No data	94.5% (Medium)	100% (Large)	100% (Large)
Intervention vs Generalisation	94% (Medium)	100% (Large)	No data	No data	No data	94.5% (Medium)	0% (No effect)	43% (Small)
Intervention vs Follow up	No follow up	0% (No effect)	No follow up	No follow up	No follow up	No follow up	No follow up	No follow up
Measure	The use of a written script to interact with peers	The use of a written script to interact with peers	The use of visual symbols to interact with peers	The use of visual symbols to interact with peers	The use of a SGD to interact with peers	The use of an iPad to interact with peers	The use of visual symbols to interact with peers	The use of a SGD to interact with peers
WoE D	2.1 (Medium)	2.0 (Medium)	2.4 (High)	1.9 (Medium)	1.9 (Medium)	2.2 (Medium)	2.3 (Medium)	2.1 (Medium)

Note. *Speech Generating Device (SGD)*.

Table 7 indicates that there was a moderate to large effect of peer-mediated, aided AAC on social interactions for all studies between baseline and intervention. Ledbetter-Cho et al. (2015) was the only study to conduct follow up, and the results show that there was no effect between intervention and follow up. This signals that the results of the intervention were not maintained over time.

Conclusions and Recommendations

The findings in this review show promising evidence that peer-mediated, aided AAC's are effective in improving the social interactions of young children with communication difficulties. The interventions have been implemented with young children aged from 2-12 with communication difficulties that included ASD, Prada Willi syndrome and 22q deletion. The studies have included peers that have both typically developing communication skills and those who themselves have communication difficulties. This review found that peer-mediated aided AAC's are more effective when they included young children who have ASD as opposed to other communication difficulties. Although none of the studies evaluated in this review were conducted in the UK, the research may be generalised on the basis that all of the studies were conducted in OECD's, signifying a common thread in educational foundations (OECD, 2018). The studies were all single case experimental designs with most using a naturalistic setting with which to conduct their research. Follow up on the effectiveness of the intervention on social interactions could only be found in one of the studies and this did not show that the effects were maintained over time. Aided AAC could be separated into those that use technology e.g. SGD

and those that do not e.g. PECS. The variation in evidence evaluated on technologically based AAC means that no firm conclusions can be drawn on this matter.

This review can support EPs to work collaboratively with schools when deciding on an intervention that supports the social interactions of young children with communication difficulties. This review can be used to support discussions around the various forms of peer-mediated, aided AAC and whether it is best for all children in the setting to have an awareness of the intervention, so not to limit the target child's social interactions to a few young children. Nelson et al. (2007) was awarded the highest WoE D. This study adopted the use of peer-mediated, aided AAC that was adopted by all the peers in the entire setting. Nelson and colleagues (2007) research design can be mapped on to UK classrooms, who may be struggling to find time and resources to remove young children for small intervention groups.

Evidence was also found that could support a debate on whether technologically based ACC's are more effective in improving the social interactions of young children. Many schools may prefer to use technologically based AAC's and EPs can broaden their view on this by challenging the notion that these forms of AAC are more effective in supporting the social interactions of young children when used with a peer, as this review found contradicting evidence. EPs could present schools with the possibility that aided AAC has multiple functions. In addition to the commonly known function of peer-mediated, aided AAC improving language and communication (Barker et al., 2013; Drager et al., 2010), social interactions are also positively influenced (Ganz & Flores, 2007; Ledbetter-Cho et al., 2015; Nelson et al., 2007; Paden

et al., 2012; Strasberger & Ferreri, 2013; Therrien & Light, 2016; Thiemann-Bourque et al., 2016; Trembath et al., 2009).

Some of the limitations with a single case research include the ability to generalise the findings. The sample size of all the participants included in this review is small which presents challenges, in addition to the fact that none of the studies were conducted in the UK. Single cases studies can lack representativeness (Morgan & Morgan, 2008), but this review begins to address that by capturing participants and peers with a range of needs.

Some of the studies provided little information on participant recruitment (Paden et al., 2012; Strasberger & Ferreri, 2013), under these circumstances replicability of the research is compromised thus effecting reliability (Golafshani, 2003). Effect sizes calculated from data presented in the studies suggest that peer-mediated, aided AAC is effective in improving the social interactions of young children with communication difficulties.

This review has identified that more research is needed. Research on this area is urgently required in the UK. All of the studies were conducted abroad and although they were countries with a similar education system to that of the UK, they are not identical. Many schools use peer-mediated, aided AAC's and research in the UK would establish how effective they are for improving social interactions among UK participants. Furthermore, research could be conducted to provide further evidence on whether technologically based AAC's are more effective than non-technologically based methods. This was not the original focus of this review, but was uncovered as part of the critical analysis

of the data. It may be beneficial to conduct research specifically on this area, in light of the increased use of technology in UK schools.

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Nelson, C., McDonnell, A. P., Johnston, S. S., & Crompton, A. (2007). Keys to Play : A Strategy to Increase the Social Interactions of Young Children with Autism and their Typically Developing. *Education and Training in Developmental Disabilities*, 42(2), 165–181.

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Parker, R. I., Vannest, K. J., & Davis, J. L. (2011). Effect Size in Single-Case Research: A Review of Nine Nonoverlap Techniques. *Behavior Modification*, 35(4), 303–322.

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Petticrew, M., & Roberts, H. (2003). Evidence, hierarchies, and typologies: Horses for courses. *Journal of Epidemiology and Community Health*, 57(7), 527–529.

Romski, M., & Sevcik, R. A. (2005). Augmentative communication and early intervention: Myths and realities. *Infants & Young Children*, 18(3), 174-185.

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Appendix A

Table A1 *Studies excluded at Title screening*

Article	Database	Exclusion Criteria Number(s)
Adolfsson, M., Björck-Åkesson, E., & Lim, C. I. (2013). Code sets for everyday life situations of children aged 0–6: sleeping, mealtimes and play—a study based on the International Classification of Functioning, Disability and Health for Children and Youth. <i>British Journal of Occupational Therapy</i> , 76(3), 127-136.	PsycINFO	8
Arthur, M. (2003). Socio-Communicative Variables and Behavior States in Students with Profound and Multiple Disabilities: Descriptive Data from School Settings. <i>Education and Training in Developmental Disabilities</i> , 38(2), 200-219.	PsycINFO	7
Breslin, C. M., & Rudisill, M. E. (2011). The effect of visual supports on performance of the TGMD-2 for children with autism spectrum disorder. <i>Adapted Physical Activity Quarterly</i> , 28(4), 342-353.	PsycINFO	9
Brewton, C. M., Nowell, K. P., Lasala, M. W., & Goin-Kochel, R. P. (2012). Relationship between the social functioning of children with autism spectrum disorders and their siblings' competencies/problem behaviors. <i>Research in Autism Spectrum Disorders</i> , 6(2), 646-653.	PsycINFO	8
Clibbens J. (2001). Signing and lexical development in children with Down syndrome. <i>Down Syndrome: Research & Practice</i> , 7(3), 101-5.	MEDLINE	8

Article	Database	Exclusion Criteria Number(s)
Copple, K., Koul, R., Banda, D., & Frye, E. (2015). An examination of the effectiveness of video modelling intervention using a speech-generating device in preschool children at risk for autism. <i>Developmental neurorehabilitation</i> , 18(2), 104-112.	PsycINFO	7
Duchesne, L., Sutton, A., & Bergeron, F. (2009). Language achievement in children who received cochlear implants between 1 and 2 years of age: Group trends and individual patterns. <i>Journal of Deaf Studies and Deaf Education</i> , 14(4), 465-485.	PsycINFO	9
Dydia, J. M., Lawton, K., Logan, J. A., & Justice, L. M. (2014). Comparing emergent-literacy skills and home-literacy environment of children with autism and their peers. <i>Topics in Early Childhood Special Education</i> , 34(3), 142-153.	PsycINFO	9
Fahim, D., & Nedwick, K. (2014). Around the world: Supporting young children with ASD who are dual language learners. <i>Young Exceptional Children</i> , 17(2), 3-20.	ERIC	5
Guzinski, E. M., Cihon, T. M., & Eshleman, J. (2012). The effects of tact training on stereotypic vocalizations in children with autism. <i>The Analysis of verbal behavior</i> , 28(1), 101-110.	PsycINFO	9
Hindman, A. H., Miller, A. L., Froyen, L. C., & Skibbe, L. E. (2012). A portrait of family involvement during Head Start: Nature, extent, and predictors. <i>Early Childhood Research Quarterly</i> , 27(4), 654-667.	PsycINFO	8
Howlin, P., Gordon, R. K., Pasco, G., Wade, A., & Charman, T. (2007). The effectiveness of Picture Exchange Communication System (PECS) training for teachers of children with autism: a pragmatic, group randomised controlled trial. <i>Journal of Child Psychology and Psychiatry</i> , 48(5), 473-481.	PsycINFO	8
Hughes, C., Marks, A., Ensor, R., & Lecce, S. (2010). A longitudinal study of conflict and inner state talk in children's conversations with mothers and younger siblings. <i>Social Development</i> , 19(4), 822-837.	PsycINFO	8

Article	Database	Exclusion Criteria Number(s)
Janecka, M., Haworth, C. M., Ronald, A., Krapohl, E., Happé, F., Mill, J., & Rijdsdijk, F. (2017). Paternal age alters social development in offspring. <i>Journal of the American Academy of Child & Adolescent Psychiatry</i> , 56(5), 383-390.	PsycINFO	8
Lee, S. H., & Lee, L. W. (2015). Promoting snack time interactions of children with autism in a Malaysian preschool. <i>Topics in Early Childhood Special Education</i> , 35(2), 89-101.	PsycINFO	5
Lorah, E. R., Crouser, J., Gilroy, S. P., Tincani, M., & Hantula, D. (2014). Within stimulus prompting to teach symbol discrimination using an iPad® speech generating device. <i>Journal of Developmental and Physical Disabilities</i> , 26(3), 335-346.	PsycINFO	9
McDuffie, A., Oakes, A., Machalicek, W., Ma, M., Bullard, L., Nelson, S., & Abbeduto, L. (2016). Early language intervention using distance video-teleconferencing: a pilot study of young boys with fragile X syndrome and their mothers. <i>American journal of speech-language pathology</i> , 25(1), 46-66.	PsycINFO	7
Nunes, D. R., Araújo, E. R., Walter, E., Soares, R., & Mendonça, C. (2016). Augmenting Caregiver Responsiveness: An Intervention Proposal for Youngsters with Autism in Brazil. <i>Early Childhood Education Journal</i> , 44(1), 39-49.	PsycINFO	5
Pennington, L., & Noble, E. (2010). Acceptability and usefulness of the group interaction training programme It Takes Two to Talk to parents of pre-school children with motor disorders. <i>Child: care, health and development</i> , 36(2), 285-296.	PsycINFO	8
Plavnick, J. B., Mariage, T., Sue Englert, C., Constantine, K., Morin, L., & Skibbe, L. (2014). Promoting independence during computer assisted reading instruction for children with autism spectrum disorders. <i>Revista Mexicana de Análisis de la Conducta</i> , 40(2).	PsycINFO	9

Article	Database	Exclusion Criteria Number(s)
Romski, M. A., Sevcik, R. A., Adamson, L. B., Cheslock, M., & Smith, A. (2007). Parents can implement AAC interventions: Ratings of treatment implementation across early language interventions. <i>Early Childhood Services, 1</i> , 100-115.	PsycINFO	8
Schwartzberg, E. T., & Silverman, M. J. (2014). Music therapy song repertoire for children with autism spectrum disorder: A descriptive analysis by treatment areas, song types, and presentation styles. <i>The Arts in Psychotherapy, 41</i> (3), 240-249.	PsycINFO	7
Selwyn, N., Boraschi, D., & Özkula, S. M. (2009). Drawing digital pictures: An investigation of primary pupils' representations of ICT and schools. <i>British Educational Research Journal, 35</i> (6), 909-928.	PsycINFO	7
Sigafos, J., Lancioni, G. E., O'Reilly, M. F., Achmadi, D., Stevens, M., Roche, L., & Marschik, P. B. (2013). Teaching two boys with autism spectrum disorders to request the continuation of toy play using an iPad®-based speech-generating device. <i>Research in Autism Spectrum Disorders, 7</i> (8), 923-930.	PsycINFO	8
Simpson, L. A., & Oh, K. (2013). Using circle time books to increase participation in the morning circle routine. <i>Teaching Exceptional Children, 45</i> (6), 30-36.	ERIC	7

Table A2 *Studies excluded at Abstract screening*

Article	Database	Exclusion Criteria Number(s)
Batorowicz, B., Mcdougall, S., & Shepherd, T. A. (2006). AAC and community partnerships: The participation path to community inclusion. <i>Augmentative and Alternative Communication</i> , 22(3), 178-195.	PsycINFO	8
Camargo, S. P. H., Rispoli, M., Ganz, J., Hong, E. R., Davis, H., & Mason, R. (2014). A review of the quality of behaviorally-based intervention research to improve social interaction skills of children with ASD in inclusive settings. <i>Journal of autism and developmental disorders</i> , 44(9), 2096-2116.	PsycINFO	7, 8
Conallen, K., & Reed, P. (2012). The effects of a conversation prompt procedure on independent play. <i>Research in Autism Spectrum Disorders</i> , 6(1), 365-377.	PsycINFO	7
Dicarolo, C. F., & Banajee, M. (2000). Using voice output devices to increase initiations of young children with disabilities. <i>Journal of Early Intervention</i> , 23(3), 191-199.	PsycINFO	8
Eliçin, Ö., & Kaya, A. (2017). Determining Studies Conducted upon Individuals with Autism Spectrum Disorder Using High-Tech Devices. <i>Educational Sciences: Theory and Practice</i> , 17(1), 27-45.	PsycINFO	8
Falkman, K. W., Sandberg, A. D., & Hjelmquist, E. (2005). Theory of mind in children with severe speech and physical impairment (SSPI): A longitudinal study. <i>International Journal of Disability, Development and Education</i> , 52(2), 139-157.	PsycINFO	7
Feeley, K. M., Jones, E. A., Blackburn, C., & Bauer, S. (2011). Advancing imitation and requesting skills in toddlers with Down syndrome. <i>Research in Developmental Disabilities</i> , 32(6), 2415-2430.	PsycINFO	7

Article	Database	Exclusion Criteria Number(s)
Ganz, J. B., Davis, J. L., Lund, E. M., Goodwyn, F. D., & Simpson, R. L. (2012). Meta-analysis of PECS with individuals with ASD: Investigation of targeted versus non-targeted outcomes, participant characteristics, and implementation phase. <i>Research in developmental disabilities</i> , 33(2), 406-418.	MEDLINE	8
Ganz, J. B., Hong, E. R., & Goodwyn, F. D. (2013). Effectiveness of the PECS Phase III app and choice between the app and traditional PECS among preschoolers with ASD. <i>Research in Autism Spectrum Disorders</i> , 7(8), 973-983.	PsycINFO	9
Guerette, P., Furumasu, J., & Tefft, D. (2013). The positive effects of early powered mobility on children's psychosocial and play skills. <i>Assistive Technology</i> , 25(1), 39-48.	PsycINFO	7
Gunn, K. S., Trembath, D., & Hudry, K. (2014). An examination of interactions among children with autism and their typically developing peers. <i>Developmental neurorehabilitation</i> , 17(5), 327-338.	PsycINFO	7
Hattier, M. A., Matson, J. L., Sipes, M., & Turygin, N. (2011). Communication deficits in infants and toddlers with developmental disabilities. <i>Research in developmental disabilities</i> , 32(6), 2108-2113.	PsycINFO	7, 9
Hwang, B., & Hughes, C. (2000). Increasing early social-communicative skills of preverbal preschool children with autism through social interactive training. <i>Journal of the Association for Persons with Severe Handicaps</i> , 25(1), 18-28.	PsycINFO	8
Isaksen, J., & Holth, P. (2009). An operant approach to teaching joint attention skills to children with autism. <i>Behavioral Interventions</i> , 24(4), 215-236.	PsycINFO	7

Article	Database	Exclusion Criteria Number(s)
Jurgens, A., Anderson, A., & Moore, D. W. (2009). The effect of teaching PECS to a child with autism on verbal behaviour, play, and social functioning. <i>Behaviour Change</i> , 26(1), 66-81.	PsycINFO	8, 9
Katz, E., & Girolametto, L. (2013). Peer-mediated intervention for preschoolers with ASD implemented in early childhood education settings. <i>Topics in Early Childhood Special Education</i> , 33(3), 133-143.	PsycINFO	7
Konst, M. J., Matson, J. L., Goldin, R. L., & Williams, L. W. (2014). Socialization and nonverbal communication in atypically developing infants and toddlers. <i>Research in developmental disabilities</i> , 35(12), 3416-3422.	PsycINFO	7
Lee, A., Lang, R., Davenport, K., Moore, M., Rispoli, M., van der Meer, L., & Chung, C. (2015). Comparison of therapist implemented and iPad-assisted interventions for children with autism. <i>Developmental Neurorehabilitation</i> , 18(2), 97-103.	PsycINFO	9
Leech, E. R. B., & Cress, C. J. (2011). Indirect facilitation of speech in a late talking child by prompted production of picture symbols or signs. <i>Augmentative and Alternative Communication</i> , 27(1), 40-52.	PsycINFO	8, 9
McFadd, E., & Hustad, K. C. (2013). Assessment of social function in four-year-old children with cerebral palsy. <i>Developmental neurorehabilitation</i> , 16(2), 102-112.	PsycINFO	7, 8
Medeiros, K. F., Cress, C. J., & Lambert, M. C. (2016). Mastery motivation in children with complex communication needs: longitudinal data analysis. <i>Augmentative and Alternative Communication</i> , 32(3), 208-218.	PsycINFO	8

Article	Database	Exclusion Criteria Number(s)
Murdock, L. C., Ganz, J., & Crittendon, J. (2013). Use of an iPad play story to increase play dialogue of preschoolers with autism spectrum disorders. <i>Journal of autism and developmental disorders</i> , 43(9), 2174-2189.	PsycINFO	8
Murdock, L. C., & Hobbs, J. Q. (2011). Picture me playing: increasing pretend play dialogue of children with autism spectrum disorders. <i>Journal of Autism and Developmental Disorders</i> , 41(7), 870-878.	PsycINFO	7, 8, 9
Murdock, L. C., & Hobbs, J. Q. (2011). Tell me what you did today: A visual cueing strategy for children with ASD. <i>Focus on Autism and Other Developmental Disabilities</i> , 26(3), 162-172.	PsycINFO	8
Nabors, L. A., McGrady, M. E., Rosenzweig, K. J., & Srivorakiat, L. (2007). Improving the competence of preschoolers with disabilities on playgrounds. <i>Early Childhood Services: An Interdisciplinary Journal of Effectiveness</i> , 1(4), 235-247.	PsycINFO	8
Nijs, S., Vlaskamp, C., & Maes, B. (2016). The nature of peer-directed behaviours in children with profound intellectual and multiple disabilities and its relationship with social scaffolding behaviours of the direct support worker. <i>Child: care, health and development</i> , 42(1), 98-108.	PsycINFO	8
Nijs, S., Penne, A., Vlaskamp, C., & Maes, B. (2016). Peer interactions among children with profound intellectual and multiple disabilities during group activities. <i>Journal of Applied Research in Intellectual Disabilities</i> , 29(4), 366-377.	PsycINFO	7
O'Gorman Hughes, C. A., & Carter, M. (2002). Toys and materials as setting events for the social interaction of preschool children with special needs. <i>Educational Psychology</i> , 22(4), 429-444.	PsycINFO	7

Article	Database	Exclusion Criteria Number(s)
O'Neill, D. K., Main, R. M., & Ziemski, R. A. (2009). 'I like Barney': Preschoolers' spontaneous conversational initiations with peers. <i>First Language</i> , 29(4), 401-425.	PsycINFO	7
Ostryn, C., & Wolfe, P. S. (2011). Teaching children with autism to ask "what's that?" Using a picture communication with vocal results. <i>Infants & Young Children</i> , 24(2), 174-192.	PsycINFO	8
Pelatti, C. Y., Dynia, J. M., Logan, J. A., Justice, L. M., & Kaderavek, J. (2016, December). Examining quality in two preschool settings: Publicly funded early childhood education and inclusive early childhood education classrooms. In <i>Child & Youth Care Forum</i> , 45(6), 829-849.	PsycINFO	7, 8, 9
Pennington, L. (2009). Effects of It Takes Two to Talk—The Hanen Program for parents of preschool children with cerebral palsy: Findings from an exploratory study. <i>Journal of Speech, Language, and Hearing Research</i> , 52(5), 1121-1138.	PsycINFO	7, 8
Peters, B. (2016). A model for enhancing social communication and interaction in everyday activities for primary school children with ASD. <i>Journal of Research in Special Educational Needs</i> , 16(2), 89-101.	PsycINFO	8
Peterson, C., Slaughter, V., Moore, C., & Wellman, H. M. (2016). Peer social skills and theory of mind in children with autism, deafness, or typical development. <i>Developmental psychology</i> , 52(1), 46.	PsycINFO	7
Power, D., & Hyde, M. (2002). The characteristics and extent of participation of deaf and hard-of-hearing students in regular classes in Australian schools. <i>Journal of deaf studies and deaf education</i> , 7(4), 302-311.	PsycINFO	7

Article	Database	Exclusion Criteria Number(s)
Punch, R., & Hyde, M. (2010). Children with cochlear implants in Australia: Educational settings, supports, and outcomes. <i>Journal of Deaf Studies and Deaf Education</i> , 15(4), 405-421.	PsycINFO	7
Ramdoss, S., Lang, R., Mulloy, A., Franco, J., O'Reilly, M., Didden, R., & Lancioni, G. (2011). Use of computer-based interventions to teach communication skills to children with autism spectrum disorders: A systematic review. <i>Journal of Behavioral Education</i> , 20(1), 55-76.	PsycINFO	7, 9
Richels, C., Bobzien, J., Raver, S. A., Schwartz, K., Hester, P., & Reed, L. (2014). Teaching emotion words using social stories and created experiences in group instruction with preschoolers who are deaf or hard of hearing: An exploratory study. <i>Deafness & Education International</i> , 16(1), 37-58.	PsycINFO	7
Schlosser, R. W., Laubscher, E., Sorce, J., Koul, R., Flynn, S., Hotz, L., & Shane, H. (2013). Implementing directives that involve prepositions with children with autism: A comparison of spoken cues with two types of augmented input. <i>Augmentative and Alternative Communication</i> , 29(2), 132-145.	PsycINFO	9
Sigafos, J., Kagohara, D., van der Meer, L., Green, V. A., O'Reilly, M. F., Lancioni, G. E., ... & Zisimopoulos, D. (2011). Communication assessment for individuals with Rett syndrome: A systematic review. <i>Research in Autism Spectrum Disorders</i> , 5(2), 692-700.	PsycINFO	8
Skokut, M., Robinson, S., Openden, D., & Jimerson, S. R. (2008). Promoting the social and cognitive competence of children with autism: Interventions at school. <i>The California School Psychologist</i> , 13(1), 93-108.	ERIC	8

Article	Database	Exclusion Criteria Number(s)
Smith, T., & Iadarola, S. (2015). Evidence base update for autism spectrum disorder. <i>Journal of Clinical Child & Adolescent Psychology</i> , 44(6), 897-922.	PsycINFO	7
Stanton-Chapman, T. L., Walker, V. L., Voorhees, M. D., & Snell, M. E. (2016). The Evaluation of a Three-Tier Model of Positive Behavior Interventions and Supports for Preschoolers in Head Start. <i>Remedial and Special Education</i> , 37(6), 333-344.	PsycINFO	9
Stromer, R., Kimball, J. W., Kinney, E. M., & Taylor, B. A. (2006). Activity schedules, computer technology, and teaching children with autism spectrum disorders. <i>Focus on autism and other developmental disabilities</i> , 21(1), 14-24.	PsycINFO	8, 9
Tierney, C. D., Kurtz, M., Panchik, A., & Pitterle, K. (2014). 'Look at me when I am talking to you': evidence and assessment of social pragmatics interventions for children with autism and social communication disorders. <i>Current opinion in pediatrics</i> , 26(2), 259-264.	MEDLINE	8
Tõugu, P., Tulviste, T., & Suits, K. (2014). Gender differences in the content of preschool children's recollections: A longitudinal study. <i>International Journal of Behavioral Development</i> , 38(6), 563-569.	PsycINFO	7, 9
Vismara, L. A., & Lyons, G. L. (2007). Using perseverative interests to elicit joint attention behaviors in young children with autism: Theoretical and clinical implications for understanding motivation. <i>Journal of Positive Behavior Interventions</i> , 9(4), 214-228.	PsycINFO	7
Wheeler, A. C., Raspa, M., Bishop, E., & Bailey, D. B. (2016). Aggression in fragile X syndrome. <i>Journal of intellectual disability research</i> , 60(2), 113-125.	PsycINFO	7

Article	Database	Exclusion Criteria Number(s)
Woodman, A. C., Mawdsley, H. P., & Hauser-Cram, P. (2015). Parenting stress and child behavior problems within families of children with developmental disabilities: Transactional relations across 15 years. <i>Research in developmental disabilities</i> , 36, 264-276.	PsycINFO	8
Yilmaz, R. M., Kucuk, S., & Goktas, Y. (2017). Are augmented reality picture books magic or real for preschool children aged five to six?. <i>British Journal of Educational Technology</i> , 48(3), 824-841.	PsycINFO	9
Yoder, P., & Stone, W. L. (2006). A randomized comparison of the effect of two prelinguistic communication interventions on the acquisition of spoken communication in preschoolers with ASD. <i>Journal of Speech, Language, and Hearing Research</i> , 49(4), 698-711.	PsycINFO	9
Yoder, P., & Stone, W. L. (2006). Randomized comparison of two communication interventions for preschoolers with autism spectrum disorders. <i>Journal of consulting and clinical psychology</i> , 74(3), 426.	PsycINFO	7,8

Table A3 *Studies excluded at Full Text screening*

Article	Database	Exclusion Criteria Number(s)
DiStefano, C., Shih, W., Kaiser, A., Landa, R., & Kasari, C. (2016). Communication growth in minimally verbal children with ASD: The importance of interaction. <i>Autism Research</i> , 9(10), 1093-1102. DOI:10.1002/aur.1594	PsycINFO	8,9
Kennedy, C. H., & Haring, T. G. (1993). Teaching choice making during social interactions to students with profound multiple disabilities. <i>Journal of Applied Behavior Analysis</i> , 26(1), 63-76.	PsycINFO	6
Lerna, A., Esposito, D., Conson, M., Russo, L., & Massagli, A. (2012). Social–communicative effects of the Picture Exchange Communication System (PECS) in autism spectrum disorders. <i>International journal of language & communication disorders</i> , 47(5), 609-617.	PsycINFO	5,8
Lorah, E. R., Gilroy, S. P., & Hineline, P. N. (2014). Acquisition of peer manding and listener responding in young children with autism. <i>Research in Autism Spectrum Disorders</i> , 8(2), 61-67.	PsycINFO	8

Appendix B

Table B1

Weight of evidence A (WoE A) criteria and rationale

	WoE A Score	Criteria	Rationale
Horner et al. (2005)	3	Average score of 2-3 across all areas	Average scores range from 0-3 which can be converted on to the WoE A scores of 1-3
	2	Average of 1-1.9 across all areas	
	1	Average of 0- 0.9 across all areas	

Table B2

Weight of evidence B (WoE B) criteria and rationale

Weighting	Type of study design	Rational
1	Qualitative research, survey, case control, non-experimental evaluation	Petticrew & Roberts (2002) suggest that these are the best studies to use to answer questions on “effectiveness”. Systematic Literature reviews have been omitted from the list
2	Cohort studies, quasi-experimental studies, single case experimental designs	
3	Randomised control trials	

Note. Ratings of 1 = low, 2 = medium, 3 = high

Table B3

Weight of evidence C (WoE C) criteria and rationale

Criteria	Weightings	Rationale
A Age group	3 Pre-school aged participants (2-5) 2 Participants aged 6-8 1 Participants aged 9-12	To capture the age ranges specified in the research question i.e. young children.
B School setting	3 English education system 2 Similar education system to England 1 Very different education system than England	To identify interventions that can be used in the English education system even if the research was not based here.
C Intervention design	3 In a naturalistic environment with all members of the setting involved in the intervention 2 In a naturalistic environment with some members of the setting involved in the intervention 1 In a laboratory environment	The effects of the intervention are easier to generalise/maintain if the conditions of study are closer to the everyday life of the participants
D Measurement of social interaction improvement	3 Effects of the intervention are present at follow up 2 Effects of the intervention are not present at follow 1 No follow up conducted	To see if the intervention has had lasting effects on the participants

Note. Scores for A, B, C and D are averaged to calculate the WoE C score

Table B4

Weight of evidence C (WoE C) rating for the eight studies included

Study	Criteria Score				WoE C
	A	B	C	D	
Ganz & Flores (2008)	3	2	2	1	2
Ledbetter-Cho et al. (2015)	2	2	1	2	1.75
Nelson, et al. (2007)	3	2	3	1	2.25
Paden et al. (2012)	2	2	2	1	1.75
Strasberger & Ferreri (2014)	1	2	1	1	1.25
Therrien & Light (2016)	3	2	2	1	2.2
Thiemann-Bourque et al. (2016)	3	2	3	1	2.25
Trembath et al. (2009)	3	2	3	1	2.25

Appendix C
Coding Protocol Example

Horner et al. (2005). The use of single-subject research to identify evidence-based practice in special education – quality indicators within single-subject research.

Article Reference:

Ganz, Jennifer B & Flores, Margaret M. (2008). Effects of the use of visual strategies in play groups for children with autism spectrum disorders and their peers. *Journal of Autism and Developmental Disorders*, 38, 926-940.

Description of Participants and Settings

Participants are described with sufficient detail to allow others to select individual with similar characteristics (e.g., age, gender, disability, diagnosis)

- Yes
- No
- N/A
- Unable to Code

The process for selecting participants is described with replicable precision

- Yes
- No
- N/A
- Unable to Code

Critical features of the physical setting are described with sufficient precision to allow replication

- Yes
- No
- N/A
- Unable to Code

Dependent variable

Dependent variable are described with operational precision

- Yes
- No
- N/A
- Unable to Code

Each dependent variable is measured with a procedure that generates a quantifiable index

- Yes
- No
- N/A
- Unable to Code

Measurement of the dependent variable is valid and described with precision

- Yes
- No
- N/A
- Unable to Code

Dependent variables are measured repeatedly over time

- Yes
- No
- N/A
- Unable to Code

Data are collected on the reliability or inter-observer agreement associated with each dependent variable and IOA levels meets minimal standards (e.g., IOA = 80%; Kappa = 60%)

- Yes
- No
- N/A
- Unable to Code

Independent Variable

Independent variable is described with replicable precision

- Yes
- No
- N/A
- Unable to Code

Independent variable is systematically manipulated and under the control of the experimenter

- Yes
- No
- N/A
- Unable to Code

Overt measurement of the fidelity of implementation for the independent variable is highly desirable

- Yes
- No
- N/A
- Unable to Code

Baseline

The majority of single-subject research studies will include a baseline phase that provided repeated measurement of a dependent variable and establishes a pattern of responding that can be used to predict the pattern of future performance, if introduction of manipulation of the independent variable did not occur

- Yes
- No
- N/A
- Unable to Code

Baseline conditions are described with replicable precision

- Yes
- No
- N/A
- Unable to Code

Experimental Control/Internal Validity

The design provides at least three demonstrations of experimental effect at three different points in time

- Yes
- No
- N/A
- Unable to Code

The design controls for common threats to internal validity (e.g., permits elimination of rival hypotheses)

- Yes
- No
- N/A
- Unable to Code

The results document a pattern that demonstrated experimental control

- Yes
- No
- N/A
- Unable to Code

External Validity

Experimental effect are replicated across participants, settings or materials to establish external validity

- Yes
- No
- N/A
- Unable to Code

Social Validity

The dependent variable is socially important

- Yes
- No
- N/A
- Unable to Code

The magnitude of change in the dependent variable resulting from the intervention is socially important

- Yes
- No
- N/A
- Unable to Code

Implementation of the independent variable is practical and cost effective

- Yes
- No
- N/A
- Unable to Code

Social validity is enhanced by implementation of the independent variable over extended time periods, by typical intervention agents, in typical physical and social contexts

- Yes
- No
- N/A
- Unable to Code