Interventions for Children with Autism Mediated by Someone Other Than

a Highly-Qualified Autism Professional: An Umbrella Review

by

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A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Education

in

School and Clinical Child Psychology

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Abstract

Aim: There has been a recent explosion in research, including systematic reviews, examining the effects of interventions for children with ASD. The present umbrella review collected, appraised, and summarized evidence from multiple systematic reviews of interventions for children with ASD mediated by someone other than a highly-qualified autism professional. Specifically, the clinical findings and methodological quality of these reviews is considered.

Method: Systematic reviews were identified through comprehensive searches of 24 electronic databases from January 2006 to April 2016. Studies included were systematic reviews of interventions for children with ASD mediated by someone other than a highly-qualified autism professional. Two reviewers independently assessed study relevance and quality.

Results: Sixteen systematic reviews of psychosocial interventions for children with ASD mediated by someone other than a highly-qualified autism professional were included. The interventions were divided into four categories: interventions mediated by parents, interventions mediated by siblings, interventions mediated by peers, and interventions mediated by other non-specialists. Overall, these interventions were related to positive outcomes for children with ASD. Reviews varied in terms of methodological quality but were generally of relatively poor quality.

Interpretation: These interventions were generally associated with positive outcomes for children with ASD. However, the low methodological quality of many of these reviews threatens the validity and reliability of these findings. This evidence should be considered tentative until it has been confirmed by additional high-quality systematic reviews.

Preface

This thesis is an original work by Elizabeth Gange. The research conducted for this thesis was supervised by Dr. Veronica Smith at the University of Alberta. The larger research project, of which this thesis is part of, was developed by Kendra Seatter, a fellow graduate student at the University of Alberta, and Dr. Smith. A research librarian, Lisa Tjosvold, developed and carried out the systematic search. Kendra Seatter served as a reviewer for the study selection procedure, the data extraction procedure, and for the methodological quality assessment procedure. Dr. Tamara Yee served as a reviewer for the methodological quality assessment procedure. I served as a reviewer for the study selection procedure and the data extraction procedure, created and managed databases, and completed calculations associated with the data.

Dedication

This thesis is dedicated to my mother, Janice Gange. I am grateful that I have had the opportunity to watch as you have dedicated your life to improving the lives of children with disabilities. Thank you for being an incredible role model in everything you do.

Acknowledgements

    I would like to express my gratitude to the many people who were involved in making this research possible. First, this accomplishment would not have been possible without the invaluable guidance, mentorship, and expertise of my supervisor, Dr. Veronica Smith. Thank you for your support throughout this thesis as well as my entire Master's program. To Dr. Heather Brown, I am grateful for your dedication, constant encouragement, and all that you have done to support me throughout writing this thesis. To Dr. George Buck, thank you for taking the time to support me in this process.

    To Kendra Seatter, thank you for allowing me to join you on this journey. I have enjoyed sharing this experience with you. It has truly been a pleasure to work with you every step of the way. To Dr. Tamara Yee, thank you for stepping in when and where we needed you at such an important time in the review process. Lisa Tjosvold, thank you for sharing your expertise and conducting the search in a comprehensive manner.

    I am incredibly grateful for the support of my family, without which I would not have reached this goal. Mom, Dad, and Will, thank you for celebrating each victory with me and also being there for the challenging times. Finally, to Ethan, thank you for your endless and unwavering patience, support, and love. Thank you for the sacrifices you have made to allow me to make my dreams a reality.

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Introduction

Systematic reviews are generally conducted as a means to synthesize research on a specific topic of inquiry (Grant & Booth, 2009). Through systematic searches, evaluations, and syntheses of research evidence, knowledge of a specific topic is drawn together and the findings of the review often inform clinical or applied practices. However, such applications may become challenging when systematic reviews become plentiful in a specific area of research because it may no longer be feasible for stakeholders to read and stay up to date with the literature. In such a case, an umbrella review may be conducted as a means to aggregate the findings of several systematic reviews that address a specific research question (Grant & Booth, 2009).

It is now estimated that approximately 1% of the world population has autism spectrum disorder (ASD; American Psychiatric Association [APA], 2013) and this number continues to grow (Christensen et al., 2016), making it one of the most prevalent neurodevelopmental disorders of childhood (Ghali et al., 2014; Ouellette-Kuntz et al., 2014). Due to the rise in the prevalence of ASD and the severity of the impairments typically associated with the disorder, it is imperative that there are evidence-based interventions for individuals with ASD. As such, there has been a recent explosion of research, including systematic reviews, examining the effectiveness of interventions designed to treat the symptoms associated with ASD (Seida et al., 2009). Thus, an umbrella review that synthesizes the current knowledge, guidelines for practice, and recommendations for future research may help narrow the divide between what is known in research and what occurs in practice. Further, there remains a need to determine whether the systematic reviews on this topic have been conducted according to a structured methodological approach that minimizes bias and errors, which subsequently allows for a greater level of confidence in the results of the review ((Seida et al., 2009; Shea et al., 2007, 2009)

The present umbrella review aggregates the findings of multiple systematic reviews of interventions for children with ASD that are mediated by someone other than a highly-qualified autism professional. Such individuals include parents, siblings, peers, and other non-specialists. To date, there has not been an umbrella review published in this area of inquiry. Thus, the present review aims to fill this gap in the literature.

Autism Spectrum Disorder

First described by Leo Kanner in 1943, ASD is currently understood as a neurodevelopmental disorder with a wide variability in symptom severity and presentation. The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) outlines several diagnostic criteria for ASD, including persistent deficits in social interaction and communication as well as restricted and repetitive patterns of behaviours and interests (APA, 2013). Such deficits become apparent in the early developmental period and impair the daily functioning of those diagnosed with the disorder. However, while ASD is generally considered a childhood disorder, financial implications of the disorder often persist into adulthood (Ganz, 2007). In the United States, it is estimated that an individual with ASD may cost society between 1.4 and 3.2 million dollars throughout their lifetime (Buescher, Cidav, Knapp, & Mandell, 2014; Ganz, 2007). Such high costs are in part due to adult care and lost productivity.

Psychosocial Interventions for ASD

Due to the rising prevalence of the disorder, the severity of symptoms typically associated with ASD, and the high financial cost to society, it is imperative that there are effective interventions for children with ASD. Although prior to the 1960s it was generally believed that children with ASD could not respond to treatment, it is now known that interventions can be effective in improving outcomes among children with the disorder

(Schreibman et al., 2015). Currently, there are many types of psychosocial interventions (i.e., non-pharmacological treatments) designed to treat impairments associated with ASD. Many interventions also aim to promote the development of a variety of skills, including daily living skills and academic skills.

Seida and colleagues (2009), in a previous umbrella review, suggested that psychosocial "interventions vary extensively in terms of their underlying theoretical framework, mode of delivery, intensity, degree of parental involvement, and comprehensiveness" (p. 95). Further, Seida and colleagues proposed that psychosocial interventions for children with ASD may be categorized as one of five types: interventions based on behavioural theory, communication-focused interventions, parent-mediated interventions, sensory motor interventions, and social development interventions. However, there are a variety of ways that psychosocial interventions could be categorized. For example, some interventions are mediated by assistive technology, others are delivered by a highly-qualified autism professional (e.g., psychologists or psychiatrists), and others are mediated by someone other than a highly-qualified autism professional.

Interventions Mediated by Someone Other Than a Highly-Qualified Autism Professional

Developing effective treatments that are delivered by non-specialists has been listed as one of the top research priorities in improving outcomes for individuals with mental illnesses (Collins et al., 2011). While many interventions for children with ASD are delivered by highly-qualified professionals (e.g., psychologists or psychiatrists), others are delivered by someone other than a highly-qualified autism professional (e.g., parents, siblings, peers, teachers, aides). In such a case, parents, siblings, peers, and other non-specialists are typically trained to use specific intervention strategies that are aimed to promote positive outcomes for the child with

ASD. Interventions mediated by someone other than a highly-qualified autism professional require less direct service from professionals. As such, these types of interventions, if effective, may be a more viable option than one-on-one interventions for children with ASD. Additionally, the context of relationships between a parent and the child, a sibling and the child, and a peer and the child may allow for many opportunities to teach skills within the natural occurrence of their interactions.

Parent-mediated interventions. Training parents as intervention providers for children with ASD was first seen as an important component of intervention by Lovaas, Koegel, Simmons, and Long (1973). Since then, parents have been taught to implement numerous intervention techniques to target the core domains of ASD, such as to increase social communication skills (e.g., Harris, 1986) and decrease restricted and repetitive behaviours and interests (e.g., Marcus et al., 1978). Because of the pivotal role a parent holds in a child's life, parent-implemented interventions may be invaluable for the child's development.

Sibling-mediated interventions. Interactions with siblings tend to be a critical part of a child's development because siblings share experiences and provide support to one another (Verté, Roeyers, & Buysse, 2003). For individuals with disabilities, siblings are significant family members because they provide long-term care as well as social, emotional, and financial support (Banda, 2015). Teaching typically developing siblings intervention strategies that they can use with their brother or sister with ASD may be beneficial for both the sibling and the individual with ASD. In sibling-mediated interventions, siblings may model appropriate behaviours, implement prompting procedures, or reinforce target behaviours.

Peer-mediated interventions. Peer-mediated interventions (PMI) are often considered to be more natural intervention methods than adult-mediated interventions, and it appears to

diminish the concern regarding the limited generalizability that is apparent in adult-mediated interventions (Strain, Schwartz, & Bovey, 2008). In PMI, typically developing peers are "taught social interaction strategies, such as sharing, helping, prompting, instructing, or praising" (Wang, Cui, & Parrila, 2011, p. 564). Following training, peers apply these strategies in their interactions with children with ASD with the goal of promoting social interaction (Wang, Cui, & Parrila, 2011).

Interventions mediated by other non-specialists. Many children with ASD receive interventions that are implemented by paraprofessionals, including paraprofessionals, educators, and other non-specialists. Giangreco and Broer (2005) reported that paraprofessionals generally spend the majority of their day implementing behaviour plans and providing instruction to individuals with disabilities. In such a case, paraprofessionals, educators, and other non-specialists are typically trained to implement specific intervention strategies for the child with ASD.

Systematic Reviews

In conducting a systematic review, researchers systematically and objectively search for research evidence in a particular area of inquiry (Shea et al., 2007). In such a review, relevant primary studies that meet specific inclusion criteria are critically appraised and synthesized according to a predetermined and replicable methodology (Grant & Booth, 2009; Shea et al., 2007). Using predetermined methods ensures the minimization of random errors (Seida et al., 2009). Because systematic reviews aim to address specific research questions through the analysis of all known information on the topic of inquiry, these reviews are often considered an appropriate method to assess, summarize, and stay up to date with current literature (Grant & Booth, 2009; Shea et al., 2007).

Currently, there are protocols and guidelines that have been developed to standardize the process of conducting systematic reviews. For example, research groups such as the Campbell Collaboration and the Cochrane Methods Group have developed protocols that may be used in conducting a review. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, 2015) outlines the minimum set of items that should be reported in a systematic review or meta-analysis. Further, to add to the credibility and reliability of reviews and to notify other researchers that a review is being conducting in the particular area of inquiry, researchers may opt to register their review protocol a priori in a database such as the International Prospective Register of Systematic Reviews (PROSPERO).

To ensure the reliability and validity of the findings of a systematic review, it is important that the review is of high methodological quality. Poor methodological quality may impact both the internal validity of the systematic review (i.e., the reliability or the accuracy of the results) as well as the external validity of the review (i.e., the generalizability of the results). Shea and colleagues (2007) developed a methodological quality assessment tool for systematic reviews, the Assessment of Multiple Systematic Reviews (AMSTAR). In developing the AMSTAR tool, Shea and colleagues combined and factor analyzed items from two previously developed tools, the Overview Quality Assessment Questionnaire (OQAQ; Oxman et al., 1991) and the Sacks' instrument (Sacks, Berrier, Reitman, Ancona-Berk, & Chalmers, 1987), along with additional items that were deemed important to methodological quality. An exploratory factor analysis identified 11 underlying components: (1) establishing an a priori design; (2) performing duplicate study selection and data extraction; (3) conducting a comprehensive literature search; (4) using status of publication as an inclusion criterion; (5) providing a list of included and excluded studies; (6) providing the characteristics of the included studies; (7) assessing and

documenting the scientific quality of the included studies; (8) considering the scientific quality of the included studies in formulating conclusions; (9) combining findings appropriately; (10) assessing the likelihood of publication bias; and (11) stating conflicts of interest (Shea et al., 2007).

Following the development of the AMSTAR tool, Shea and colleagues (2009) measured the agreement, reliability, construct validity, and feasibility of their tool by using the AMSTAR, the OQAQ, and Sacks' instrument to assess 30 systematic reviews. Results suggested that AMSTAR has adequate agreement, reliability, construct validity, and feasibility to measure the quality of systematic reviews. Additionally, the AMSTAR performed similarly to the OQAQ and better than the Sacks' instrument while adding additional items that are not present in the other two measurement tools. Shea and colleagues suggested that an important benefit of choosing the AMSTAR tool over the other two measurement tools is that it balances comprehensiveness with feasibility because the AMSTAR "adds relevant dimensions to those covered in the OQAQ without becoming unwieldy, as with the Sacks' instrument" (Shea et al., 2009, p. 1016).

Umbrella Reviews

In research areas that have such an abundance of systematic reviews that makes it unrealistic or impractical for individuals to read and synthesize this information, it is important that there is a mechanism to aggregate findings from multiple reviews (Grant & Booth, 2009). An umbrella review serves this purpose by "compiling evidence from multiple reviews into one accessible and usable document" (Grant & Booth, 2009, p.95). While a systematic review synthesizes findings from multiple primary studies, an umbrella review synthesizes the findings of multiple systematic reviews. As such, an umbrella review allows "the reader a quick overview (and exhaustive list) of reviews relevant to the decision at hand" (Grant & Booth, 2009, p. 103).

Further, umbrella reviews often evaluate the methodological quality of systematic reviews in order to determine the likelihood of biased results. Because one of the primary aims of the current review is to ensure stakeholders, including parents, teachers, physicians, and policy-makers, can access and read research regarding the effectiveness of psychosocial interventions for children with ASD, an umbrella review is an appropriate methodology to employ.

Purpose of Research

As it becomes increasingly important that there are evidence-based interventions for children with ASD, the number of primary studies, and subsequently the number of systematic reviews, is also increasing. The purpose of the present umbrella review is to collect, appraise, and summarize evidence from multiple systematic reviews examining the effects of interventions for children with ASD mediated by someone other than a highly-qualified autism professional. In doing so, the methodological quality of these reviews will be assessed, the clinical findings will be summarized, and gaps in the research will be discussed.

Research Questions

This umbrella review addresses the following research questions:

1. What is the methodological quality of systematic reviews that examine the effects of interventions for children with ASD mediated by someone other than a highly-qualified autism professional?

2. a) What are the clinical findings of systematic reviews that examine the effects of interventions for children with ASD mediated by someone other than a highly-qualified autism professional?

   b) What are the gaps in the research of this area of inquiry?

Method

Study Design

The present umbrella review is part of a larger study that was designed to examine all systematic reviews of psychosocial interventions for children with ASD. The larger study was designed with the PICO (+D) framework (Richardson, Wilson, Nishikawa, & Hayward, 1995), to guide the development of research questions and appropriate search strategies. In the PICO (+D) framework, P represents the population, patient, or problem of interest; I represents the intervention; C represents the comparison or experimental control; O represents the clinical outcome(s); and D represents the design of the studies eligible for inclusion. The larger umbrella review, of which the present review is part of, used the following PICO (+D) guideline in formulating the search strategy and the inclusion criteria:

P – Children (ages 0-12) with ASD

I – Psychosocial interventions

C – No psychosocial intervention or treatment as usual

O – Social communication, behavioural, or cognitive outcomes

D – Systematic reviews

Search Strategy

The systematic search for this umbrella review followed a prospective protocol that was developed a priori using the PICO (+D) framework. Comprehensive searches of the scientific literature were conducted by a research librarian in 24 electronic databases from January 2006 to April 2016. The search strategy consisted of keywords and medical subject headings for ASD and related disorders and various psychosocial interventions. A list of the bibliographic databases searched and the details of the MEDLINE search strategy, which was adapted for all

other electronic database searches, is provided in Appendix 1. Manual searches of the reference lists and searches of personal collections were conducted to identify additional citations.

Study Selection

The procedure used to select systematic reviews included in the present umbrella review involved two steps. In the first step, systematic reviews of any psychosocial intervention for children with ASD were considered for inclusion. In this step, reviews were assessed according to the study design, population, intervention, outcome, publication date, and language. Studies selected for inclusion in step one met six criteria as follows:

1. The authors must have conducted a systematic review (i.e., there must have been a defined search strategy and data from primary studies must have been analyzed in either a quantitative or a qualitative manner);

2. The population addressed in the review must have included children (up to age 12) with ASD, including descriptors of autistic disorder, atypical autism, high-functioning autism, Asperger syndrome, pervasive developmental disorder not otherwise specified (PDD-NOS), or suspected but not yet diagnosed autism;

3. The intervention addressed in the review must have been a psychosocial intervention (i.e., non-pharmacological) aimed at improving the functioning of individuals with ASD;

4. The authors must have reported numerical or measurable outcomes related to at least one of the following outcomes: core symptoms of ASD, social communication, restricted and/or repetitive behaviour, psychological symptoms, cognitive skills, or challenging behaviours;

5. The review must have been published in 2006 or later; and

6. The review must have been available in English.

Reviews that analyzed results quantitatively through meta-analysis and reviews that analyzed results qualitatively were eligible for inclusion. A review was considered eligible for inclusion if it included individuals with ASD and other developmental disorders as long as it conducted separate analyses for individuals with ASD. Reviews that included children up to age 12 and individuals older than age 12 were considered for inclusion if analyses were conducted separately for participants age 12 and under. Abstracts, correspondences, editorials, review summaries, and books were not eligible for inclusion.

In step two, a further set of inclusion criteria were applied to the pool of reviews compiled in step one. The aim of the second step was to locate systematic reviews that specifically related to interventions for children with ASD that were mediated by someone other than a highly-qualified autism professional (e.g., interventions mediated by parents, siblings, peers, and other non-specialists). Systematic reviews of interventions for children with ASD that were mediated by someone other than a highly-qualified autism professional were selected for inclusion in the present umbrella review. Systematic reviews that included primary studies of interventions mediated by highly-qualified autism professionals in addition to individuals who were not highly-qualified autism professionals were excluded.

The flow of studies through the study retrieval and selection process is depicted in Figure 1. The electronic search yielded 993 citations that were screened at the title and abstract level. Two reviewers independently coded which of the 993 citations were duplicates, not relevant, or relevant. Disagreements were resolved through a consensus procedure between the two reviewers. The full texts of each of the 329 systematic reviews considered potentially relevant were evaluated by two independent reviewers through the use of the inclusionary criteria described above in step one. If all inclusionary criteria were met, the review was eligible for
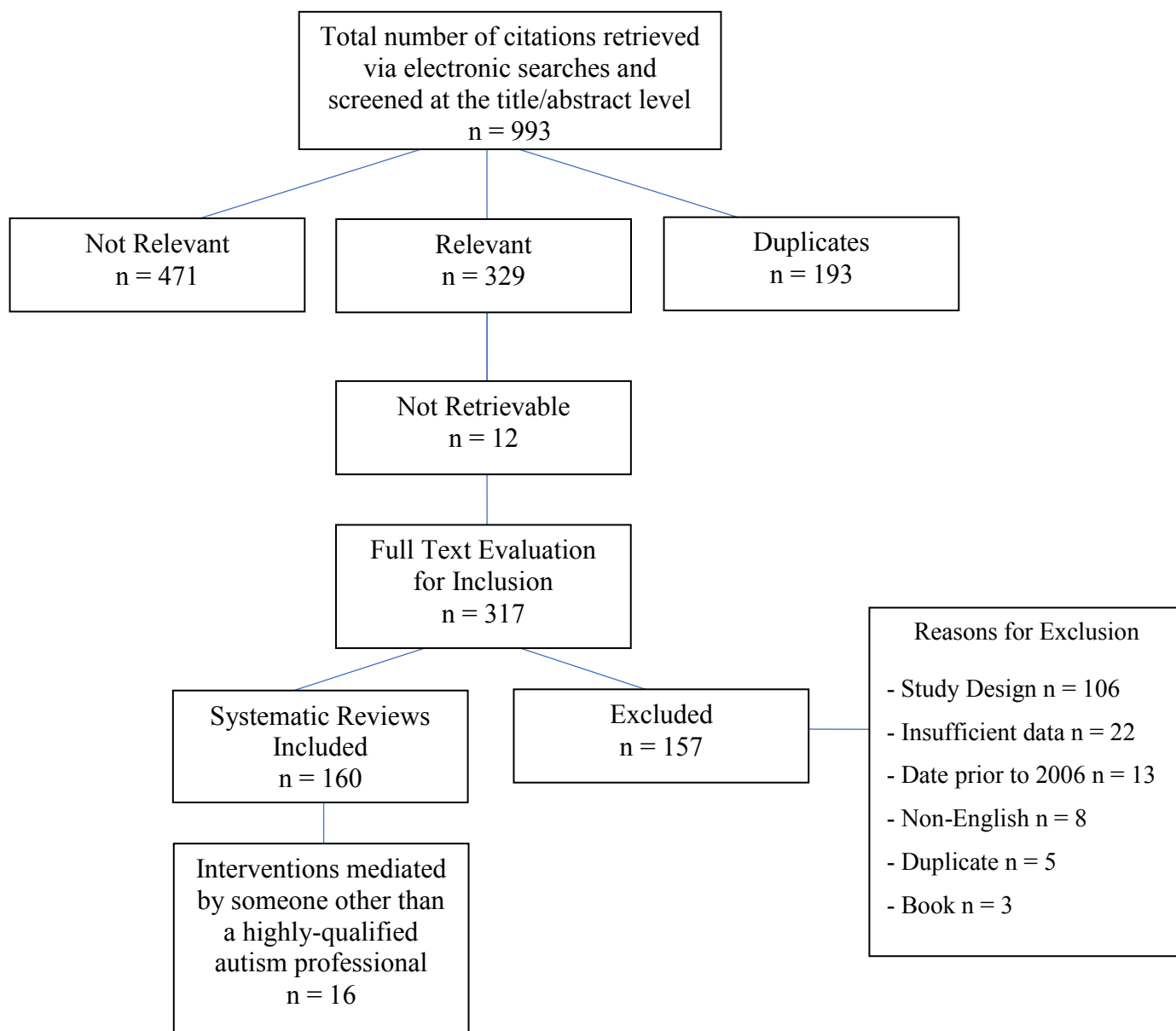
Figure 1. Flow diagram of study retrieval and selection process.

inclusion in the first step. Interrater agreement for the coding of the inclusionary criteria was 94.6%. Disagreements were resolved through a consensus procedure with a third reviewer. Through the application of the inclusionary criteria and the consensus procedure, 160 systematic reviews were identified as acceptable for inclusion in the first step. In step two, this pool of reviews was then sorted according to intervention type and 16 systematic reviews were identified as reviewing interventions mediated by someone other than a highly-qualified autism professional and were therefore included in the present umbrella review.

Quality Assessment

The methodological quality of the systematic reviews selected for inclusion was assessed using the AMSTAR tool (Shea et al., 2007), described previously. The quality of each systematic review included in the present umbrella review was assessed using the AMSTAR operationalization guide (Kitsiou, Paré, & Jaana, 2015). The AMSTAR criteria were coded as "yes" when the criteria were clearly met, "no" when the criteria were clearly unmet, and "can't answer" when there was insufficient information to determine if the criteria had been met. The criterion pertaining to the assessment of publication bias was only applied to reviews conducting a meta-analysis. Reviews that conducted a descriptive analysis received a code of "not applicable" for this criterion.

Two reviewers independently assessed the quality of each systematic review using the AMSTAR tool. Disagreements were resolved through a consensus procedure with a third reviewer. The interrater agreement for the use of the AMSTAR tool to assess the methodological quality of the 16 systematic review included in the present umbrella review was calculated to be 80.68%.

Data Extraction

Descriptive data were extracted on characteristics of the systematic reviews. Extracted data included general characteristics of the review (i.e., journal of publication, publication location, year, language, type of publication, number of authors, author affiliation, publication status, funding sources, type of analysis); clinical characteristics (i.e., age and diagnosis of participants, type of intervention); methodological features (i.e., design of primary studies included in the review, search strategy, language and publication restrictions, method for quality assessment of primary studies); results (i.e., number of primary studies included, review findings); and conclusions and recommendations for practice. One reviewer independently extracted data for all included articles and a second reviewer independently extracted data for 31% of the included studies. Interrater agreement was calculated to be 95.71%.

Analysis and Presentation of Results

The descriptive characteristics of the systematic reviews are summarized and presented in evidence tables. Table 1 provides an overview of the 16 systematic reviews included in the present umbrella review through reporting data regarding the collective characteristics of the reviews as well as the populations involved in the reviews. Table 2 reports characteristics of each individual systematic review, including the number of primary studies included in the review, the population studied, the interventionist (i.e., parents, siblings, peers, or others), whether or not a meta-analysis was performed, and the research design of the primary studies (i.e., singles-subject or group designs). A table with the AMSTAR score of each systematic review, the interventionist, a summary of the intervention strategies used, and a summary of the results, including positive, negative, and unclear outcomes is provided in Appendix B.

Total AMSTAR scores for each review were calculated by determining the number of "yes" responses each review received. Calculations were also completed to determine the number of reviews that received each total AMSTAR score (Figure 2) as well as to determine the average AMSTAR rating for the entire sample of reviews. In addition, the number of studies that met each individual AMSTAR criterion was calculated (Figure 3) so specific areas of methodological strength and weakness could be determined.

Results

Sixteen systematic reviews of interventions for children with ASD that were mediated by someone other than a highly-qualified autism professional are included in the present umbrella review.[1] Eleven systematic reviews included at least one intervention mediated by parents (Banda, 2015; Beaudoin, Sébire, & Couture, 2014; Flippin & Crais, 2011; Lang, Machalicek, Rispoli, & Regester, 2009; McConachie & Diggle, 2007; Meadan, Ostrosky, Yu, & Zaghlawan, 2009; Oono, Honey, & McConachie, 2013; Patterson, Smith, & Mirenda, 2012; Reichow, Servili, Yasamy, Barbui, & Saxena, 2013; Schultz, Schmidt, & Stichter, 2011; Shire & Kasari, 2014). Three systematic reviews evaluated sibling-mediated interventions (Banda, 2015; Shivers & Plavnick, 2015; Zhang & Wheeler, 2011). Four systematic reviews evaluated PMI (Chan et al., 2009; Wang, Cui, & Parrila, 2011; Watkins et al., 2015; Zhang & Wheeler, 2011). Finally,

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[1] Several systematic reviews included primary studies of interventions mediated by more than one interventionist. As such, some systematic reviews are present in multiple categories.

two systematic reviews evaluated interventions mediated by other non-specialists (e.g.,

paraprofessionals, educators; Reichow et al., 2013; Shire & Kasari, 2014).

Description of Systematic Reviews

Table 1 provides an overview of the collective general descriptive characteristics of the

reviews included in the present umbrella review (e.g., publication type, country of corresponding

author, mean number of authors per review, funding reported, age of population studied,

diagnosis of population studied, mean number of primary studies included in the reviews, types

of study designs in the primary studies, and intervention mediator). All 16 reviews were

published in journal articles. Of the 16 reviews, 12 of the corresponding authors were located in

the United States, two were in Canada, and two were in England. The mean number of authors

on each review was 3; the minimum was one and the maximum was seven. Funding was

reported in five reviews. While all reviews included children ages 12 and under, eight reviews

also included adolescents (i.e., individuals ages 13-18) and one also included adults (i.e.,

individuals ages 19 and over). All reviews included participants who had been diagnosed with

some form of ASD (e.g., autism, Asperger's syndrome, pervasive developmental disorder, or

pervasive developmental disorder not-otherwise-specified) according to the criteria outlined in

either the fourth or the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders

(DSM-IV or DSM-5). The mean number of primary studies included in each review was 19, with

a range of three to 45. Six reviews included primary studies with both single-subject and group

designs, seven reviews included only primary studies with single-subject designs and three

reviews included only primary studies with group designs.

Specific characteristics of the individual reviews are provided in Table 2, including the

first author of the review and the year the review was published, the number of primary studies

Table 1

Descriptive characteristics of systematic reviews of interventions for children with ASD mediated by someone other than a highly-qualified autism professional

Publication type	
▪ Journal Article	16
Country of corresponding author	
▪ United States	12
▪ Canada	2
▪ England	2
Mean number of authors per review (min, max)	3 (1, 7)
Funding reported	5
Type of population studied*	
▪ Children (0-12 years)	16
▪ Adolescents (13-18 years)	8
▪ Adults (19+ years)	1
Type of diagnosis described*	
▪ ASD	10
▪ Autism	11
▪ Asperger's Syndrome	7
▪ PDD/PDD-NOS	10
Mean number of primary studies included (min, max)	19 (3, 45)
Type of study designs of the primary studies included in the reviews	
▪ Single-subject designs only	6
▪ Group designs only	4
▪ Single-subject and group designs	6
Intervention mediator*	
▪ Siblings	3
▪ Parents	11
▪ Peers	4
▪ Other non-specialists	2

*Categories were not mutually exclusive

Table 2

Characteristics of systematic reviews of interventions for children with ASD mediated by someone other than a highly-qualified autism professional

First author, year	Studies included (N)	Population characteristics		Interventionist	Meta-analysis (yes/no)	Design of Primary Studies
		Diagnosis	Age range (years)			
Banda, 2015	15	Autism, PDD, PDD-NOS	3 – 15	Siblings, parents	No	Single-subject designs
Beaudoin, 2014	15	ASD, Autism, Autistic disorder, PDD, Strong early markers of ASD, At risk of ASD, Infant siblings of autistic probands	<1 – 3	Parents	No	Single-subject & group designs
Chan, 2009	42	Autism, High-functioning autism, PDD-NOS, Asperger's syndrome	2 – 13	Peers	No	Single-subject & group designs
Flippin, 2011	3	ASD	2 – 5	Parents	No	
Lang, 2009	11	Autism, PDD-NOS, Asperger's syndrome	<1 – 18	Parents	No	Single-subject designs
McConachie, 2007	12	Autism	1 – 12	Parents	No	Group designs
Meadan, 2009	12	Autism, PDD	1 – 9	Parents	No	Singles-subject & group designs
Oono, 2013	18	ASD (Autism, Asperger's syndrome, PDD, PDD-NOS)	1 – 6	Parents	Yes	Group designs
Patterson, 2012	11	ASD, Autism, Asperger's syndrome, PDD-NOS	<1 – 9	Parents	Yes	Single-subject designs

Reichow, 2013	29	ASD, intellectual disability	<1 – 15	Parents, others (teachers, therapists, aides)	No	Group designs
Schultz, 2011	30	ASD	3 – 13	Parents	No	Single-subject & group designs
Shire, 2014	12	ASD, Autism, Asperger's syndrome, PDD, Speech/language impairment, Health impairment	Toddlers – Adolescents	Parents, peers, others (job center staff, aides, teachers, tutors)	Yes	Single-subject & group designs
Shivers, 2015	17	ASD, Autism, Asperger's syndrome	3 – 15	Siblings	No	Single-subject designs
Wang, 2011	14	ASD	4 – 11	Peers	Yes	Single-subject designs
Watkins, 2015	14	Autism, Asperger's syndrome, PDD-NOS	4 – 21	Peers	No	Single-subject designs
Zhang, 2011	45	Autism, Asperger's syndrome, PDD-NOS	0 – 8	Peers, siblings	Yes	Single-subject designs

included in the review, population characteristics (i.e., diagnosis and age range), the

interventionist (i.e., parent, sibling, peer, or other), whether or not a meta-analysis was

conducted, and the designs of the primary studies included in the review. The reviews were

published between 2007 and 2015. Four reviews conducted a meta-analysis (i.e., analyzed results

quantitatively), while the remaining 12 reviews analyzed results qualitatively.

Methodological Quality

The AMSTAR score of each systematic review is reported in Appendix B, and the

number of reviews that received each total AMSTAR score is presented in Figure 2. Kitsiou and

colleagues (2015) suggested that an AMSTAR score between 0 and 3 could be considered a low

score that represents significant methodological flaws, an AMSTAR score between 4 and 7 as a

middle score that represent moderate methodological flaws, and an AMSTAR score between 8

and 11 as an upper score that represents either minor or no methodological flaws. The overall

methodological quality of the systematic reviews included in the present umbrella review was in

the middle range; the mean AMSTAR score of the 16 systematic reviews was 4.50 and the range

of scores was 2 to 10 on a scale of 0 to 11. Of the 16 reviews, 43.75% fell within the low range,

suggesting that many of the reviews had severe methodological flaws. Fifty percent of the

reviews fell within the middle range, which suggests that they had moderate methodological

flaws. Finally, only 6.25% of the reviews included in this umbrella review fell within the upper

range, suggesting that few reviews had minor or no methodological flaws. Although no

systematic review satisfied all 11 AMSTAR criteria, one review (Oono et al., 2013) met 10 of
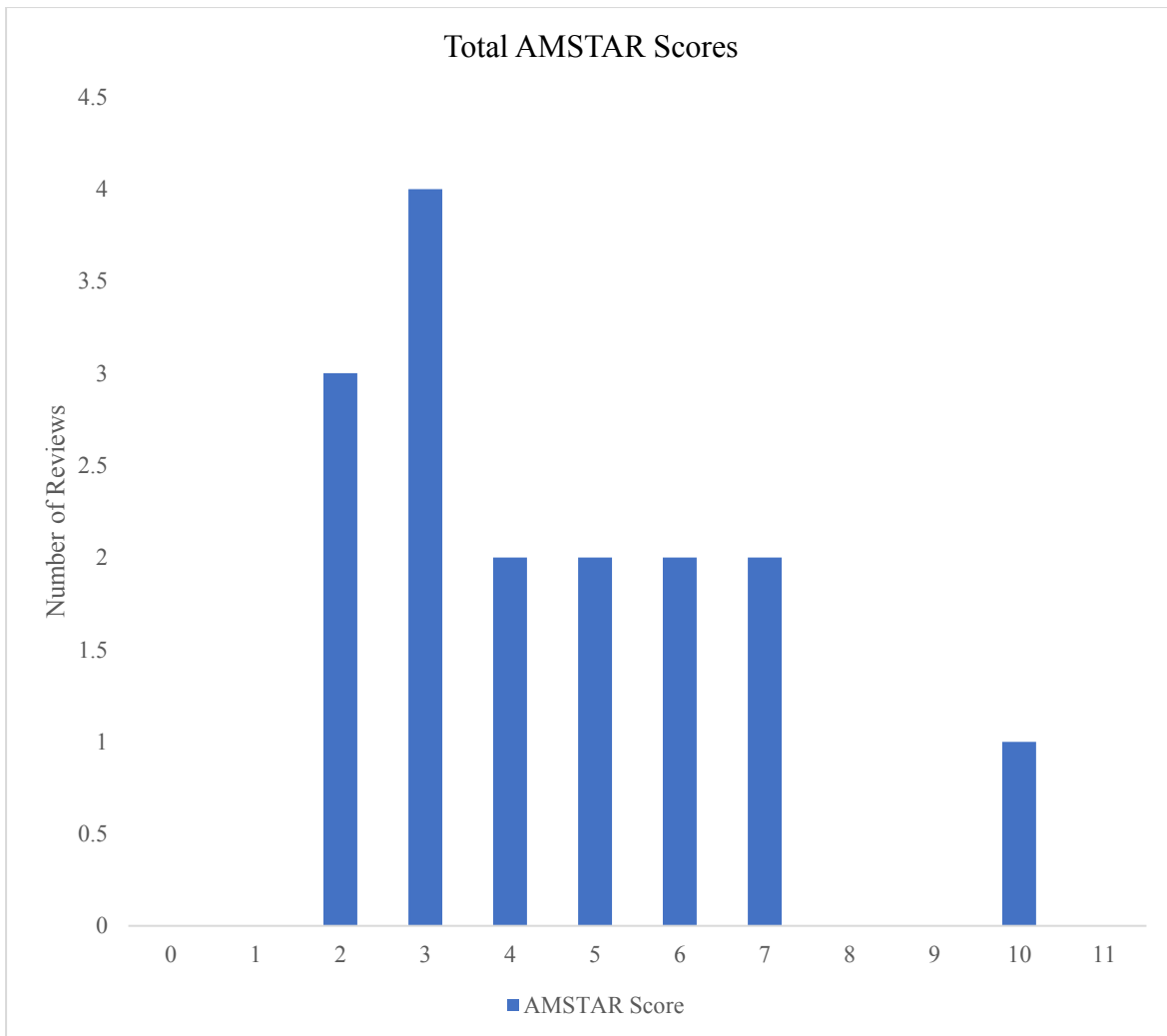
the 11 criteria.

Figure 2. Total AMSTAR scores for systematic reviews of interventions mediated by someone other than a highly-qualified autism professional.

The AMSTAR rating by criterion is presented in Figure 3. Few reviews had lists of both included and excluded primary studies or declared conflicts of interests; only 6.25% of the systematic reviews had either one of these quality indicators. In 12.50% of the systematic reviews, the authors reported using an a priori design. Also in 12.50% of the reviews, the authors explicitly assessed the likelihood of publication bias. In 18.75% of the reviews, the authors did not exclude primary studies based on language or publication type. In 43.75% of the reviews, the authors assessed and reported the scientific quality of the included studies. In 50% of reviews, the authors stated that two reviewers independently selected studies for inclusion, stated that two reviewers independently extracted the data, and reported the method used for reaching a consensus if there were disagreements between the two reviewers. Also in 50% of the reviews, the authors indicated that the quality of the primary studies was taken into consideration when making conclusions. In 68.75% of the systematic reviews, the authors used appropriate methods to combine the findings from the primary studies. In 87.50% of the reviews, the authors conducted a comprehensive literature search. Finally, the overall strength of the systematic reviews included in the present study was that, in 93.75% of reviews, the authors described the characteristics of the included studies.

Effectiveness of Interventions

A summary of the outcomes of the systematic reviews is provided in Appendix B. Overall, across systematic reviews, the effectiveness of interventions mediated by someone other than a highly-qualified autism professional was reported to be positive, although some reviews reported mixed or unclear findings for certain outcomes. When interpreting findings and results of the reviews, it is imperative that consideration is given to the methodological quality of the review, especially because many reviews were assessed as having relatively poor methodological
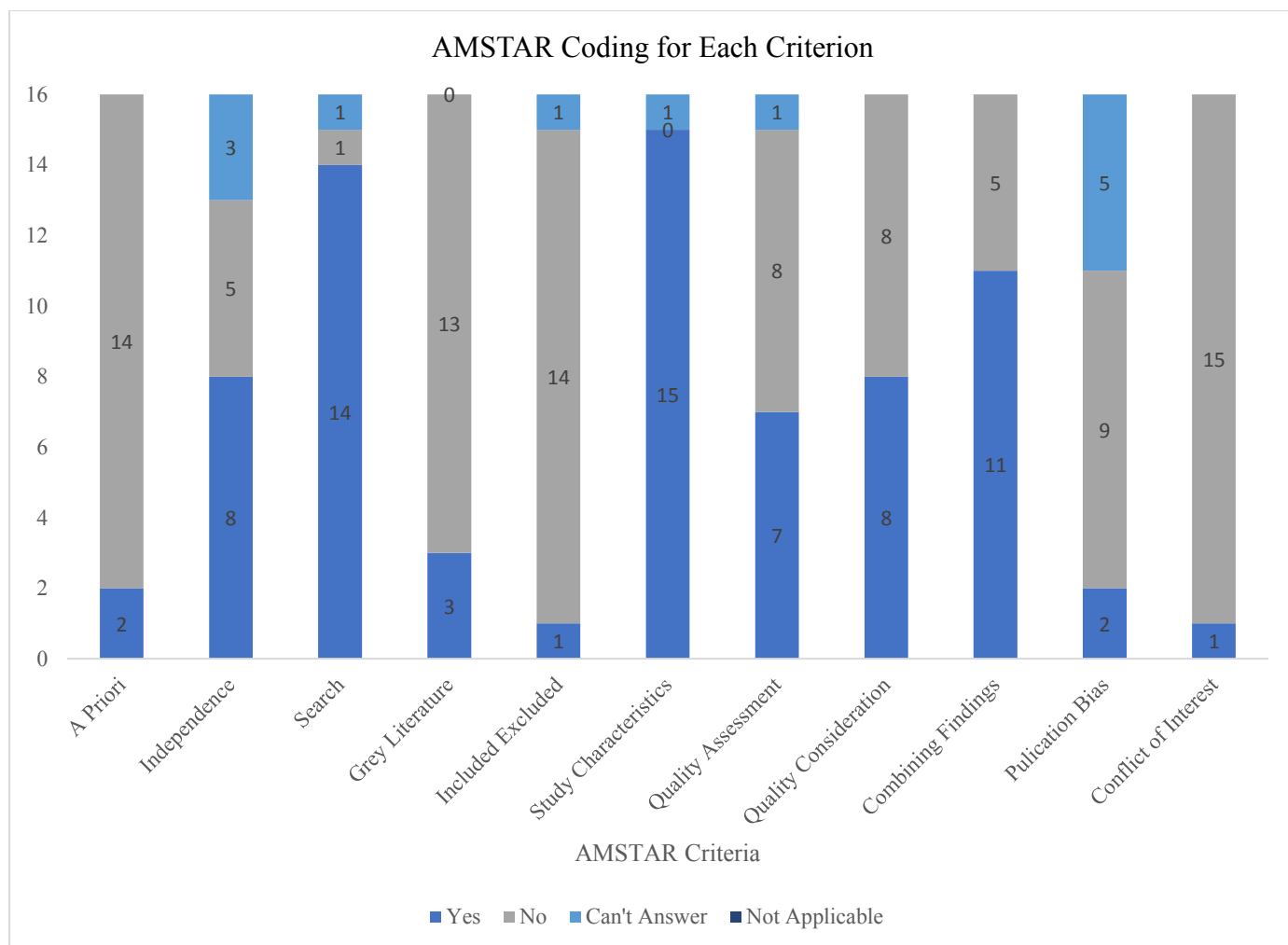
Figure 3. AMSTAR scores for each criterion.

quality. Poor methodological quality poses a threat to the internal validity (i.e., the reliability or accuracy of the results) of a systematic review (e.g., study selection, independence of data extraction, failure to note publication bias) as well as the external validity (i.e., the generalizability of the results) of the review (e.g., specifying a priori research questions and designs). As such, poor methodological quality is likely to negatively impact the reliability of results (Shea et al., 2007; Shea et al., 2009).

Parent-mediated interventions. Eleven systematic reviews (Banda, 2015; Beaudoin et al., 2014; Flippin & Crais, 2011; Lang et al., 2009; McConachie & Diggle, 2007; Meadan et al., 2009; Oono et al., 2013; Patterson et al., 2012; Reichow et al., 2013; Schultz et al., 2011) examined the effectiveness of parent-mediated interventions. Generally, parents were trained in implementing intervention strategies for their children with ASD and then subsequently implemented the intervention with the aim of improving skills and behaviours associated with ASD. Each of the reviews reported on various outcomes as described in the below sections.

Oono, Honey, and McConachie's (2013) review was the highest scoring systematic review included in the present umbrella review, which lends credibility to their results. The authors concluded that there was statistically significant evidence for positive change in patterns of parent-child interactions following parent-implemented intervention. Additionally, there is evidence to suggest that children's language comprehension improved and severity of autism characteristics decreased following the intervention. However, Oono and colleagues reported that there was minimal evidence of positive effects related to other outcomes (e.g., most aspects of language and communication, frequency of child initiations in parent-child interactions, child adaptive behaviour, parents' stress). Further, the authors reported that findings were largely inconclusive and inconsistent across the primary studies included in their review.

The results of Patterson, Smith and Mirenda's (2011) review, supported by improvement rate difference (IRD) analysis, indicated several positive effects for both child and parent outcomes. Positive child outcomes included joint attention, imitation, vocalization, verbal language, and communication. Positive parent outcomes include increased bids for joint attention, verbalizations, and fidelity of implementation of the intervention. No negative outcomes were reported, but Patterson and colleagues reported that child responding (i.e., verbal, written, and labeling) was an unclear outcome. No unclear or mixed outcomes were reported for parents.

Shire and Kasari (2014) conducted a systematic review of train the trainer effectiveness trials of behavioural interventions and included primary studies in which parents were trained as interventionists. Positive outcomes for children with ASD included increased social engagement, an improvement in language skills, and a decrease in challenging behaviour. Shire and Kasari also reported positive outcomes for parents, including fidelity of implementation of the intervention and decreased parental stress. No negative or unclear/mixed outcomes were reported.

In Banda's (2015) review, which mainly focused on sibling involvement in interventions, some of the included studies examined the effectiveness of parent-implemented interventions that were implemented for both the child with ASD and his or her sibling. In these interventions, the reported positive outcomes included fidelity of implementation of social skills interventions as well as the ability to successfully provide prompts and praise, which subsequently improved social interactions between children with autism and their siblings. There were no negative or unclear outcomes reported.

Reichow, Servili, Yasamy, Barbui and Saxena (2013) conducted a systematic review of interventions conducted by non-specialists and included studies in which the child's parents received a parent training intervention delivered by a non-specialist provider. In this review, positive effects related to parent-implemented interventions included improvement in symbolic play and vocabulary for children with ASD, while parents began implementing more appropriate parenting techniques. There were no negative outcomes for either the child or the parents. For children with ASD, problem behaviour was an unclear outcome, while parental stress and maternal distress were also unclear outcomes.

Beaudoin, Sébire, and Couture (2014) conducted a review of parent training interventions for toddlers with ASD. Although fifteen primary studies were included in this review, Beaudoin and colleagues determined that only two of the included studies met criteria for conclusive evidence. No positive outcomes emerged for toddlers with ASD, but both parental satisfaction and therapeutic relationship were both reported as positive outcomes for parents. No negative outcomes were reported for either the child or the parent. However, there were a number of unclear outcomes for children with ASD, including visual attention, communication, play, socioemotional functioning, global development, and engagement with his or her parents. Two unclear or mixed outcomes were also reported for parents: stress and engagement with the child.

McConachie and Diggle (2007) concluded that most studies did not have adequate research designs, which made it difficult for conclusions to be made regarding the effectiveness of parent-implemented early intervention. Nonetheless, a number of positive outcomes did emerge. For children with ASD, positive outcomes included social communication, a decrease in problem behaviours at home, and a decrease in obsessions and rituals. For the parents, positive outcomes included communicative behaviours, a better understand of ASD, and a decrease in

maternal depression. However, this review is the only one that reported negative outcomes related to parent-implemented intervention. The results of this review suggest that children who participated in intensive applied behaviour analysis had significantly higher intelligence quotients than did the children who were in the parent training group. Further, parent-reported levels of child play were higher in a control group than in the parent training group. Additionally, parent-reported levels of child responsiveness were higher in a control group than in the parent training group. There were no unclear or mixed outcomes reported in this review.

Lang, Machalicek, Rispoli and Regester (2009) conducted a systematic review to examine the effects of training parents to implement communication interventions for their children with ASD. Numerous positive child outcomes were reported, including joint attention, attentiveness, imitation, and communication (i.e., verbal, non-verbal, and spontaneous), and receptive language. Additionally, positive effects were reported for parents, including increased use of intervention strategies, fidelity of implementation of the intervention, and a decrease in the number of errors in following the child's lead. There were no negative or unclear outcomes reported.

Schultz, Schmidt, and Stitcher (2011) conducted a review of parent education programs. The authors reported numerous positive outcomes for children with ASD, including spontaneous speech, play behaviour, social skills, appropriate behaviour, a decrease in aggression, a decrease in disruptive behaviour, and a decrease in noncompliance. Additionally, positive outcomes were reported for parents, such as an increase in knowledge of behavioural strategies as well as the child's disability in general and a decrease in parental stress. No negative or unclear outcomes were reported.

Flippin and Crais (2011) conducted a systematic review of parents' contributions to symbolic play outcomes for children with ASD and other developmental disabilities. Three positive outcomes were reported for children with ASD: communication, functional play acts, and social interaction. No outcomes were reported for parents, and no negative or unclear outcomes were reported.

Finally, Meaden, Ostrosky, Zaghlawan, & Yu (2009) conducted a review of parent-implemented interventions for young children with ASD. The authors reported numerous positive outcomes for children with ASD, including joint attention, communication, social skills, a decrease in detachment, and a decrease in challenging and problem behaviour. Positive outcomes were also reported for parents: accuracy of intervention delivery, imitating/animating, expectant waiting, affect, and responsiveness. No negative outcomes were reported, but one unclear outcome was reported: child's responding.

The mean AMSTAR score for methodological quality of the systematic reviews examining parent-implemented interventions for children with ASD was 5 out of 11 with a range of 2 to 10; a large range in quality. Oono and colleagues' (2013) review met 10 of the 11 AMSTAR criteria, which lends credibility and reliability to their results. The authors of this review concluded that findings of parent-mediated interventions are largely inconclusive and inconsistent. Additionally, across the 11 systematic reviews that examined parent-mediated interventions, numerous unclear or mixed outcomes were reported. Further, in one review, three negative outcomes were reported: IQ, play skills, and responsiveness to adults and peers (McConachie & Diggle, 2007). As such, it appears to be too premature to consider parent-mediated intervention a viable method of producing positive effects for children with ASD.

Sibling-mediated interventions. Three systematic reviews (Banda, 2015; Shivers &

Plavnick, 2015; Zhang & Wheeler, 2011) examined the effectiveness of sibling-mediated

interventions. Banda and Shivers and Plavnick reported results according to the siblings' role in

the intervention (i.e., whether the sibling was the instructor of the intervention, the model in

video or live modeling, a character in social stories, or a co-recipient of the intervention), but

Zhang and Wheeler did not specify the siblings' roles in the interventions.

In the majority of the interventions reviewed by Banda (2015) and Shivers and Plavnick

(2015), siblings directly instructed the child with ASD. In this case, siblings were taught

intervention strategies that they then implemented with their brother or sister. Among these

interventions, numerous positive outcomes were reported for children with ASD. Findings from

both reviews suggest that sibling-instructed interventions promote play skills, verbal language,

social skills, a positive sibling relationship, and fine motor skills for children with ASD (Banda,

2015; Shivers & Plavnick, 2015). Shivers and Plavnick's review also suggested that such

interventions promote academic skills for children with ASD. In addition, positive outcomes

were reported for the sibling instructor, such as improvement in the relationship with their

sibling with ASD and fidelity in the implementation of the intervention. While no negative

outcomes were reported for children with ASD or the sibling instructor and no unclear outcomes

were reported for the sibling, there were two unclear outcomes reported for children with ASD:

requesting behaviour (Banda, 2015) and joint attention (Shivers & Plavnick, 2015).

Siblings also appeared as models in video or live modeling and as a character in social

stories. In these types of interventions, Banda (2015) reported numerous positive outcomes for

children with ASD, including increased scripted comments during play and a decrease in

excessive directions during play. Shivers and Plavnick (2015) also reported various positive

outcomes for children with ASD, including increased social play, scripted statements during play, shoe tying skills, academic skills, and a decrease in problem behaviour. No negative outcomes were reported, but Banda reported unclear outcomes for the child with ASD, such as unscripted comments during play, imitation, fine motor skills, and complimenting during play. Shivers and Plavnick also reported unclear outcomes, including functional skills and spontaneous speech during play. In these types of interventions, no outcomes were reported for siblings in either Banda's or Shivers and Plavnick's reviews.

In some interventions, siblings were co-recipients of the intervention. Because Banda (2015) specified that parents implemented the interventions in his review, the results of his review are also discussed in the parent-implemented intervention section of this umbrella review. Banda reported that such interventions successfully promoted social interactions between the child with ASD and his or her sibling. Shivers and Plavnick (2015) did not report who implemented the intervention, but they reported a number of positive outcomes for the child with ASD, including joint attention, social play, a decrease in ritualistic behaviour, an improved sibling relationship, and functional skills (i.e., swimming). Additionally, Shivers and Plavnick reported that this type of intervention promoted the sibling relationship and functional skills (i.e., swimming) for the sibling of the child with ASD. Neither Banda or Shivers and Plavnick reported any negative or unclear/mixed outcomes were reported for the child with ASD or his or her sibling.

Zhang and Wheeler (2011) did not describe the roles siblings played in interventions, but they determined that siblings effectively promoted social responses and social interactions for their brother or sister with ASD. Further, the results of this review suggested that siblings were

more effective than peers in promoting these skills. There were no negative or unclear outcomes reported in this review.

Overall, there was high agreement among the outcomes reported by Banda (2015), Shivers and Plavnick (2015), and Zhang and Wheeler (2011). However, the quality of these reviews was middle to low, with one review (Banda, 2015) scoring 6 out of 11 on the AMSTAR criteria and two reviews (Shivers & Plavnick, 2015; Zhang & Wheeler, 2011) scoring 3 out of 11 on the AMSTAR criteria. With a mean AMSTAR score of 4 across the three reviews, the methodological quality must be considered when interpreting the results of these reviews. Although sibling-mediated interventions are a potentially promising practice and produced various positive effects without any negative outcomes, there is a limited literature base pertaining to these interventions.

Peer-mediated interventions. Five reviews (Chan et al., 2009; Shire & Kasari, 2014; Wang et al., 2011; Watkins et al., 2015; Zhang & Wheeler, 2011) examined the effectiveness of peer-mediated interventions for children with ASD. In these interventions, peers were taught to implement intervention techniques and then subsequently used the techniques with a child with ASD in order to target skills or behaviours associated with ASD.

Peer-mediated interventions were associated with positive outcomes for children with ASD in a number of domains. First, Shire and Kasari (2014) reported that peer-mediated intervention was successful in promoting peer interactions for children with ASD. Second, Watkins and colleagues (2015) found that peer-mediated interventions successfully promoted various social skills (e.g., interactions, initiations, responses, social engagement, communicative acts) and play skills (e.g., scripted phrases, context-related comments, responses, narrative play, turn taking exchanges) among children with ASD. These authors concluded that peer-mediated

intervention appears to be a promising method of improving the social interactions of children with ASD with positive generalization, maintenance, and social validity outcomes. Third, Chan and colleagues (2009) reported that peer-mediated intervention had a number of positive outcomes for children with ASD, including some social skills (e.g., social initiations, maintaining interactions, turn taking, affection), environmental transitions, functional/self-help skills, and academic skills. The findings in this systematic review also suggest that peer-mediated intervention was successful in decreasing stereotypy. However, the results of Chan and colleagues' review also revealed unclear outcomes, including joint attention, communication skills, and appropriate talking. Next, Zhang and Wheeler (2011) suggested that peer-mediated interventions were highly effective in promoting social responses and interactions for children with ASD, although peers were slightly less effective than were siblings. Finally, Wang, Cui, and Parrila (2011) found that peer-mediated intervention significantly improved the social skills of children with ASD. The authors of this review also reported that age significantly moderated the effectiveness of the intervention, with the effectiveness of the intervention decreasing as children get older.

The mean AMSTAR score of the systematic reviews examining peer-mediated interventions was 4.2 out of 11, with a range of 2 to 7. This represents relatively low methodological quality and does not contribute to strong reliability of the results. As such, the results of these reviews must be interpreted with methodological quality in mind. Although the results of the systematic reviews suggest that peer-mediated intervention has been successful in promoting a variety of skills for children with ASD, the overall methodological quality of these reviews was relatively poor. However, it should be noted that none of the reviews reported negative results. It is the contention of this review that peer-mediated

interventions are a viable intervention for producing positive outcomes for children with ASD, but it is imperative that reviews of higher methodological quality are produced in this area.

   Interventions mediated by other non-specialists. Two systematic reviews (Reichow et al., 2013; Shire & Kasari, 2014) examined the effects of interventions mediated by other non-specialists. Shire and Kasari (2014) examined the effectiveness of behavioural interventions implemented by job center staff, aides, teachers, and tutors. In this review, interventions were reported to promote joint engagement, joint attention, communication, cognition, and daily living skills for children with ASD. However, there were two unclear outcomes: language and motor skills. Additionally, Shire and Kasari suggested that the effectiveness of the intervention was related to the child's developmental level, where children with the most skills at the beginning of the intervention made the greatest gains. Reichow and colleagues (2013) examined the effectiveness of interventions implemented by teachers, therapists, and aides. The authors reported that such interventions were successful in promoting joint engagement, cognition, and academic skills, and decreasing parental stress. Nonetheless, there were some unclear outcomes, including joint attention, language, problem behaviour, and daily living skills.

   The mean AMSTAR score of the reviews examining interventions mediated by other non-specialists was 6.5 out of 11, with a range of 6 to 7; a moderate level to methodological quality. Although interventions mediated by other non-specialists appear to be effective for a variety of outcomes, only two systematic reviews were included in this category, and as such, there is a limited literature base pertaining to these interventions.

Discussion

   This umbrella review collected, appraised, and summarized the available evidence from 16 systematic reviews examining the effects of interventions for children with ASD mediated by

someone other than a highly-qualified autism professional. The systematic reviews included in this synthesis covered interventions mediated by parents, peers, siblings and other non-specialists (e.g., paraprofessionals, educators). The results of the present study highlight the clinical findings and the methodological quality of these systematic reviews.

Methodological Quality

The results of this umbrella review indicated that many systematic reviews had considerable deficiencies and received relatively low scores on the AMSTAR. As such, the findings of these systematic reviews must be interpreted with caution. Thus, this umbrella review demonstrated that there is little high-quality evidence for, or against, the effectiveness of interventions for children with ASD mediated by someone other than a highly-qualified autism professional. Although 6.25% of the reviews scored in the "upper" range by meeting at least eight of the 11 AMSTAR criteria, no review met all 11 AMSTAR criteria; the highest scoring review met 10 of the 11 criteria (Oono et al., 2013). Across the 16 reviews, the most common methodological weaknesses were that the authors did not provide a list of included and excluded studies (6.25%), did not state conflicts of interest (6.25%), did not provide an a priori design (12.5%), and did not explicitly assess the likelihood of publication bias (12.5%). These areas of methodological weakness threaten both the internal and external validity of the systematic reviews.

While reviews included in this study generally scored poorly on the AMSTAR, a comparison between the present umbrella review and one conducted by Seida and colleagues (2009) suggests that the methodological quality of the systematic reviews seems to be improving in some areas. For example, Seida and colleagues reported that the systematic reviews included in their study "often lacked a comprehensive search strategy, reliable study selection, and

assessment of the quality of primary studies" (p. 101). In contrast, the systematic reviews included in the present study generally used comprehensive search strategies (87.5%), frequently used appropriate procedures to select studies for inclusion (50%), and sometimes evaluated the methodological quality of the primary studies included in the review (43.75%). As such, it appears that despite the overall methodological issues present in the systematic reviews included in this umbrella review, the methodological quality of reviews is increasing in specific areas.

It is important to note that authors often failed to clearly report the methodological procedures used in their review. It was often difficult, or even impossible, to determine accurately determine if authors had indeed used the methodological procedure necessary to receive a "yes" coding for certain AMSTAR criteria. As such, it is possible that some studies may have used appropriate methodological procedures in conducting their review but failed to report these details. In such a case, review would have been given a "can't answer" or "no." It is important to note that it was beyond the scope of this thesis to email individual authors directly to inquire whether they had used the methodological procedure. However, the methodological quality rating of many of these reviews could have been improved with a simple modification to the text if the methods were indeed used. As such, it should not be necessary to follow up with individual authors to inquire whether or not they had used the methodological procedure. Further, it may be important that scientific journals publishing ASD research begin to appraise the quality of a systematic review and request editorial changes related to reporting the methodological procedures used, if warranted, before a review is published.

Clinical Findings

The results of the present study suggest that a number of positive outcomes are associated with interventions for children with ASD mediated by someone other than a highly-qualified

autism professional. Despite the fact that concrete recommendations regarding which specific intervention will be appropriate or beneficial for specific children, some broad outcomes from the systematic reviews are discussed. This information may be relevant and important for parents, teachers, clinicians, policy-makers, and other stakeholders.

Overall, interventions mediated by someone other than a highly-qualified autism professional were associated with a variety of positive outcomes for children with ASD, including social communication, play skills, academic skills, functional skills, decreasing the severity of autism characteristics (e.g., restricted and repetitive patterns of behaviour, stereotypy), and decreasing challenging behaviour. Further, in some cases, parent-mediated interventions appeared to promote the parent-child relationship, while sibling-mediated interventions appeared to sometimes promote the sibling relationship.

Each systematic review included primary studies that examined the effectiveness of a variety of intervention strategies, including Pivotal Response Treatment (PRT), the Early Start Denver Model (ESDM), discrete trial training (DTT), and video modeling. The intervention strategies included in these systematic reviews are so numerous that is difficult to determine specific best practice intervention recommendations for children with ASD. Nonetheless, a summary of the intervention strategies used are provided in Appendix B.

Different primary studies, and subsequently different systematic reviews, examined different outcomes, used different tools to measure change, and employed different intervention strategies. Further, in many cases, one systematic review reported multiple outcomes, used multiple tools to measure change, and reported the effects of multiple intervention strategies. As such, it is difficult to summarize the positive effects of a particular intervention. Additionally,

there is uncertainty regarding the best practices for interventions for children with ASD because, at this time, it is not possible to compare the relative effectiveness of these interventions.

Findings from the Highest Quality Review

Oono and colleagues' (2013) review was the review with the highest methodological quality in the present umbrella review, meeting 10 of the 11 AMSTAR criteria. Because this review is a Cochrane review and was therefore conducted according to an established protocol, it should not be surprising that it scored highly on the AMSTAR tool. Oono and colleagues' review examined parent-mediated interventions, and interestingly, the findings of this review differed from the findings of other, lower quality, reviews examining parent-mediated interventions. While other reviews found that parent-mediated interventions were successful in promoting a variety of outcomes (e.g., joint attention, social interaction, communication, parents' stress), Oono and colleagues found that there was only statistically significant evidence for positive change in patterns of parent-child interactions, and some evidence that child language comprehension and severity of autism characteristics improved. Oono and colleagues did not find statistical evidence of gains in other aspects of language, communication, frequency of child initiations in parent-child interactions, child adaptive behaviour, or parents' stress.

Usability of the AMSTAR Tool

While the AMSTAR tool (Shea et al., 2007; Shea et al., 2009) provided important information regarding the methodological quality of the systematic reviews included in the present study, there was a relatively large amount of discrepancy between the two reviewers, which suggests that the AMSTAR tool may not be easy to use. Even with the use of the AMSTAR Operationalization guide (Kitsiou et al., 2015), the interrater agreement for the use of the AMSTAR to assess the methodological quality of the 16 reviews was barely acceptable at

80.68%. There were a few specific areas of discrepancy. The fourth question on the AMSTAR, which assessed whether the status of publication was used as an inclusion criterion in the systematic review, appeared to be particularly difficult because the two independent reviewers were discrepant on seven of the 16 (43.75%) reviews. For example, one reviewer reported that Shire and Kasari's (2014) review did not meet this specific criterion while the other reviewer reported that the review did meet the criterion. In this case, a consensus procedure was employed and it was determined that this review did indeed meet this criterion. Question two, which assessed whether duplicate study selection and data extraction was conducted, also appeared to be difficult as the two raters were discrepant on six of the 16 (37.5%) of the reviews. This question may have been difficult because in many cases this information had to be inferred rather than explicitly stated. Further, question nine, which assessed the appropriateness of the methods used to combine findings, was relatively difficult as the reviewers were discrepant on five of the 16 (31.25%) of the reviews. Unfortunately, such discrepancies may threaten the validity of the AMSTAR findings. It is likely that many of these questions were difficult to answer, and thus the reviewers were discrepant on a large number of studies, because the information needed to determine whether the criteria were met was often not explicitly stated. Perhaps if the authors of systematic reviews had ensured that this information was clearly stated within the review, it would have increased the reliability of the AMSTAR tool.

Implications for Future Research

The findings of this umbrella review demonstrate that, overall, there is a considerable breadth of information regarding the effectiveness of interventions mediated by someone other than a highly-qualified autism professional in general. Nonetheless, there are certainly gaps in the research. Researchers who are looking to conduct either primary studies or systematic

reviews in this area should consider the body of evidence that has already been published to address the gaps that currently exist in this area of research. For example, although there were 16 systematic reviews included in the current study, only two reviews (Reichow et al., 2013; Shire & Kasari, 2014) examined the effects of interventions mediated by someone other than parents, siblings, or peers. Additionally, many systematic reviews did not consider the role of child characteristics (e.g., age, developmental level) in intervention outcomes. Additional studies should examine the impact child characteristics on intervention outcomes.

While many systematic reviews have attempted to evaluate the effectiveness of interventions mediated by someone other than a highly-trained autism professional, the methodological quality of these systematic reviews remains low. For findings of systematic reviews to be valid, reliable, and relevant for stakeholders, rigorous methodological procedures, and the subsequent reporting of such procedures, is essential. To increase the validity and reliability of the reported findings, it is imperative that the methodological quality of systematic reviews improves. To do so, authors of systematic reviews could select a quality assessment tool, such as the AMSTAR, and apply its criteria throughout the systematic review process to ensure that the necessary methodological procedures are followed.

While Seida and colleagues' (2009) umbrella review included 30 systematic reviews, the studies included in the present umbrella review were selected from a corpus of 160 systematic reviews that were published over the past 10 years. This five-fold increase, which occurred in fewer than 10 years, reflects a recent explosion in publication of systematic reviews of interventions for children with ASD. Nonetheless, there appears to be a large divide between research and what is done in practice. While systematic reviews may be able to narrow the gap between research and practice, there are now so many reviews examining interventions for

children with ASD that there is an increasing need for umbrella reviews that examine this area of inquiry.

Limitations

The present umbrella review has limitations that should be considered. First, the diversity in the reporting of outcomes across the systematic reviews included in this umbrella review did not allow for a quantitative synthesis, and instead findings were analyzed in a descriptive manner. Second, because the present study included reviews that described findings both qualitatively and quantitatively, it was not possible to conduct a quantitative analysis of publication bias. While it may have been possible to assess publication qualitatively, this was not done. Third, some studies that had been identified as potentially relevant for inclusion in this umbrella review were excluded because they could not be retrieved or because there was no English translation of the article. Nevertheless, due to an extensive and systematic search strategy, it is likely that the systematic reviews included in the present study are representative of the published body of reviews in this area of inquiry. Fourth, a list of excluded studies is not included in this manuscript but it is available upon request. Finally, while an a priori design was used in this umbrella review, there was no formal registration with PRISMA or PROSPERO.

<div align="center">

Conclusions

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This umbrella review indicated that there is currently some evidence to support interventions for children with ASD mediated by someone other than a highly-qualified autism professional. Indeed, the analysis of the 16 systematic reviews revealed that interventions mediated by parents, siblings, peers, and other non-specialists (e.g., paraprofessionals, educators) are generally associated with positive outcomes. However, much of this evidence is of low methodological quality and therefore should be considered tentative until it has been confirmed by additional

high-quality systematic reviews. For reviews to be valid, reliable, and transparent, it is essential that more rigorous methods and reporting of such methods are used in future systematic reviews.

Declaration of Conflicts of Interest

There are no conflicts of interest to declare. No financial support or compensation was provided for the completion of this study.

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*Denotes systematic reviews included in the present umbrella review

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    meta-analysis in single-case research using HLM. *Research in Autism Spectrum Disorders*,

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Appendix A: Search strategy

A research librarian (Lisa Tjosvold) conducted a comprehensive literature search for publications published between January 2006 and April 2016 in the following electronic databases: Medline, ERIC, PsychINFO, Cochrane Database of Systematic Reviews, DARE and the HTA Database. The searches were restricted to systematic reviews. The search was developed a priori and carried out prior to the study selection process.

Database	Edition or date searched	Search Terms [††]
Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present	Searched: April 13, 2016 Results: 368 (English) 22(Non English)	1. exp Child Development Disorders, Pervasive/ 2. exp Autistic Disorder/ 3. autis$.ti,hw,kw. 4. autis*.ab. /freq=2 5. asd.ti,ab. 6. kanner$.ti,ab. 7. asperger$.ti,ab. 8. (pervasive and development and disorder).ti,ab. 9. PDD.ti,ab. 10. pdd-nos.ti,ab. 11. childhood disintegrative disorder.ti,ab. 12. ((speech or communicat$) adj3 disorder$).ti,ab. 13. (child$ adj3 schizophren$).ti,ab,sh. 14. (language adj3 delay$).ti,ab. 15. or/1-14 16. exp Behavior Therapy/ 17. exp Imitative Behavior/ 18. ((behavio$ or social) adj5 (therap$ or interven$ or analy*)).ti,ab,jn. 19. ABA.ti,ab. 20. (IBI or IBT).ti,ab. 21. verbal behavio$.ti,ab. 22. (verbal adj5 (therap$ or communicat$)).ti,ab. 23. lovaas.ti,ab. 24. linwood.ti,ab. 25. Douglass.ti,ab. 26. CABAS.ti,ab. 27. DTT.ti,ab. 28. (Treatment adj2 Education adj2 Autistic adj communication adj Handicapped adj children).ti,ab. 29. teacch.ti,ab.

		30. floor time.ti,ab. 31. (Social adj Communication adj Emotional adj Regulation adj Transactional adj Support).ti,ab. 32. scerts.ti,ab. 33. (pivotal adj3 response).ti,ab. 34. discrete trial$.ti,ab. 35. (((sensory or auditory) adj integration) and (treat$ or therap$)).mp. 36. facilitated communication.ti,ab. 37. ((parent or parents or caregiver$ or care-giver$ or family or families or mother$ or father$ or maternal$ or paternal$) adj2 (treat$ or therap$ or interven$ or direct$ or program$ or train$ or mediat$ or rehabilit$)).mp. 38. Picture Exchange.ti,ab. 39. photic stimulation/ and (treat$ or therap$ or interven$ or direct$ or program$ or train$ or mediat$ or rehabilit$).mp. 40. exp Language Therapy/ or exp Speech Therapy/ 41. occupational therapy/ 42. exp Computer-Assisted Instruction/ 43. (assist$ adj3 tech$).ti,ab. 44. (computer adj3 (teach$ or instruct$)).ti,ab. 45. (ipad or podd or tablet or chromebook).ti,ab. 46. exp Sensory Art Therapies/ Or Play Therapy/ 47. exp Animal Assisted Therapy/ 48. ((music or art or dance or play or animal or animals or dog or cat or pet) adj2 therap*).ti,ab. 49. Early Intervention/ 50. (computer adj3 (teach$ or instruct$)).ti,ab. 51. (social adj (stories or narrative*)).ti,ab. 52. prompt$.mp. 53. ((augment$ or social) adj3 communicat$).ti,ab. 54. (relationship adj develop$).ti,ab. 55. (cognitive and (treat$ or therap$ or psychotherap$)).mp. 56. cbt.ti,ab. 57. (sound adj3 (treat$ or therap$)).ti,ab. 58. (natural adj environment).ti,ab. 59. (activity adj schedule$).ti,ab. 60. (direct adj instruct$).ti,ab. 61. (giant adj step$).ti,ab. 62. developmental individual difference.ti,ab. 63. option.ti,ab. 64. (sonrise or kaufman).ti,ab. 65. precision.ti,ab. 66. (social adj (skill* or pragmatic)).ti,ab. 67. hanen.ti,ab. 68. miller.ti,ab. 69. patterning$.ti,ab. 70. philadelphia.ti,ab. 71. (dolman or delaccato).ti,ab. 72. (echange adj3 developpement).ti,ab. 73. bartelemy.ti,ab. 74. (gentle adj teach$).ti,ab. 75. denver.ti,ab. 76. leap.ti,ab. 77. (learning experiences adj alternative program).ti,ab. 78. pcdi.ti,ab. 79. princeton child development institute.ti,ab,af. 80. rutgers.ti,ab. 81. (natural adj teach$).ti,ab. 82. milieu.ti,ab. 83. (neurodevelop$ adj treat$).ti,ab. 84. ndt.ti,ab. 85. walden.ti,ab. 86. adlerian.ti,ab. 87. theraplay.ti,ab. 88. Eden.ti,ab. 89. "early bird".ti,ab. 90. (video adj3 model$).ti,ab. 91. (self adj3 (manage$ or monitor$)).ti,ab. 92. yale.ti,ab. 93. bancroft.ti,ab. 94. horizon.ti,ab. 95. (may adj institute).ti,ab.

		96. task analysis.mp.
		97. chaining.mp.
		98. (restrict* adj2 repetitive pattern*).mp.
		99. "symbol use".mp.
		100. attention/ or joint attention.ti,ab.
		101. exp "Reinforcement (Psychology)"/
		102. Conditioning, Operant/
		103. (differential adj2 reinforce*).ti,ab.
		104. time delay.ti,ab.
		105. exp peer group/ and exp teaching/
		106. (peer adj2 (mediat* or instruct* or teach* or learn* or tutor*)).ti,ab.
		107. (function* adj2 behavio?r* adj assess*).ti,ab.
		108. fba.ti,ab.
		109. (stimulus adj3 (control or modif*)).ti,ab.
		110. extinction.ti,ab.
		111. (response interrupt* adj2 redirect*).mp.
		112. RIRD.ti,ab.
		113. exp Social Skills/ and group*.ti,ab.
		114. (visual adj2 (script* or support* or aids or aid)).mp.
		115. voca.ti,ab.
		116. "Augmentative and alternative communication".kw.
		117. "communication intervention".kw.
		118. ((speech or communicat*) adj3 device*).ti,ab.
		119. or/16-118
		120. 15 and 119
		121. meta-analysis.pt.
		122. (meta-anal$ or metaanal$).mp.
		123. ((quantitativ$ adj3 review$1) or (quantitativ$ adj3 overview$)).mp.
		124. ((systematic$ adj3 review$) or (systematic adj3 overview$)).mp.
		125. ((methodologic adj3 review$1) or (methodologic adj3 overview$)).mp.
		126. (integrat$ adj5 research).mp.
		127. (quantitativ$ adj3 synthes$).mp.
		128. or/121-127
		129. review.pt. or (review$ or overview$).mp.
		130. (medline or medlars or pubmed or index medicus or embase or cochrane).mp.
		131. (scisearch or web of science or psycinfo or psychinfo or cinahl or cinhal).mp.
		132. (excerpta medica or psychlit or psyclit or current contents or science citation index or sciences citation index or scopus).mp.
		133. (hand search$ or manual search$).mp.
		134. ((electronic adj3 database$) or (bibliographic adj3 database$) or periodical index$).mp.
		135. (pooling or pooled or mantel haenszel).mp.
		136. (peto or der simonian or dersimonian or fixed effect$).mp.
		137. ((combine$ or combining) adj5 (data or trial or trials or studies or study or result or results)).mp.
		138. or/130-137
		139. 129 and 138
		140. (hta$ or health technology assessment$ or biomedical technology assessment$).mp.
		141. technology assessment, biomedical/ or biomedical technology assessment/
		142. 128 or 139 or 140 or 141
		143. limit 120 to "systematic reviews"
		144. 120 and 142
		145. 143 or 144
		146. limit 145 to yr="2006 -Current"
		147. remove duplicates from 146
		148. limit 147 to english language

ERIC 1965 to February 2016	Searched: April 13, 2016 Results: 244	1. exp Pervasive Developmental Disorders/ 2. exp Autism/ 3. exp Asperger Syndrome/ 4. autis$.mp. 5. kanner$.ti,ab. 6. asperger$.ti,ab. 7. (pervasive and development and disorder).ti,ab. 8. PDD.ti,ab. 9. pdd-nos.ti,ab. 10. childhood disintegrative disorder.ti,ab. 11. ((speech or communicat$) adj3 disorder$).ti,ab,sh. 12. (child$ adj3 schizophren$).ti,ab,sh. 13. (language adj3 delay$).ti,ab. 14. Delayed Speech/ 15. or/1-14 16. exp Behavior Modification/ 17. exp Behavior Change/ 18. exp IMITATION/ 19. exp Special Education/ 20. exp Classroom Techniques/ 21. Cognitive Restructuring/ 22. ((behavio$ or social) adj5 (therap$ or interven$ or analy*)).ti,ab,jn. 23. ABA.ti,ab. 24. (IBI or IBT).ti,ab. 25. exp Verbal Communication/ 26. verbal behavio$.ti,ab. 27. (verbal adj5 (therap$ or communicat$)).ti,ab. 28. exp Speech Therapy/ 29. occupational therapy/ 30. Music Therapy/ or Art Therapy/ or Dance Therapy/ or Play Therapy/ 31. ((music or art or dance or play or animal or animals or dog or cat or pet) adj2 therap*).ti,ab. 32. lovaas.ti,ab. 33. linwood.ti,ab. 34. Douglass.ti,ab. 35. CABAS.ti,ab. 36. DTT.ti,ab. 37. (Treatment adj2 Education adj2 Autistic adj communication adj Handicapped adj children).ti,ab. 38. teacch.ti,ab. 39. floor time.ti,ab. 40. (Social adj Communication adj Emotional adj Regulation adj Transactional adj Support).ti,ab. 41. scerts.ti,ab. 42. (pivotal adj 3 response).ti,ab. 43. discrete trial$.ti,ab. 44. exp Sensory Integration/ 45. (((sensory or auditory) adj integration) and (treat$ or therap$)).mp. 46. facilitated communication.ti,ab. 47. ((parent or parents or caregiver$ or care-giver$ or family or families or mother$ or father$ or maternal$ or paternal$) adj2 (treat$ or therap$ or interven$ or direct$ or program$ or train$ or mediat$ or rehabilit$)).mp. 48. Picture Exchange.ti,ab. 49. exp Computer-Assisted Instruction/ 50. exp Assistive Technology/ 51. (assist$ adj3 tech$).ti,ab. 52. (computer adj3 (teach$ or instruct$)).ti,ab. 53. (ipad or podd or tablet or chromebook).ti,ab. 54. exp Early Intervention/ 55. (social adj (stories or narrative*)).ti,ab. 56. exp Prompting/ 57. prompt$.mp. 58. exp "augmentative and alternative communication"/ 59. ((augment$ or social) adj3 communicat$).ti,ab. 60. (relationship adj develop$).ti,ab. 61. (cognitive and (treat$ or therap$ or psychotherap$)).mp. 62. cbt.ti,ab. 63. (natural adj environment).ti,ab. 64. (activity adj schedule$).ti,ab. 65. (direct adj instruct$).ti,ab. 66. (giant adj step$).ti,ab.

		67. developmental individual difference.ti,ab.
		68. option.ti,ab.
		69. (sonrise or kaufman).ti,ab.
		70. precision.ti,ab.
		71. exp Interpersonal Competence/ and exp Skill Development/
		72. (social adj (pragmatic or skill*)).ti,ab.
		73. hanen.ti,ab.
		74. miller.ti,ab.
		75. patterning$.ti,ab.
		76. philadelphia.ti,ab.
		77. (dolman or delaccato).ti,ab.
		78. (echange adj 3 developpement).ti,ab.
		79. bartelemy.ti,ab.
		80. (gentle adj teach$).ti,ab.
		81. denver.ti,ab.
		82. leap.ti,ab.
		83. (learning experiences adj alternative program).ti,ab.
		84. pcdi.ti,ab.
		85. princeton child development institute.ti,ab,af.
		86. rutgers.ti,ab.
		87. (natural adj teach$).ti,ab.
		88. milieu.ti,ab.
		89. (neurodevelop$ adj treat$).ti,ab.
		90. ndt.ti,ab.
		91. walden.ti,ab.
		92. adlerian.ti,ab.
		93. theraplay.ti,ab.
		94. Eden.ti,ab.
		95. (early adj bird).ti,ab.
		96. (video adj3 model$).ti,ab.
		97. (self adj3 (manage$ or monitor$)).ti,ab.
		98. (yale or bancroft or horizon).ti,ab.
		99. (may adj institute).ti,ab.
		100. task analysis.mp.
		101. exp task analysis/
		102. (restrict* adj2 repetitive pattern*).mp.
		103. "symbol use".mp.
		104. attention/
		105. joint attention.ti,ab.
		106. exp reinforcement/
		107. chaining.mp.
		108. time delay.mp.
		109. exp Peer Teaching/ or peer-mediated.mp.
		110. exp functional behavioral assessment/
		111. fba.mp.
		112. (function* adj2 behavio?r* adj assess*).ti,ab.
		113. (stimulus adj3 (control or modif*)).ti,ab.
		114. extinction.mp.
		115. (response interrupt* adj2 redirect*).mp.
		116. RIRD.ti,ab.
		117. differential reinforc*.mp.
		118. (visual adj2 (script* or support* or aids or aid)).mp.
		119. voca.ti,ab.
		120. ((speech or communicat*) adj3 device*).ti,ab.
		121. or/16-120
		122. 15 and 121
		123. meta analysis/
		124. exp Literature Reviews/
		125. ((systematic* adj3 (review* or overview*)) or (methodologic* adj3 (review* or overview*))).ti,ab.
		126. ((quantitative adj3 (review* or overview* or synthes*)) or (research adj3 (integrati* or overview*))).ti,ab.
		127. ((integrative adj3 (review* or overview*)) or (collaborative adj3 (review* or overview*)) or (pool* adj3 analy*)).ti,ab.
		128. (data synthes* or data extraction* or data abstraction*).ti,ab.
		129. (handsearch* or hand search*).ti,ab.
		130. (mantel haenszel or peto or der simonian or dersimonian or fixed effect* or latin square*).ti,ab.
		131. (met analy* or metanaly* or technology assessment* or HTA or HTAs or technology overview* or technology appraisal*).ti,ab.

		132. (meta regression* or metaregression*).ti,ab.
		133. (meta-analy* or metaanaly* or systematic review* or biomedical technology assessment* or bio-medical technology assessment*).mp,hw.
		134. (medline or cochrane or pubmed or medlars or embase or cinahl).ti,ab,hw.
		135. (comparative adj3 (efficacy or effectiveness)).ti,ab.
		136. (outcomes research or relative effectiveness).ti,ab.
		137. ((indirect or indirect treatment or mixed-treatment) adj comparison*).ti,ab.
		138. or/123-137
		139. 122 and 138
		140. limit 139 to yr="2006 -Current"

PsycINFO	Searched: April 13, 2016	1. autism spectrum disorders/
2002 to April Week 1 2016		2. autis$.mp.
		3. kanner$.ti,ab.
	Results: 337	4. asperger$.ti,ab.
		5. (pervasive and development and disorder).ti,ab.
		6. PDD.ti,ab.
		7. pdd-nos.ti,ab.
		8. childhood disintegrative disorder.ti,ab.
		9. ((speech or communicat$) adj3 disorder$).ti,ab,sh.
		10. (child$ adj3 schizophren$).ti,ab,sh.
		11. (language adj3 delay$).ti,ab.
		12. Delayed Speech/
		13. or/1-12
		14. exp communication skills training/ or exp social skills training/
		15. exp Behavior Modification/
		16. exp Behavior Change/
		17. exp social Learning/
		18. exp Special Education/
		19. ((behavio$ or social) adj5 (therap$ or interven$ or analy*)).ti,ab,jn.
		20. ABA.ti,ab.
		21. (IBI or IBT).ti,ab.
		22. exp Verbal Communication/
		23. verbal behavio$.ti,ab.
		24. (verbal adj5 (therap$ or communicat$)).ti,ab.
		25. exp Speech Therapy/
		26. occupational therapy/
		27. exp Movement Therapy/ or Play Therapy/
		28. Animal Assisted Therapy/
		29. exp Creative Arts Therapy/
		30. ((music or art or dance or play or animal or animals or dog or cat or pet) adj2 therap*).ti,ab.
		31. lovaas.ti,ab.
		32. linwood.ti,ab.
		33. Douglass.ti,ab.
		34. CABAS.ti,ab.
		35. DTT.ti,ab.
		36. (Treatment adj2 Education adj2 Autistic adj communication adj Handicapped adj children).ti,ab.
		37. teacch.ti,ab.
		38. floor time.ti,ab.
		39. (Social adj Communication adj Emotional adj Regulation adj Transactional adj Support).ti,ab.
		40. scerts.ti,ab.
		41. (pivotal adj 3 response).ti,ab.
		42. discrete trial$.ti,ab.
		43. exp Sensory Integration/
		44. (((sensory or auditory) adj integration) and (treat$ or therap$)).mp.
		45. facilitated communication.ti,ab.
		46. ((parent or parents or caregiver$ or care-giver$ or family or families or mother$ or father$ or maternal$ or paternal$) adj2 (treat$ or therap$ or interven$ or direct$ or program$ or train$ or mediat$ or rehabilit$)).mp.
		47. Picture Exchange.ti,ab.
		48. exp Computer-Assisted Instruction/
		49. exp Assistive Technology/
		50. (assist$ adj3 tech$).ti,ab.
		51. (computer adj3 (teach$ or instruct$)).ti,ab.
		52. (ipad or podd or tablet or chromebook).ti,ab.
		53. exp Early Intervention/
		54. (social adj (stories or narrative*)).ti,ab.
		55. exp Prompting/
		56. prompt$.mp.
		57. exp augmentative communication/
		58. ((augment$ or social) adj3 communicat$).ti,ab.
		59. (relationship adj develop$).ti,ab.
		60. (cognitive and (treat$ or therap$ or psychotherap$)).mp.
		61. cbt.ti,ab.
		62. (natural adj environment).ti,ab.
		63. (activity adj schedule$).ti,ab.
		64. (direct adj instruct$).ti,ab.
		65. (giant adj step$).ti,ab.
		66. developmental individual difference.ti,ab.

| | | 67. option.ti,ab.
68. (sonrise or kaufman).ti,ab.
69. precision.ti,ab.
70. (exp Communication Skills/ or exp Interpersonal Interaction/) and exp Skill Learning/
71. (social adj (pragmatic or skill*)).ti,ab.
72. hanen.ti,ab.
73. miller.ti,ab.
74. patterning$.ti,ab.
75. philadelphia.ti,ab.
76. (dolman or delaccato).ti,ab.
77. (echange adj 3 developpement).ti,ab.
78. bartelemy.ti,ab.
79. (gentle adj teach$).ti,ab.
80. denver.ti,ab.
81. leap.ti,ab.
82. (learning experiences adj alternative program).ti,ab.
83. pcdi.ti,ab.
84. princeton child development institute.ti,ab,af.
85. rutgers.ti,ab.
86. (natural adj teach$).ti,ab.
87. milieu.ti,ab.
88. (neurodevelop$ adj treat$).ti,ab.
89. ndt.ti,ab.
90. walden.ti,ab.
91. adlerian.ti,ab.
92. theraplay.ti,ab.
93. Eden.ti,ab.
94. (early adj bird).ti,ab.
95. (video adj3 model$).ti,ab.
96. (self adj3 (manage$ or monitor$)).ti,ab.
97. (yale or bancroft or horizon).ti,ab.
98. (may adj institute).ti,ab.
99. task analysis.mp.
100. exp task analysis/
101. (restrict* adj2 repetitive pattern*).mp.
102. "symbol use".mp.
103. attention/
104. joint attention.ti,ab.
105. exp reinforcement/
106. chaining.mp.
107. time delay.mp.
108. exp Peer Tutoring/ or peer-mediated.mp.
109. exp Behavioral Assessment/ and exp Functional Analysis/
110. fba.mp.
111. (function* adj2 behavio?r* adj assess*).ti,ab.
112. (stimulus adj3 (control or modif*)).ti,ab.
113. "Extinction (Learning)"/
114. extinction.mp.
115. (response interrupt* adj2 redirect*).mp.
116. RIRD.ti,ab.
117. differential reinforc*.mp.
118. (visual adj2 (script* or support* or aids or aid)).mp.
119. voca.ti,ab.
120. ((speech or communicat*) adj3 device*).ti,ab.
121. or/14-120
122. 13 and 121
123. meta analysis/
124. ((systematic* adj3 (review* or overview*)) or (methodologic* adj3 (review* or overview*))).ti,ab.
125. ((quantitative adj3 (review* or overview* or synthes*)) or (research adj3 (integrati* or overview*))).ti,ab.
126. ((integrative adj3 (review* or overview*)) or (collaborative adj3 (review* or overview*)) or (pool* adj3 analy*)).ti,ab.
127. (data synthes* or data extraction* or data abstraction*).ti,ab.
128. (handsearch* or hand search*).ti,ab.
129. (mantel haenszel or peto or der simonian or dersimonian or fixed effect* or latin square*).ti,ab.
130. (met analy* or metanaly* or technology assessment* or HTA or HTAs or technology overview* or technology appraisal*).ti,ab.
131. (meta regression* or metaregression*).ti,ab. |

		132. (meta-analy* or metaanaly* or systematic review* or biomedical technology assessment* or bio-medical technology assessment*).ti,ab,hw. 133. (medline or cochrane or pubmed or medlars or embase or cinahl).ti,ab,hw. 134. (comparative adj3 (efficacy or effectiveness)).ti,ab. 135. (outcomes research or relative effectiveness).ti,ab. 136. ((indirect or indirect treatment or mixed-treatment) adj comparison*).ti,ab. 137. or/123-136 138. 122 and 137 139. limit 122 to "0830systematic review" 140. 138 or 139 141. limit 140 to yr="2006 -Current" 142. limit 141 to (abstract collection or bibliography or "column/opinion" or "comment/reply" or editorial or encyclopedia entry or "erratum/correction" or letter or obituary or poetry or publication information or reprint or review-book or review-media or review-software & other) 143. 141 not 142 144. limit 143 to ("0110 peer-reviewed journal" or "0280 edited book" or "0400 dissertation abstract")

EBM Reviews – Cochrane Database of Systematic Reviews 2005 to April 07, 2016	Searched: April 13, 2016	1. exp Child Development Disorders, Pervasive/
	CDSR: 44	2. exp Autistic Disorder/
		3. autis$.ti,hw,kw.
	DARE: 59	4. autis*.ab. /freq=2
		5. asd.ti,ab.
	HTA: 29	6. kanner$.ti,ab.
EBM Reviews – Database of Abstracts of Reviews of Effects 1st Quarter 2016		7. asperger$.ti,ab.
		8. (pervasive and development and disorder).ti,ab.
		9. PDD.ti,ab.
		10. pdd-nos.ti,ab.
		11. childhood disintegrative disorder.ti,ab.
		12. ((speech or communicat$) adj3 disorder$).ti,ab.
		13. (child$ adj3 schizophren$).ti,ab,sh.
		14. (language adj3 delay$).ti,ab.
		15. or/1-14
EBM Reviews – Health Technology Assessment 1st Quarter 2016		16. exp Behavior Therapy/
		17. exp Imitative Behavior/
		18. ((behavio$ or social) adj5 (therap$ or interven$ or analy*)).ti,ab,jn.
		19. ABA.ti,ab.
		20. (IBI or IBT).ti,ab.
		21. verbal behavio$.ti,ab.
		22. (verbal adj5 (therap$ or communicat$)).ti,ab.
		23. lovaas.ti,ab.
		24. linwood.ti,ab.
		25. Douglass.ti,ab.
		26. CABAS.ti,ab.
		27. DTT.ti,ab.
		28. (Treatment adj2 Education adj2 Autistic adj communication adj Handicapped adj children).ti,ab.
		29. teacch.ti,ab.
		30. floor time.ti,ab.
		31. (Social adj Communication adj Emotional adj Regulation adj Transactional adj Support).ti,ab.
		32. scerts.ti,ab.
		33. (pivotal adj3 response).ti,ab.
		34. discrete trial$.ti,ab.
		35. (((sensory or auditory) adj integration) and (treat$ or therap$)).mp.
		36. facilitated communication.ti,ab.
		37. ((parent or parents or caregiver$ or care-giver$ or family or families or mother$ or father$ or maternal$ or paternal$) adj2 (treat$ or therap$ or interven$ or direct$ or program$ or train$ or mediat$ or rehabilit$)).mp.
		38. Picture Exchange.ti,ab.
		39. photic stimulation/ and (treat$ or therap$ or interven$ or direct$ or program$ or train$ or mediat$ or rehabilit$).mp.
		40. exp Language Therapy/ or exp Speech Therapy/
		41. occupational therapy/
		42. exp Computer-Assisted Instruction/
		43. (assist$ adj3 tech$).ti,ab.
		44. (computer adj3 (teach$ or instruct$)).ti,ab.
		45. (ipad or podd or tablet or chromebook).ti,ab.
		46. exp Sensory Art Therapies/ or Play Therapy/
		47. exp Animal Assisted Therapy/
		48. ((music or art or dance or play or animal or animals or dog or cat or pet) adj2 therap*).ti,ab.
		49. Early Intervention/
		50. (computer adj3 (teach$ or instruct$)).ti,ab.
		51. (social adj (stories or narrative*)).ti,ab.
		52. prompt$.mp.
		53. ((augment$ or social) adj3 communicat$).ti,ab.
		54. (relationship adj develop$).ti,ab.
		55. (cognitive and (treat$ or therap$ or psychotherap$)).mp.
		56. cbt.ti,ab.
		57. (sound adj3 (treat$ or therap$)).ti,ab.
		58. (natural adj environment).ti,ab.
		59. (activity adj schedule$).ti,ab.
		60. (direct adj instruct$).ti,ab.
		61. (giant adj step$).ti,ab.
		62. developmental individual difference.ti,ab.
		63. option.ti,ab.
		64. (sonrise or kaufman).ti,ab.
		65. precision.ti,ab.

		66. (social adj (skill* or pragmatic)).ti,ab. 67. hanen.ti,ab. 68. miller.ti,ab. 69. patterning$.ti,ab. 70. philadelphia.ti,ab. 71. (dolman or delaccato).ti,ab. 72. (echange adj3 developpement).ti,ab. 73. bartelemy.ti,ab. 74. (gentle adj teach$).ti,ab. 75. denver.ti,ab. 76. leap.ti,ab. 77. (learning experiences adj alternative program).ti,ab. 78. pcdi.ti,ab. 79. princeton child development institute.ti,ab,af. 80. rutgers.ti,ab. 81. (natural adj teach$).ti,ab. 82. milieu.ti,ab. 83. (neurodevelop$ adj treat$).ti,ab. 84. ndt.ti,ab. 85. walden.ti,ab. 86. adlerian.ti,ab. 87. theraplay.ti,ab. 88. Eden.ti,ab. 89. "early bird".ti,ab. 90. (video adj3 model$).ti,ab. 91. (self adj3 (manage$ or monitor$)).ti,ab. 92. yale.ti,ab. 93. bancroft.ti,ab. 94. horizon.ti,ab. 95. (may adj institute).ti,ab. 96. task analysis.mp. 97. chaining.mp. 98. (restrict* adj2 repetitive pattern*).mp. 99. "symbol use".mp. 100. attention/ or joint attention.ti,ab. 101. exp "Reinforcement (Psychology)"/ 102. Conditioning, Operant/ 103. (differential adj2 reinforce*).ti,ab. 104. time delay.ti,ab. 105. exp peer group/ and exp teaching/ 106. (peer adj2 (mediat* or instruct* or teach* or learn* or tutor*)).ti,ab. 107. (function* adj2 behavio?r* adj assess*).ti,ab. 108. fba.ti,ab. 109. (stimulus adj3 (control or modif*)).ti,ab. 110. extinction.ti,ab. 111. (response interrupt* adj2 redirect*).mp. 112. RIRD.ti,ab. 113. exp Social Skills/ and group*.ti,ab. 114. (visual adj2 (script* or support* or aids or aid)).mp. 115. voca.ti,ab. 116. "Augmentative and alternative communication".kw. 117. "communication intervention".kw. 118. ((speech or communicat*) adj3 device*).ti,ab. 119. or/16-118 120. 15 and 119 121. limit 120 to yr="2006 -Current"

Note:

†† "*", "# ", and "?" are truncation characters that retrieve all possible suffix variations of the root word e.g. surg* retrieves surgery, surgical, surgeon, etc.

Appendix B: Results of systematic reviews of interventions for children with ASD mediated by someone other than a highly-qualified

autism professional

First author, year	AMSTAR Score	Interventionist	Summary of intervention strategies	Summary of results
Oono, 2013	10	Parents	Pivotal Response Treatment, Developmental Individual-Difference Relationship Based techniques	**Positive outcomes**: Child – severity of autism characteristics, language comprehension Parent - parent-child interaction (e.g., parent synchrony, shared attention) **Negative outcomes**: Child – none Parent – none **Unclear/Mixed outcomes**: Child – expressive language, communication, child initiations in parent-child interaction, adaptive skills Parent – stress
Patterson, 2012	7	Parents	Pivotal Response Treatment, the Natural Language Paradigm, the Early Start Denver Model, discrete trial teaching, Reciprocal Imitation Training, milieu teaching, joint attention training, parent-implemented augmentative and alternative communication, general case teaching	**Positive outcomes**: Child – joint attention, imitation, vocalizations, verbal language, communication Parent – bids for joint attention, verbalizations, fidelity of implementation of the intervention **Negative outcomes**: Child – none Parent – none **Unclear/Mixed outcomes**: Child – responding (verbal, written, labeling)

				Parent – none
Shire, 2014*	7	Parents	AIM HI, Project ImPACT	**Positive outcomes:** Child - social engagement, language, decrease in challenging behaviour Parent – decreased stress, fidelity of implementation of the intervention **Negative outcomes:** Child – none Parent – none **Unclear/Mixed outcomes:** Child – none Parent – none
Banda, 2015*	6	Parents	Videotaped training with siblings, home-based social skill interventions through videos	**Positive outcomes:** Child – social interaction with sibling Parent – providing prompts, providing praise, fidelity of implementation of the intervention **Negative outcomes:** Child – none Parent – none **Unclear/Mixed outcomes:** Child – none Parent – none

Reichow, 2013*	6	Parents	Autism 1-2-3- program, Stepping Stones Tripe P model, More Than Words curriculum	**Positive outcomes:** Child – symbolic play, vocabulary Parent – appropriate parenting techniques **Negative outcomes:** Child – none Parent – none **Unclear/Mixed outcomes:** Child – problem behaviour Parent – parental stress, maternal distress
Beaudoin, 2014	5	Parents	Behavioural interventions, sociopragmatic interventions (e.g., DIR Floortime), the Early Start Denver Model parent training program	**Positive outcomes**: Child – none Parent – satisfaction, therapeutic relationship **Negative outcomes**: Child – none Parent – none **Unclear/Mixed outcomes**: Child –visual attention, communication, play, socioemotional functioning, global development, engagement with parent Parent – stress, engagement with child
McConachie, 2007	4	Parents	Social communication training, joint attention focused patient training, autism pre-school programme, pivotal response training, parent training in behaviour modification principles, TEACCH, maternal psycho-educational treatment	**Positive outcomes**: Child - social communication, decrease in problem behaviours at home, decrease in obsessions and rituals Parent – communicative behaviours, knowledge about ASD, decrease in maternal depression

				Negative outcomes: Child - intelligence quotient, play skills, responsiveness to adults and peers Parent – none **Unclear/Mixed outcomes**: Child – none Parent – none
Lang, 2009	3	Parents	Expectant waiting, imitating/animating, environmental arrangement, incidental teaching, feedback, use of target language, use of teaching procedures, number of expansions, balance of communication turns, number of responsive feedback, number of parent utterances at the child's communication level, providing clear instruction, interspersing demands, providing opportunity for child choice, providing reinforcement, providing a discriminative stimulus for speech, providing joint attention initiations, providing opportunities to use picture cards)	**Positive outcomes**: Child – joint attention, attentiveness, imitation, verbal communication, non-verbal communication, vocal utterances/vocalizations, spontaneous communication, receptive language Parent –fidelity of implementation of intervention, decrease in number of errors following child's lead **Negative outcomes**: Child – none Parent – none **Unclear/Mixed outcomes**: Child – none Parent – none
Schultz, 2011	3	Parents	Behaviour analysis skills, pivotal response training, discrete trial training, natural intervention technique, relationship focused intervention, Lovaas method, developmental	**Positive outcomes**: Child – spontaneous speech, play behaviour, social skills, appropriate behaviour, decrease in aggression, decrease in disruptive behaviour, decrease in noncompliance Parent - increase in knowledge of behavioural strategies or child's disability in general, decrease in parental stress

			individual differences relationship-based model/floor-time	**Negative outcomes**: Child – none Parent – none **Unclear/Mixed outcomes**: Child – none Parent – none
Flippin, 2011	2	Parents	Not specified	**Positive outcomes**: Child – communication, functional play acts, social interaction Parent – none **Negative outcomes**: Child – none Parent – none **Unclear/Mixed outcomes**: Child – diversity of symbolic play Parent – none
Meaden, 2009	2	Parents	Incidental teaching, modified incidental teaching, discrete trial procedures, imitating/animating, expectant waiting, reciprocal imitation training, prompting, pivotal response training strategies, naturalistic language intervention strategies, arranging the environment, natural reinforcement, imitating contingently, modeling,	**Positive outcomes**: Child – joint attention, communication, social skills, decrease in detachment, decrease in challenging/problem behaviour Parent – accuracy of intervention delivery, imitating/animation, expectant waiting, affect, responsiveness

			gesture/visual cuing, responsive teaching, functional communication training, Denver model	**Negative outcomes**: Child – none Parent – none **Unclear/Mixed outcomes**: Child - children's responding Parent – none
Banda, 2015*	6	Siblings	Playing with sibling, prompting play, eliciting appropriate play related comments, prompting for no response or incorrect response, social stories during play sessions, instruction, modeling, role play, feedback, reinforcement, Pivotal Response Training, Discrete Trial Teaching, backward chaining, video modeling, role play, shaping, facilitating eye contact, initiating conversations, offering help, expanding speech	*Sibling as instructor:* **Positive outcomes**: Child with ASD – play skills, verbal language, social skills, sibling relationship, fine motor skills Sibling – eliciting responses, providing feedback, providing praise, modeling, role playing, providing prompts, social interactions with sibling, attending behaviour, manual signs, decrease in commands, play behaviour **Negative outcomes:** Child with ASD – none Sibling – none **Unclear/mixed outcomes:** Child with ASD – requesting behaviour Sibling – none *Siblings in modeling or social story interventions:* **Positive outcomes:** Child with ASD – scripted comments during play, decrease in excessive directions during play Sibling – none

				Negative outcomes: Child with ASD – none Sibling – none **Unclear/mixed outcomes:** Child with ASD – unscripted comments during play, imitation, fine motor skills (minimal improvement), complimenting during play (initial improvement but failed to continue) Sibling – none ***Siblings as co-recipient of the intervention:*** **Positive outcomes:** Child with ASD – social interaction with sibling Sibling – social interaction with sibling **Negative outcomes:** Child with ASD – none Sibling – none **Unclear/mixed outcomes:** Child with ASD – none Sibling – none

| Shivers, 2015 | 3 | Siblings | ***Sibling as instructor:*** Play skills instruction, fine motor skill instruction, academic skills instruction

Sibling as model: Live modeling, video modeling, live play

Sibling as co-recipient of the intervention: Incorporation of ritualistic behaviour into games, scripted social skills instruction groups, group and pair instruction | ***Sibling as instructor:***
Positive outcomes:
Child with ASD –play skills, verbal language, social skills, sibling relationship, fine motor skills, academic skills
Sibling – implementation of the intervention, sibling relationship

Negative outcomes:
Child with ASD **–** none
Sibling – none

Unclear/Mixed outcomes:
Child with ASD – joint attention
Sibling – none

Sibling as model:
Positive outcomes:
Child with ASD – scripted statements during play, social play, problem behaviour, shoe tying, academic skills
Sibling – none

Negative outcomes:
Child with ASD **–** none
Sibling – none

Unclear/mixed outcomes:
Child with ASD – functional skills (skill imitation), spontaneous speech during play
Sibling – none |

				Sibling as co-recipient of the intervention: **Positive outcomes:** <u>Child with ASD</u> – joint attention, social play, decrease in ritualistic behaviour, sibling relationship, functional skills (swimming) <u>Sibling</u> – sibling relationship, functional skills (swimming) **Negative outcomes**: <u>Child with ASD</u> – none <u>Sibling</u> – none **Unclear/mixed outcomes:** <u>Child with ASD</u> – none <u>Sibling</u> – none
Zhang, 2011*	3	Siblings	Modeling, initiation training, monitoring, networking, tutoring	**Positive outcomes**: <u>Child with ASD</u> - social responses, social interactions <u>Sibling</u> – none **Negative outcomes**: <u>Child with ASD</u> – none <u>Sibling</u> – none **Unclear/Mixed outcomes**: <u>Child with ASD</u> – none <u>Sibling</u> – none
Shire, 2014*	7	Peers	Music therapy	**Positive outcomes:** peer interactions, fidelity of implementation **Negative outcomes:** <u>Child with ASD</u> – none <u>Sibling</u> – none

				Unclear/Mixed outcomes: Child with ASD – none Sibling – none
Watkins, 2015	5	Peers	Initiation, prompting, reinforcing, proximity	**Positive outcomes**: social skills (e.g., interactions, initiations, responses, social engagement, communicative acts), play skills (e.g., scripted phrases, context-related comments, responses, narrating play, turn taking exchanges) **Negative outcomes**: none **Unclear/Mixed outcomes**: none
Chan, 2009	4	Peers	Use of task analysis checklist, reinforcement, redirected stereotypy, initiated and maintained play interactions, prompting, verbal correction of errors, clarification of academic instructions, on-going feedback, social skills training, sharing of ideas, correction of work, initiation of conversations, responding to communication attempts, complimenting, maintaining conversations, extinction of challenging behaviour, modeling, pivotal response training, corrected errors, taught vocabulary words, played curriculum-related game, discrete trial training with flash cards, shared ideas, corrected other's work, token economy, played together, shared, suggested play ideas,	**Positive outcomes**: social skills (e.g., initiations, maintaining interactions, turn taking, affection), environmental transitions, functional/self-help skills, academic skills, stereotypy **Negative outcomes**: none **Unclear/Mixed outcomes**: joint attention, communication skills, appropriate talking

			showed affection, responded to questions	
Zhang, 2011*	3	Peers	Modeling, initiation training, monitoring, network, tutoring	**Positive outcomes**: social responses, social interactions **Negative outcomes**: none **Unclear/Mixed outcomes**: none
Wang, 2011	2	Peers	Not specified	**Positive outcomes**: social skills **Negative outcomes**: none **Unclear/Mixed outcomes**: none
Shire, 2014	7	Teachers, aides, tutors, job center staff	Behavioural job skills training, Lovaas style early intensive behavioural intervention, intensive behavioural intervention, applied behavioural analysis-based services, pivotal response treatment, adapted joint attention intervention	**Positive outcomes:** joint engagement, joint attention, cognition, daily living skills, receptive language **Negative outcomes:** none **Unclear/mixed outcomes:** language, motor skills, communication, expressive language, socialization
Reichow, 2013*	6	Teachers, therapists, aides	Joint attention training, behavioural treatment based on the Early Start Denver Model, training on behavioural principles in behaviour management, low-intensity behaviour analytic intervention, intensive behaviour analytic intervention, Early Literacy Skills Builder curriculum, Early	**Positive outcomes:** joint engagement, cognition, academic skills, decrease in parent stress **Negative outcomes**: none **Unclear/Mixed outcomes:** joint attention, language, problem behaviour/RRB, daily skills

			Interventions in Reading, TEACCH program, cognitive education program	

*Review appears in multiple categories because it included a combination of intervention agents.