Non-pharmacological interventions for children on the autism spectrum: An umbrella review

David Trembath

Griffith University, Gold Coast, Australia

Kandice Varcin

Griffith University, Gold Coast, Australia

Hannah Waddington

Victoria University of Wellington, Wellington, New Zealand

Rhylee Sulek

Griffith University, Gold Coast, Australia

Cathy Bent

La Trobe University, Melbourne

Jill Ashburner

Autism Queensland, Brisbane, Australia

Valsamma Eapen

University of New South Wales, Sydney, Australia

Emma Goodall, Healthy Possibilities, Adelaide, Australia

Kristelle Hudry

La Trobe University, Melbourne, Australia

Jacqueline Roberts

Griffith University, Brisbane, Australia

Natalie Silove

Sydney Children's Hospital Network Westmead, Sydney, Australia

Andrew Whitehouse

Telethon Kids Institute, University of Western Australia, Perth, Australia

Correspondence:

Andrew Whitehouse

Andrew.Whitehouse@telethonkids.org.au

Key points and relevance (80-120 words)

- This umbrella review found evidence for positive effects for a range of interventions for children with autism on a variety of child and family outcomes.
- However, some interventions had inconsistent, null, and or adverse effects, and no single intervention successfully addressed all outcomes of interest.
- There was limited evidence for the possible effects of intervention and child characteristics on outcomes.
- The evidence, along with the identified gaps, will help caregivers, clinicians, and policy makers make informed decisions about the current evidence for interventions, within an evidence-based practice decision-making framework.
- Future research should focus on improving the quality of research evidence for both group and individual outcomes, including consistent reporting of any adverse effects.

Abstract

Background: It is critical that the interventions children on the autism spectrum receive are evidence-based. Given the breadth of available non-pharmacological interventions, a synthesis of research evidence on interventions for children on the autism spectrum is needed.

Methods: We completed an umbrella review of systematic reviews, published between 2010-2020, focusing on interventions for children aged 0-12 years. Only systematic reviews that included at least one primary study with a controlled group design were included. Interventions were classified as Behavioural, Developmental, Naturalistic Developmental Behavioural Interventions (NDBIs), Sensory-based, Technology-based, Animal-assisted, Cognitive Behaviour Therapy (CBT), Treatment and Education of Autistic and related Communication-handicapped Children (TEACCH), and ‘other’ (i.e., interventions that didn’t correspond to the other categories).

Results: Evidence from 58 systematic reviews indicated positive therapeutic effects for Behavioural interventions, Developmental interventions, NDBIs, Technology-based interventions, and CBT on a range of child and family outcomes. Positive effects for Sensory-based interventions were reported for certain practices only and were limited to select child and family outcomes. A mix of inconsistent and null intervention effects on child and family outcomes were reported for TEACCH and Animal-assisted interventions. There were no consistent findings of the possible effects of intervention delivery (e.g., amount, agent, delivery format, delivery mode) or child characteristics (e.g., age, cognitive skills) on outcomes. Few studies measured outcomes beyond children’s characteristics and skills, to consider broader participation, quality of life, or family outcomes. Adverse effects were rarely reported, and

findings were based predominantly on lower quality reviews and/or reviews with a mixture of study designs.

Conclusions: There is evidence for the positive effects of a range of interventions, but not for a single best intervention for all children, nor an intervention conferring positive effects across all outcomes examined. The potential influence of intervention and child characteristics on outcomes remains a critical priority for future research.

Keywords: Autism, intervention, non-pharmacological, evidence, review

Abbreviations: Systematic review (SR), Autism Spectrum Disorder (autism; on the autism spectrum)

Non-pharmacological interventions for children on the autism spectrum: An umbrella review

Autism Spectrum Disorder, herein referred to as autism, is a neurodevelopmental condition characterised by persistent difficulties in social-communication and interaction, and by restricted, repetitive patterns of behaviour, interests, or activities (American Psychiatric Association, 2013). These characteristics, which are generally observable in the first three years of life, may create significant barriers to an individual's learning, inclusion, and participation in the community (Lord et al., 2020), particularly when accompanied by common co-occurring conditions such as intellectual disability, epilepsy, and language disorders and in environments that do not cater for diverse learners (Lai, Anagnostou, Wiznitzer, Allison, & Baron-Cohen, 2020; Woods, 2017). Accordingly, a range of interventions have been developed to support children's development, which vary with respect to theoretical underpinnings, delivery characteristics, and empirical evidence to support their use. While affording choice, this range also creates challenges for caregivers, clinicians, and policy makers in navigating a rapidly growing body of evidence. In addition, the potential for interventions to pose adverse effects on children's development, family functioning, and the judicious use of scarce economic and community resources, highlights the importance of ensuring effective, evidence-based interventions are utilized (Gentles, Nicholas, Jack, McKibbin, & Szatmari, 2019; Grant, Rodger, & Hoffmann, 2016; Lord et al., 2020).

There is no universally accepted method for describing and categorizing interventions for children on the autism spectrum. However, a taxonomy proposed by Sandbank et al. (2020) reflects the different, and evolving, nature of interventions. Sandbank et al., completed a systematic review and meta-analysis of randomized controlled trials (RCTs), focusing on nine

intervention categories: Behavioural interventions, Developmental interventions, Naturalistic Developmental Behavioural Interventions (NDBIs), Sensory-based intervention, Technology-based interventions, Animal-assisted interventions, Cognitive Behaviour Therapy (CBT), Treatment and Education of Autistic and related Communication-handicapped Children (TEACCH), and 'other' interventions that do not fit within these categories. Each category comprised a set of related intervention practices, such as the behavioural category including Early Intensive Behavioural Intervention (Eldevik et al., 2009), Discrete Trial Training, and the Picture Exchange Communication System (Bondy & Frost, 2001). The authors reported positive effects for Behavioural, Developmental, and NDBI interventions when study quality indicators were not considered; however, there was no evidence for positive effects for any category of intervention when quality indicators were included. While these findings suggest potential benefits of some intervention practices, they also highlight the risk of bias present in research upon which clinical decision making and policy development is reliant.

The evidence-based selection and delivery of interventions to children on the autism spectrum requires the combination of the best available research evidence, evidence from clinical practice, and the preferences and priorities of children and caregivers (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). The systematic review by Sandbank et al. (2020) is one of numerous published since 2010, a decade that has also seen rapid growth in evidence for intervention effects based on RCTs for both non-pharmacological (e.g., Binns & Oram Cardy, 2019; French & Kennedy, 2018; Kent et al., 2020; Oono, Honey, & McConachie, 2013) and pharmacological (Rodrigues et al.; Siafis et al., 2020) interventions. Just as interventions for children on the autism spectrum vary widely, so does the scope, method, and quality of systematic reviews published in this time, limiting our collective ability to achieve a broad

understanding of the state of the current evidence base. Accordingly, there is a need for a synthesis of findings from systematic reviews, in a way that can directly inform policy and practice.

An umbrella review, also known as a review of reviews, provides a synthesis and appraisal of evidence across a broader topic area than can usually be achieved through an individual systematic review and thus is particularly helpful for the development of evidence-based policy (Aromataris et al., 2015). Here, we present the first umbrella review of non-pharmacological interventions for children on the autism spectrum. The review is derived from a report [details provided to editor, withheld for blind review], intended to directly inform decision-making in the sector. The research questions reflect the need for cohesive evidence regarding the nature of interventions and their effects, for which children on the autism spectrum (i.e., child characteristics), and under what circumstances (i.e., intervention characteristics):

1. What non-pharmacological interventions have been examined in systematic reviews?
2. What effects do non-pharmacological interventions have on child outcomes?
3. What effects do non-pharmacological interventions have on family outcomes?
4. What are the optimal delivery characteristics of non-pharmacological interventions, with a focus on the amount of intervention, setting, format, agent, and mode?
5. What child characteristics influence intervention effects, with a focus on child age, core autism characteristics, cognition, and communication skills?

Method

We conducted the review according to procedures outlined in the Joanna Briggs Institute manual for evidence synthesis (Aromataris et al., 2020) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher, Liberati, Tetzlaff, &

Altman, 2009). The protocol was pre-registered on PROSPERO (provided to editor, withheld for blind review], published on the Open Science Framework (provided to editor, withheld for blind review), and is presented along with minor variations as supplementary (S) material (see S1, S2).

Search Strategy

A literature search was conducted on June 15th, 2020 and updated on July 15th, 2020 using the following databases: PsycINFO, Education Resources Information Centre (ERIC), Medline, PubMed, EMBASE, CINAHL, Cochrane Database of Systematic Reviews, Scopus, EBSCO Education Source, and Epistemonikos. The search terms were: (Autis* OR ASD* OR Asperger* OR pervasive developmental disorder* OR PDD* OR pervasive child development disorder* OR pervasive childhood developmental disorder* OR PCDD* OR disintegrative disorder*) AND (intervention* OR therap* OR treat* OR teach* OR program* OR package*) AND (systematic review* OR systematic literature review* OR evidence syntheses* OR meta-analy* OR meta-regression*). The search was limited to the year 2010 to present, as the vast majority of RCTs have been published post 2010 (French & Kennedy, 2018). Grey literature searches were conducted using Google and PROSPERO (see S3) and ancestral searches completed for the reference lists of included systematic reviews (herein referred to as SR/SRs for brevity) and umbrella reviews identified during the search.

Eligibility Criteria

The criteria are summarised here but presented in full in S1. To be included in this umbrella review, source publications had to: (a) be a SR (with or without meta-analysis); (b) include children on the autism spectrum aged 0-12 years (SRs which included individuals over the age of 12 years were included where outcomes were reported separately for the 0-12 cohort); (c) report on at least one non-pharmacological intervention relevant to the categories described

by Sandbank et al., (2020) and target the acquisition or development of educational skills; (d) include at least one RCT, quasi-RCT, and/or controlled clinical trial; (e) report summarised quantitative data on the impact of the intervention on child and family outcomes of interest including any adverse effects; and (f) be published in a peer-reviewed journal or as a publicly available scientific report with a full-text copy available in the English language. Reasons for exclusion included not meeting inclusion criteria or SR searches being restricted to a specific geographical region.

Study Selection

Study screening and selection was completed by four reviewers (KV, HW, DT, AW) using Covidence (Veritas Health Innovation, 2020) for data management. First, two reviewers (KV, HW) completed independent screening of titles and abstracts for all records. In cases where it was not clear if an intervention would fall within the scope of the categories outlined by Sandbank et al. (2020), the label and description of the intervention was recorded in a central document (S4) for independent review by the other three reviewers ahead of resolution by consensus. Second, the same two reviewers (KV, HW) completed independent full text screening of all potentially relevant articles. Where study design/s were not clearly specified, the reviewers examined the SR reference list to determine if at least one study with an RCT, quasi-RCT, or controlled cohort design was included. Once completed, any disagreements were resolved via consensus.

Prior to resolving disagreements, agreement was automatically calculated using Covidence software. Cohen's Kappa for the combined initial and updated title/abstract screening was 0.71 and the percentage of agreement $[\text{agreements} / (\text{disagreements} + \text{agreements}) \times 100]$ was 93%. Cohen's Kappa for the initial and updated full-text review was 0.69 with 91% raw

agreement. At the point of extraction, it became apparent that some included SRs would need to be excluded from synthesis due to (a) the SR having been superseded by an updated version of the same review; (b) the same SR having been published in multiple forms (e.g., a report and a scholarly article); (c) the authors having categorised interventions in a different way to the current umbrella review, such that it would not be possible to map reported intervention effects to the categories used here; (d) the SR having examined the combined effect of a range of intervention practices/categories (such that it would not be possible to attribute intervention effects to the specific categories/practices defined here) and did not provide any information about potential child or intervention characteristics that may influence the intervention effect; and/or (e) closer reading of the systematic review revealed it violated one or more of the eligibility criteria. All reviewers (DT, KV, HW, AW) were independently responsible for identifying if a SR should be considered for exclusion on this basis and, if so, to present a rationale to the group. A second reviewer (of the four) then assessed the SR and recommendation, and either endorsed or refuted it. If both reviewers agreed, the SR was excluded from the review. All four authors reviewed all decisions.

Corrected Covered Area

The corrected covered area (CCA) was calculated to determine the overlap of primary, or index, publications across the included SRs. The CCA was calculated by dividing the frequency of repeated occurrences of an index publication in other SRs by the total number of index publications and reviews, reduced by the number of index publications (Pieper et al., 2014).

Data Extraction

Data extraction occurred in two stages using a standardized form (see S5). At each stage, reviewers were randomly assigned to extract data from the SRs using a random list generator.

Stage one involved four reviewers (DT, KV, HW, AW) independently extracting: (a) the type of SR, (b) the objectives of the SR, (c) the number of studies included, (d) the design of included studies, (e) the quality of included studies, (f) sources of funding and conflicts of interest, and (g) the characteristics of included participants, interventions, comparison groups, and outcomes.

Stage two involved extraction of data related to each individual practice or category included in the SRs. Two reviewers (DT, AW) extracted: (a) the name of the category or practice; (b) the amount of intervention including, where stated, intensity (e.g., hours per week) and total duration of the intervention for each included study and for each practice/category; (c) the delivery setting (e.g., clinic, home, school), format (individual, group), agent (e.g., clinicians/researchers, parents/caregivers, peers/siblings), and mode (e.g. face-to-face, telepractice); and (d) the intervention effects reported, including any examination of the influence of child and intervention characteristics on intervention effects, for the predefined characteristics and outcomes of interest. At this stage, five reviewers (CB, RS, DT, KV, and HW) also independently extracted information on the number of studies examining each intervention effect.

Coding of intervention effects. Intervention effects were extracted for outcomes of interest. A positive intervention effect represented an increase in children's skills/participation and/or family wellbeing, and/or and a reduction in autism characteristics and/or social-emotional/challenging behaviours. The term 'positive' refers to the intended effect of an intervention according to the original SR authors, and not the current review authors' own subjective judgment about the benefit of an intervention.

Data extraction of intervention effects focused on recording one pooled (meta-analysis) or summary (for narrative review) effect for each relevant outcome reported in each SR. Effects derived from between-group and within-group analyses were eligible for extraction, with between-group analyses (i.e., between at least one intervention group and another group) prioritised where available. On occasions where meta-analyses reported more than one pooled effect for a specific outcome (e.g., main analyses and sensitivity analyses), we extracted the effect that was presented by the SR authors as the primary analysis. For meta-analyses, findings were recorded as either a positive pooled effect (90/95% confidence intervals of the pooled effect did not overlap with the null), a negative pooled effect (90/95% confidence intervals of the pooled effect did not overlap with the null), or a null effect (90/95% confidence intervals of the pooled effect overlapped with the null). Where a SR did not include a meta-analysis, the recording of an intervention effect focused on the summary provided by the SR authors in the results section. Findings were recorded as either a summarised positive effect (60% or more of studies summarised reported a positive intervention effect), a negative summarised effect (60% or more of studies summarised reported a negative intervention effect), a null effect (60% or more of studies summarised reported a null intervention effect) or a summarized inconsistent effect (no direction of intervention effect meeting a 60% threshold).

The influence of child and intervention characteristics on intervention effects was summarised by coding the specific independent variable (intervention or child characteristic), the dependent variable(s) (child and family outcomes), and the nature of the influence on the intervention effect (as reported by the SR authors, extracted verbatim). From these data, two reviewers (DT, AW) independently generated statements to summarise the influence of each child or intervention characteristic on the intervention effect for any relevant outcomes, with

each statement then checked by the second reviewer. Disagreements were resolved via consensus.

Reliability of extraction. Six strategies were used to ensure the reliability of data extraction. First, all reviewers worked from a pre-defined codebook (see S5) and entered data into an online spreadsheet. Second, each stage of extraction began with consensus coding to help ensure the accurate and consistent use of procedures. For this, those responsible for extracting data (SR characteristics extraction: DT, KV, HW, AW; intervention effects extraction: DT, AW) independently extracted data for a set of SRs (six for SR characteristics extraction, two for practice/category effects extraction) and then met to discuss any discrepancies and, if necessary, to further clarify aspects of the data extraction form. Third, a random number generator was used to assign SRs to each reviewer. Fourth, a second reviewer independently extracted information for a randomly selected 20% of SRs. For the remaining 80% of SRs, a second reviewer cross-checked the first reviewer's extraction against the original article. Disagreements were identified and resolved via consensus. A third reviewer was not required on any occasion. Fifth, a third independent reviewer (CB, RS, KV, HW) independently checked each intervention effect reported in the current review against the original SR to ensure accurate transfer and interpretation. Sixth, to ensure independence, all reviewers worked from Covidence and centrally stored password protected spreadsheets that were only unlocked to other reviewers at the completion of each stage of extraction. For SR level extraction, the percentage of agreement was 90% for data independently extracted by two reviewers and 95% for the cross-checks. For the practice/category level extraction, the percentage of agreement was 98% for independently extracted data and 99% for the cross-checks. Occasions where one reviewer determined that an intervention effect on an intervention outcome (e.g., social communication skills) had been

reported in a SR while a second reviewer did not were coded as one instance of disagreement, rather than a disagreement for all effects corresponding to that outcome. Systematic reviews used for consensus moderation were not included in these calculations.

Quality Appraisal. Risk of bias was assessed using an 11-item Critical Appraisal Checklist for Systematic Reviews and Research Syntheses (S6), adapted from the version created by the Joanna Briggs Institute (2020). Each item was rated dichotomously, with “yes” indicating a low risk of bias for that item, and “no” indicating a high risk of bias for that item. The item regarding the likelihood of publication bias was rated for meta-analyses only and was ‘not applicable’ for all other SRs. SRs were not excluded based on methodological quality. Four reviewers (DT, KV, HW, AW) rated the quality of SRs. The process began with consensus moderation, involving two to four reviewers independently reviewing the same six SRs and then comparing their ratings with other reviewers and resolving any disagreements in interpretation. The remaining SRs were independently rated by two reviewers, and the percentage of agreement was 77%. Disagreements were resolved via consensus.

Data Synthesis. Data were synthesised according to the process described in detail in S7, resulting in a summary of effect for each practice or category of practices examined in each systematic review. A *positive effect* was coded when all available evidence for an intervention effect for a particular practice/category on a particular outcome of interest was positive. A *null effect* was coded when all available evidence for an intervention effect for a particular practice/category on a particular outcome of interest was null, or when rated as ‘unestablished’ (National Autism Center, 2015) or ‘insufficient evidence’ (Steinbrenner et al., 2020). An *inconsistent effect* was coded when all available evidence for an intervention effect for a particular practice/category on a particular outcome of interest was a mixture of positive and

null, or when rated as ‘emerging’ evidence in the case of the National Autism Center (National Autism Center, 2015). *Adverse effects* were recorded separately. Where multiple systematic reviews provided evidence for a particular intervention practice or category of practices for a particular child or family outcome, the findings from the most recent SR that included a meta-analysis were used as the basis for summarising effects (Sandbank et al., 2020). If no meta-analysis was available, the findings from multiple reviews were summarised through the combination of evidence (consistently positive, consistently null, inconsistent).

Results

Study selection

The study selection process is represented in Figure 1. The search process yielded 9,258 records, and 3,138 records once duplicates were automatically removed. Four hundred and seventy-eight articles proceeded to full-text review, following which 393 articles were excluded. A further 27 SRs were excluded during data extraction. A summary of reasons for study exclusion is outlined in Figure 1. A full list of excluded SRs and the reasons for their exclusion provided in S8 (studies excluded during full-text screen) and S9 (studies excluded during data extraction).

[Insert Figure 1 PRISMA Diagram about here]

Study Characteristics

Of the 58 SRs retained in the umbrella review, 30 (52%) were meta-analyses with narrative synthesis, and 28 (48%) were narrative syntheses only. The majority of SRs (n=33; 57%) were published between 2018 and 2020, with the remainder (n=25, 43%) published between 2010 and 2017. The number of original studies included in the SRs ranged from three (Schoen et al., 2019) to 972 (Steinbrenner et al., 2020), with a median of 17. All but two SRs

specified the final year of the search, and 41 (71%) SRs mentioned the presence or absence (i.e., since database inception) of a starting year limit. Of these, 26 (63%) placed a limit on date, whereas 15 (37%) included all prior published research. The authors of 39 SRs (67%) provided information regarding sources of funding to conduct the SR and declarations of interest were reported in 37 SRs (64%). There were four instances in which authors identified a potential conflict of interest. A detailed outline of study characteristics is provided in S10.

Focus of reviews. While all SRs included data on the effects of interventions for children on the autism spectrum, there were differences in focus of the included SRs. Thirty-four reviews examined the intervention effects of a defined intervention practice/category on child and family outcomes. Eight reviews examined the effect of interventions, combined across practices/categories, on an outcome of interest (e.g., social-communication). Sixteen reviews examined the effect of interventions with specific delivery characteristics (e.g., setting, format, agent, mode), combined across practices/categories, on child and family outcomes. The focus and characteristics of the 58 reviews are presented in supplementary material (see S11-13).

Study designs. Forty-seven SRs (81%) provided specific information about the designs of included studies in the results section. In the remaining SRs, there was evidence for the inclusion of at least one study with a controlled group design in other sections (e.g., title, abstract, methodology, and references) as per eligibility criteria. Of the 47 SRs which provided information about design, 14 (30%) included only RCTs, 46 (98%) included at least one RCT, 26 (55%) at least one nonrandomized group design study with a control, 14 (30%) at least one non-randomised group design study without a control, 20 (43%) at least one single case experimental design, and 10 (21%) included other designs such as case studies, post-test only, retrospective cohort studies, and qualitative studies. Comparison groups were described for each included

study in 31 SRs (53%). Twenty of these (64.5%) included at least one study with a wait list control, 23 (74%) included at least one study with a treatment as usual control, and 30 (97%) included at least one study in which the comparison was another intervention.

Participants. Fifty-three (91%) SRs provided details about the total number of participating individuals. Across these SRs, a total of 41,374 individuals were identified as participants, with SRs ranging from 66 participants (Hardy & Weston, 2020) to 6,240 participants (Sandbank et al., 2020). It was not possible to calculate the number of unique participants due to overlap between included SRs and non-specific reporting. Forty-four SRs (76%) provided information about the age range of included children. Within these SRs, the youngest child was 4 months old and the oldest individual was 65 years old. Twenty-two SRs (38%) provided the total number (rather than percentage or proportion) of participating females and males. Within these SRs 11,218 of 13,482 (83.2%) individuals were identified as male and 2,264 (17%) as female.

There was inconsistent reporting of diagnostic information, although there was evidence of broad representation of children on the autism spectrum with varying levels of functional needs. Authors used terms such as autistic disorder, autism, autism spectrum disorder, Asperger's disorder, high functioning autism, child disintegrative disorder, and pervasive developmental disorders not otherwise specified (PDD-NOS). Children with increased likelihood for autism, but no formal diagnosis, were identified as being included in three (5% of) SRs. Only 24 SRs (41%) identified co-occurring diagnoses of one or more included individuals. In many of these SRs, it was not clear if all co-occurring diagnoses were identified or only particular co-occurring conditions of interest. The most common co-occurring condition, where identified, was

cognitive impairment (15 SRs, 62.5%) followed by attention deficit hyperactivity disorder (5 SRs, 21%).

Study location. Twenty-six SRs (45%) provided information about the geographical locations at which the original studies had been conducted. Of these, all included studies conducted in North America (100%), with Europe (19 SRs, 73%), Australia (19 SRs, 73%), Asia (14 SRs, 54%), South America/Caribbean (4 SRs, 15%) and the Pacific (1 SR, 4%) also represented. No studies were reported to have been conducted in Africa (see S14).

Quality ratings. The quality of SRs yielded scores of 6 to 11 out of 11 (mode = 10) for meta-analyses with narrative synthesis, and 4 to 9 out of 10 (mode = 7) for narrative syntheses without a meta-analysis. Only 4 SRs (7%; all meta-analyses) scored maximum points (Geretsegger, Elefant, Mossler, & Gold, 2014; Oono et al., 2013; Reichow, Hume, Barton, & Boyd, 2018; Tachibana et al., 2018). A full summary of item scores and totals for each SR is provided in S15. The quality of studies included within SRs was assessed by the original review authors using a variety of tools (see S16). Thirty-one SRs (53%) were identified as including at least one study at high risk of bias, five (9%) as including at least one study with at least moderate risk of bias, and two (3%) as only including studies at low risk of bias. A determination regarding overall risk of bias for included original studies could not be made for 20 SRs (34%) due to insufficient data or the reporting of bias on an item-by-item level only.

Corrected Covered Area (CCA)

The number of original publications across all SRs was 1,787. The overall CCA across these SRs was 0.65%. This is indicative of slight overlap (Pieper, Antoine, Mathes, Neugebauer, & Eikermann, 2014).

Interventions Examined

The nine categories of intervention featured in the 34 practice/category focused SRs are as follows: Behavioural interventions (8 SRs, 23.5%), Developmental interventions (5 SRs, 15%), NDBIs (7 SRs, 21%), Sensory-based interventions (9 SRs, 26%), TEACCH (2 SRs, 6%), Technology-based interventions (11 SRs, 32%), Animal-assisted interventions (7 SRs, 21%), CBT (4 SRs, 12%), and ‘other’ interventions (2 SRs, 6%). Within these, at least 111 practices (and in some cases techniques) were examined, with a list provided in Table 1. It was not possible to determine exactly how many practices were examined, as some SRs only provided a broad description of the category of intervention.

Information about intervention setting for at least one included study was specified in 38 SRs (67%). Clinics were the most common intervention setting (29 SRs, 76%), followed closely by home (28 SRs, 74%) and education (26 SRs, 68%) settings. ‘Other’ settings were reported in 19 SRs (50%). All SRs were deemed to have included delivery of interventions to individuals, with group-based interventions reported in 22 SRs (38%). Fifty-two SRs (90%) were judged to have included face-to-face delivery (i.e., in the absence of the SR authors stating otherwise), with telehealth featuring in 7 SRs (12%). Parents and other caregivers featured as intervention agents most often (30 SRs, 52%), followed by clinicians and researchers (28 SRs, 48%), educators (20 SRs, 34%), and peers/siblings (13 SRs, 22%).

Intervention effects on child outcomes

Table 1 provides a synthesis of the research evidence, organised by intervention categories. Findings from SRs that examined an assortment of practices within an intervention category are synthesised first, followed by findings from SRs of specific practices. A total of 279 different intervention effects across practices and categories are represented, drawn from the findings of 34 SRs. The effect sizes (for meta-analyses) and author statements (qualitative

summaries) are provided in S17. The number of SRs considered, and the quality of evidence for SRs that contributed evidence for each effect, are also reported in Table 1. The quality of evidence is rated as low, moderate, or high based on the following criteria that reflect two key indicators of interest in the current review: the total score using the JBI quality appraisal tool (cut-off of 80%) and the nature of included studies (RCTs only; a mixture of designs/study designs not reported). A total of 27 SRs (47%) provided "low quality evidence" (i.e., scores of <80% on the JBI tool), 24 SRs (41%) provided "moderate quality evidence" (i.e., scored $\geq$ 80% on the JBI tool and included either a mixture of non-randomised designs or did not specify the designs of the included studies), and seven SRs (12%) provided "high quality evidence" (i.e., scored $\geq$ 80% on the JBI tool and only included RCTs).

[Insert Table 1 about here]

Behavioural interventions. Three SRs (Makrygianni & Reed, 2010; National Autism Center, 2015; Sandbank et al., 2020) examined an assortment of Behavioural interventions at the category level, with positive effects reported for 11 child outcomes. Six practices were further examined across six SRs (Flippin, Reszka, & Watson, 2010; National Autism Center, 2015; Reichow et al., 2018; Sandbank et al., 2020; Steinbrenner et al., 2020; Virués-Ortega, 2010), with a mix of effects (i.e., positive, null, inconsistent) across 14 outcomes. Consistently positive effects were reported for two practices: Discrete Trial Training and Language Training (production). A mix of effects across outcomes were reported for four practices: Early Intensive Behavioural Intervention, Functional Communication Training, Language Training (Production and Understanding), and the Picture Exchange Communication System.

Developmental interventions. Two SRs (Binns & Oram Cardy, 2019; Sandbank et al., 2020) examined an assortment of Developmental interventions at the category level. A positive

effect was reported for core autism characteristics (social-communication), and a null effect for related skills and behaviours (communication). Three practices were further examined across three SRs (Boshoff et al., 2020; National Autism Center, 2015; Steinbrenner et al., 2020).

Consistently positive effects on a range of child outcomes were noted for Naturalistic Teaching strategies. A mix of effects across outcomes was reported for DIR/Floortime, and an inconsistent effect for general outcomes was reported for Developmental Relationship-based Treatment.

NDBIs. Two SRs (Sandbank et al., 2020; Tiede & Walton, 2019) examined a variety of NDBIs at the category level. A mix of effects was reported across core autism characteristics, related skills, and behaviours. Two practices were further examined across five SRs (Fuller, Oliver, Vejnaska, & Rogers, 2020; National Autism Center, 2015; Ona, Larsen, Nordheim, & Brurberg, 2020; Verschuur, Didden, Lang, Sigafoos, & Huskens, 2014; Waddington, van der Meer, & Sigafoos, 2016). A mix of effects across child outcomes were reported for the Early Start Denver Model and Pivotal Response Treatment.

Sensory-based interventions. Three SRs (Lang et al., 2012; National Autism Center, 2015; Sandbank et al., 2020) examined an assortment of Sensory-based interventions at the category level. Null effects were reported for related skills and behaviours (communication, general outcomes). Five practices were further examined across seven SRs (Geretsegger et al., 2014; National Autism Center, 2015; Schaaf, Dumont, Arbesman, & May-Benson, 2018; Schoen et al., 2019; Steinbrenner et al., 2020; Treurnicht Naylor, Kingsnorth, Lamont, McKeever, & Macarthur, 2011; Weitlauf, Sathe, McPheeters, & Warren, 2017). A mix of effects across outcomes was reported for three practices: Ayres Sensory Integration, Music Therapy, and Environmental Enrichment. Null effects were reported for Auditory Integration Training and Sensory Diet.

TEACCH. Only one SR (Sandbank et al., 2020) contributed data in relation to TEACCH at the category level, reporting a null effect on social-communication outcomes. At the practice level, one further SR (National Autism Center, 2015) reported an inconsistent effect on general outcomes for Structured Teaching.

Technology-based interventions. Five SRs (Khan, Hall, Davies, Hollis, & Glazebrook, 2019; Mazon, Fage, & Sauzéon, 2019; National Autism Center, 2015; Sandbank et al., 2020; Steinbrenner et al., 2020) examined an assortment of Technology-based interventions at the category level. A mix of effects was reported across child outcomes in relation to core autism characteristics, related skills and behaviours, and education and participation. Six practices were further examined across eight SRs (Griffith, Hagan, Heymann, Heflin, & Bagner, 2020; Knight, McKissick, & Saunders, 2013; Logan, Iacono, & Trembath, 2017; McCoy, Holloway, Healy, Rispoli, & Neely, 2016; Miguel Cruz, Ríos Rincón, Rodríguez Dueñas, Quiroga Torres, & Bohórquez-Heredia, 2017; Moon et al., 2020). A mix of effects across outcomes was reported for three practices: Augmentative and Alternative Communication, Computer-Based Instruction, and Apps. An inconsistent effect on general outcomes was reported for Sign Instruction, and a null effect on general outcomes was reported for Facilitated Communication. The use of Robots was reported to have an inconsistent effect on social-communication.

Animal-assisted interventions. Two SRs (National Autism Center, 2015; Steinbrenner et al., 2020) examined an assortment of Animal-assisted interventions at the category level, both reporting a null effect for general outcomes. The specific practices included in these SRs were not specified. Five SRs (Hardy & Weston, 2020; Hill, Ziviani, Driscoll, & Cawdell-Smith, 2019; Srinivasan, Cavagnino, & Bhat, 2018; Trzmiel, Purandare, Michalak, Zasadzka, & Pawlaczyk, 2019; Wiese, Simpson, & Kumar, 2016) examined two practices. A mix of effects across

outcomes was reported for Equine-assisted Therapy, and an inconsistent effect on social-communication was reported for Canine-assisted therapy.

Cognitive Behaviour Therapy. Four SRs (Ho, Stephenson, & Carter, 2014; National Autism Center, 2015; Steinbrenner et al., 2020; Weston, Hodgekins, & Langdon, 2016) examined cognitive behaviour therapy at the category level. A mix of effects across outcomes was reported in relation to core autism characteristics, related skills and behaviours, and education and participation. The practice labelled Exposure Package was examined in one SR (National Autism Center, 2015) and had an inconsistent effect on general outcomes.

Other. Nine practices were examined in two SRs (National Autism Center, 2015; Steinbrenner et al., 2020). A positive effect across a range of outcomes was reported for social skills training. An inconsistent effect on general outcomes was reported for five practices: Imitation Based Training, Multicomponent Package, Reductive Package, Social Communication Intervention, and Theory of Mind Training. A null effect on general outcomes was reported for three practices: Social Behavioural Learning Strategy, Social Cognition Intervention, Social Thinking Intervention.

Adverse effects. Adverse child effects were considered in eight (14%) of 58 SRs (see S18). Adverse events were reported for one or more participants in one SR of sensory-based interventions (increase in stereotypy and problem behaviour; Lang et al., 2012), two SRs of technology-based interventions (participant refusal/distress; Mazon et al., 2019; reduction in positive affect towards humans; Miguel Cruz et al., 2017), and one SR of animal-assisted interventions (tantrums, anxiety, aggression, self-stimulatory behaviour; Hill et al., 2019).

Intervention effects on family outcomes

Positive effects on caregiver communication and interaction strategies were reported for Developmental interventions at the category level and for one practice within the NDBI category (Early Start Denver Model). Evidence for intervention effects on caregiver social-emotional wellbeing was reported for Early Intensive Behavioural Intervention (1 SR, null), the Early Start Denver Model (1 SR, positive), Pivotal Response Treatment (1 SR, inconsistent), and Music Therapy (1 SR, positive). A positive effect on caregiver satisfaction was reported for the Early Start Denver Model. An inconsistent effect on caregiver satisfaction was reported at the category level for Technology-based interventions (1 SR, inconsistent) and at the practice level for Augmentative and Alternative Communication (1 SR, inconsistent). No evidence was presented in relation to caregiver financial wellbeing or child satisfaction across the 58 SRs.

Influence of intervention characteristics

The effect of the amount of intervention received on intervention outcomes was examined in 12 SRs (see S19 for summary of amounts delivered), with six reporting no effect, two reporting inconsistent effects, three reporting a combination of positive and null effects, and one reporting a positive effect (see S20). Four SRs examined the effect of setting on intervention outcomes, with positive effects observed across a range of outcomes for interventions delivered in school settings and comparable outcomes for interventions delivered in the clinic, home, or school. Three SRs provided evidence regarding the effect of intervention delivery format, with two reporting no differences between individual and group intervention delivery and one reporting mixed results across a range of outcomes. Eight SRs examined the effect of intervention agent (i.e., parent, peer, non-specialist) on child and family outcomes with a combination of positive and mixed effects associated with the involvement of non-clinician agents. Four SRs examined delivery of intervention mode, specifically of telepractice, with

positive (1 SR) and inconsistent (3 SRs) effects reported. Further summaries of the findings regarding effects of setting, format, and agent are provided in S21 and S22.

Influence of child characteristics

The influence of child characteristics on intervention effects was examined in nine SRs (see S23). There was no consistent relationship observed between child age and intervention effects across outcomes examined (9 SRs); inconsistent results were reported for the influence of adaptive behaviour (1 SR), core autism characteristics (1 SR), and pre-intervention imitation (1 SR); and no evidence for the influence of pre-intervention cognition (2 SRs) and communication (1 SR) on intervention effects. There were insufficient data to examine the influence of children's co-occurring conditions on intervention effects.

Discussion

This review synthesizes the best available evidence for the effects of interventions for children on the autism spectrum on a range of child and family outcomes, as well as examining the possible influence of intervention and child characteristics. When examined at a category level (i.e., systematic reviews of an assortment of related practices), there was evidence for positive effects on a range of child outcomes for Behavioural interventions, Developmental interventions, NDBIs, Technology-based interventions, and CBT. Within these categories, the intervention effect on outcomes was variable (null, positive) across different intervention practices. Positive intervention effects for Sensory-based interventions were reported for certain intervention practices only, and in those cases, were limited to select child and family outcomes. Inconsistent and null intervention effects on child outcomes were reported for both TEACCH and Animal-assisted interventions at the category level, with only one positive effect noted for one outcome (sensory behaviours) related to Equine-assisted therapy, based on low quality

evidence. Among ‘other’ intervention practices, only Social Skills Training had evidence for a positive intervention effect on child outcomes.

Few studies reported on the effect of interventions on caregiver outcomes, despite caregivers being considered as essential partners in intervention delivery, as per practice guidelines (e.g., Ministries of Health and Education, 2016; National Institute for Health and Care Excellence, 2013; Roberts & Williams, 2016). Where examined, practices within the Developmental and NDBI categories were reported to have a positive intervention effect on caregiver communication and interaction strategies, with positive intervention effects on caregiver social and emotional wellbeing also reported for individual practices within the NDBI and Sensory-based intervention categories. Gaps in research evidence were noted for outcomes relating to children’s education and participation, quality of life, and family well-being. The lack of evidence reinforces calls for the development and use of functional and meaningful outcome measures in autism research to better inform policy and practice (e.g., Grzadzinski, Janvier, & Kim, 2020; Lai et al., 2020; McConachie et al., 2015).

Regarding the possible effect of intervention and child characteristics, absent or inconsistent examination and reporting makes it impossible to draw reliable conclusions at this stage, or to determine from the evidence which intervention is most likely to be effective for each individual child. Where these characteristics were examined – such as the possible influence of agent, setting, delivery format, and mode; or the effect of a child’s age or autism characteristics on intervention outcomes – results were generally inconsistent between SRs and were based on SRs with low-moderate quality evidence. The few studies that examined whether the amount of intervention was related to child and family outcomes yielded no consistent evidence on the direction or strength of this relationship. While it is likely that there will be a

minimum and a maximum amount of intervention at which a positive effect is observed for any given practice (and noting that this may vary as a function of characteristics of the child), the current research literature does not provide clear information to guide this minimum or maximum amount of intervention, nor how intervention might best be distributed in terms of intensity (e.g., hours/week) and total duration across a program.

Clinical Implications

The findings of this review should help caregivers, clinicians, and educators make informed decisions about interventions, based on the best-available synthesized evidence. We suggest there are four key implications. First, the findings re-affirm the common assertion (e.g., Lai et al., 2020; Lord et al., 2020) that there is no single best intervention for all children on the autism spectrum. Second, no intervention has been demonstrated to effectively target all child and family outcomes examined in this review, including optimized education, community participation, and quality of life. Third, interventions vary considerably in terms of the total number of child and family outcomes addressed for which they promote positive effects. Fourth, there is a concerning lack of reporting of adverse effects in the literature to date, including null or negative findings. Together, these findings highlight the critical need for intervention selection to occur within an evidence-based practice framework that considers the evidence alongside client and contextual factors, including preferences (Lai et al., 2020; Hoffman, Bennett, & Del Mar, 2013; Sackett et al., 1996). Furthermore, the lack of clear direction afforded by the evidence reinforces the need for stringent monitoring of the child and family progress to ensure safe and socially valid outcomes.

Limitations

Despite the strengths of the study design, including the systematic and reproducible approach to selecting, extracting, and synthesizing data from SRs, this review is not without limitations. Key methodological decisions made a priori to facilitate the synthesis of a large and complex body of literature likely impacted the eligibility of individual SR studies for inclusion in the current umbrella review. We focused on intervention categories and practices, and not intervention techniques (e.g., modelling, prompting, shaping, reinforcement) which may be used in isolation or as part of an eclectic approach in clinical practice (Odom, Hume, Boyd, & Stabel, 2012). We acknowledge there is evidence that a range of intervention techniques can have a positive effect on discrete developmental domains (for examples see National Autism Center, 2015; Steinbrenner et al., 2020). Additionally, we adopted a particular method for categorising intervention practices (Sandbank et al., 2020) which, while suitable for extracting and synthesizing information from most SRs, resulted in the necessary exclusion of six SRs from review, because a different approach to categorization had been used that made it impossible to summarise the findings.

A further limitation of the current review related to the mix of study designs incorporated within the included SRs, meaning that findings are drawn from studies of varying quality and risk of bias. For instance, while the aim was to derive evidence, where possible, from systematic reviews of RCTs, only 14 of the 58 SRs included in the review featured RCTs only. Furthermore, we did not include systematic reviews of single-case experimental designs. We note that there are other frameworks for evaluating the quality of research evidence, and that these may differ in the hierarchy of evidence assigned to a given study design. For instance, the Oxford Centre for Evidence-Based Medicine (2011) highlighted the value of Single Case Experimental Designs (SCEDs) in evaluating treatment benefits and harms, given their utility in

evaluating variations in outcomes due to individual differences that may not be evident in RCTs including establishing functional relationships between the delivery of an intervention and changes in an individual's skills or behaviour and monitoring for safety (Koegel, Koegel, Ashbaugh, & Bradshaw, 2014). While SCEDs were indeed included in some SRs (see S12), we excluded systematic reviews focused solely on SCEDs.

Future Directions

While the main outcome of this review is a summary of the extant evidence, an equally important contribution is the clear demonstration of existing gaps. Each blank cell in Table 1 represents knowledge that could not be obtained through the current review process, and hence a possible avenue for future research. A clear shortcoming of the current evidence base is a lack of understanding of how the effect of interventions may differ according to characteristics of the child (e.g., child age, core autism characteristics, cognition, communication skills) and intervention (e.g., intervention amount, setting, format, agent, mode). There have been multiple calls for further research to examine what works best for whom and why (e.g., Vivanti, Kasari, Green, Mandell, Maye, & Hudry, 2018). Based on the distinct lack of available evidence, it is timely to repeat the appeal for moderator analysis to be included as standard in the conduct and reporting of future clinical trials. Equally clear is the need for consistency and transparency in the reporting of adverse effects (see Sandbank et al., 2020) from interventions, thus holding non-pharmacological intervention research to the same standard expected in medicine and related fields.

A related consideration is that not all interventions are specifically designed to cater for all children, and this may affect the suitability of an approach for a particular child (e.g., CBT for a preschool aged child with minimal functional language) and the nature and consistency of

effects. It is possible, for instance, that interventions that are designed specifically for children with the most complex needs, who typically have co-occurring conditions (e.g., intellectual disability, hearing and vision impairment, epilepsy) and greater variability in support needs, will yield more inconsistent results than interventions that are designed for children with fewer co-occurring conditions. For this reason, we have focused on the direction of effect (positive, null, inconsistent) in reporting our findings, rather than the magnitude of effect (although see S17 for effect sizes). There is a need for more consistent and transparent characterization of participants in future studies, so that the effects of different interventions can be compared in the context of the specific populations for which they are designed, thus ensuring a fair and clinically useful comparison.

In designing future studies, an important consideration relates to how intervention effects are defined and measured. In the current review, a ‘positive effect’ represented the desired effect of an intervention on a child or family outcome as defined by the authors of the SR. Most commonly, the measured effects were improvements in developmental skills and abilities, or reductions in autism characteristics (see Table 1). Notably, there was a paucity of studies that recorded measures of child and family wellbeing, particularly around quality of life. The ultimate goal of intervention is to increase each person’s capacity to participate in a range of life activities of their choosing, in societies that value and support this participation (Lai et al., 2020). To test interventions against this goal, it is critical to not just measure developmental outcomes that may contribute toward participation, but also measure this goal directly. Understanding how intervention outcomes may generalise to improvements in child and family wellbeing and participation, and whether any improvements are sustained over time, are critical areas of focus for future intervention research. Central to this recommendation is the involvement of autistic

individuals and their families in each phase of the research process. Grounding research in the lived experience of the autistic community provides the greatest opportunity for research to generate outcomes that are meaningful to, and have a positive impact on, the lives of children on the autism spectrum and their families. A further consideration is that while the current review summarised the intervention effects reported by SRs, it did not examine the evidence underpinning the theoretical rationale for an intervention. Future studies could address the extent to which positive effects are attributable to the intervention's purported causal mechanism rather than extraneous variables (e.g., sensory input provided during sensory interventions, or the child's interactions with horses during equine therapy, rather than the child's interactions with an engaging clinician).

Finally, we note that this review was undertaken at a crucial period of worldwide shift in community understanding of autism, including a shift to embracing and celebrating neurodiversity and individual differences, a focus on the role of society in creating and maintaining disability, and the importance of putting consumers' voices at the heart of decision making. It can be argued that implicit in our use of the term 'intervention' here is the notion that there is an issue to be 'fixed', as opposed to an opportunity for the provision of supports, strategies, or simply services that children and families find valuable. In this way, while our review provides a synthesis of the best available evidence, it stops short of, and does not purport to, act as a clinical guideline on the basis of which interventions should be selected, in general or for specific individuals. Instead, it has been our intention to provide a robust foundation of evidence upon which consumers and policymakers can combine efforts to develop guidelines that ensure the delivery of evidence-based supports to children on the autism spectrum.

Conclusion

Having access to effective intervention during childhood is an important element of the clinical pathway for children on the autism spectrum, providing an opportunity to support early development and promote longer-term quality of life. This umbrella review found evidence for a range of positive effects of interventions for children on the autism spectrum, for a range of child and family outcomes. However, there was no evidence for a single most effective intervention for all children, nor for an intervention that effectively targeted all examined outcomes, and the possible influence of intervention and child characteristics on outcomes remains broadly unclear. The findings will help to guide clinical decision making within an evidence-based practice framework, as well as policy decisions governing the delivery of interventions. From a research perspective, the findings highlight the need for greater consistency and transparency in reporting of clinical trials, in both original research and their inclusion in SRs, as the basis for refining the effectiveness of intervention for children on the autism spectrum and their families.

Acknowledgements

The authors thank Dr Cindy Stern (Joanna Briggs Institute, University of Adelaide) for consulting on the use of the Umbrella Review methodology, and Michelle DuBroy and Bonnie Dixon (Librarians, Griffith University) for assistance in developing the search protocols. This research was funded by the Australian Government National Disability Insurance Agency. All authors received a salary contribution or honorarium to support their work in the project. The authors report no conflicts of interest but have provided a complete disclosure of interests in S24. The complete commissioned report is available online (Whitehouse et al., 2020). Where content in this article is repeated from the original report, it is done so to ensure consistency and

completeness for readers, and with full acknowledgement of the original source and permission to reproduce.

References

Included Systematic Reviews

- Akemoglu, Y., Muharib, R., & Meadan, H. (2020). A systematic and quality review of parentimplemented language and communication interventions conducted via telepractice. *Journal of Behavioral Education*, 29(2), 282-316.
- Bejarano-Martín, Á., Canal-Bedia, R., Magán-Maganto, M., Fernández-Álvarez, C., Lóa-Jónsdóttir, S., Saemundsen, E., . . . Posada, M. Efficacy of focused social and communication intervention practices for young children with autism spectrum disorder: A meta-analysis. *Early Childhood Research Quarterly*, 51, 430-445.
- Binns, A. V., & Oram Cardy, J. (2019). Developmental social pragmatic interventions for preschoolers with autism spectrum disorder: A systematic review. *Autism & Developmental Language Impairments*. <https://doi.org/10.1177/2396941518824497>
- Boshoff, K., Bowen, H., Paton, H., Cameron-Smith, S., Graetz, S., Young, A., & Lane, K. (2020). Child development outcomes of DIR/Floortime TM-based programs: A systematic review. *Canadian Journal of Occupational Therapy*, 87(2), 153-164. doi:10.1177/0008417419899224
- Case, L., & Yun, J. (2019). The effect of different intervention approaches on gross motor outcomes of children with autism spectrum disorder: A meta-analysis. *Adapted Physical Activity Quarterly*, 36, 501-526. doi:10.1123/apaq.2018-0174

- Chang, Y. C., & Locke, J. (2016). A systematic review of peer-mediated interventions for children with autism spectrum disorder. *Research in Autism Spectrum Disorders*, 27, 1-10. doi:10.1016/j.rasd.2016.03.010
- Ferguson, J., Craig, E. A., & Dounavi, K. (2019). Telehealth as a model for providing behaviour analytic interventions to individuals with autism spectrum disorder: A systematic review. *Journal of Autism and Developmental Disorders*, 49, 582-616. doi:10.1007/s10803-018-3724-5
- Flippin, M., Reszka, S., & Watson, L. R. (2010). Effectiveness of the picture exchange communication system (PECS) on communication and speech for children with autism spectrum disorders: A meta-analysis. *American Journal of Speech-Language Pathology*, 19, 178-195. doi:10.1044/1058-0360(2010/09-0022)
- Fuller, E. A., & Kaiser, A. P. (2020). The effects of early intervention on social communication outcomes for children with autism spectrum disorder: A meta-analysis. *Journal of Autism and Developmental Disorders*, 50, 1683-1700. doi:10.1007/s10803-019-03927-z
- Fuller, E. A., Oliver, K., Vojnoska, S. F., & Rogers, S. J. (2020). The effects of the early start denver model for children with autism spectrum disorder: A meta-analysis. *Brain Sciences*, 10(6). doi:https://dx.doi.org/10.3390/brainsci10060368
- Geretsegger, M., Elefant, C., Mossler, K. A., & Gold, C. (2014). Music therapy for people with autism spectrum disorder. *The Cochrane Database of Systematic Reviews* (6), CD004381. doi:https://dx.doi.org/10.1002/14651858.CD004381.pub3
- Griffith, S. F., Hagan, M. B., Heymann, P., Heflin, B. H., & Bagner, D. M. (2020). Apps as learning tools: A systematic review. *Pediatrics*, 145, 1-14. doi:10.1542/peds.2019-1579

- Hampton, L. H., & Kaiser, A. P. (2016). Intervention effects on spoken-language outcomes for children with autism: A systematic review and meta-analysis. *Journal of Intellectual Disability Research*, 60, 444-463. doi:10.1111/jir.12283
- Hardy, K. K., & Weston, R. N. (2020). Canine-assisted therapy for children with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 7, 197-204. doi:10.1007/s40489-019-00188-5
- Hill, J., Ziviani, J., Driscoll, C., & Cawdell-Smith, J. (2019). Can canine-assisted interventions affect the social behaviours of children on the autism spectrum? A systematic review. *Review Journal of Autism and Developmental Disorders*, 6, 13-25. doi:10.1007/s40489-018-0151-7
- Ho, B. P. V., Stephenson, J., & Carter, M. (2014). Cognitive-behavioral approach for children with autism spectrum disorders: A meta-analysis. *Review Journal of Autism and Developmental Disorders*, 1, 18-33. doi:10.1007/s40489-013-0002-5
- Kent, C., Cordier, R., Joosten, A., Wilkes-Gillan, S., Bundy, A., & Speyer, R. (2020). A systematic review and meta-analysis of interventions to improve play skills in children with autism spectrum disorder. *Review Journal of Autism and Developmental Disorders*, 7, 91-118. doi:10.1007/s40489-019-00181-y
- Khan, K., Hall, C. L., Davies, E. B., Hollis, C., & Glazebrook, C. (2019). The effectiveness of webbased interventions delivered to children and young people with neurodevelopmental disorders: Systematic review and meta-Analysis. *Journal of Medical Internet Research*, 21(11), e13478. doi:10.2196/13478

- Knight, V., McKissick, B., & Saunders, A. (2013). A review of technology-based interventions to teach academic skills to students with autism spectrum disorder. *Journal of Autism & Developmental Disorders*, 43, 2628-2648. doi:10.1007/s10803-013-1814-y
- Lang, R., O'Reilly, M., Healy, O., Rispoli, M., Lydon, H., Streusand, W., . . . Giesbers, S. (2012). Sensory integration therapy for autism spectrum disorders: *A systematic review. Research in Autism Spectrum Disorders*, 6, 1004-1018. doi:10.1016/j.rasd.2012.01.006
- Logan, K., Iacono, T., & Trembath, D. (2017). A systematic review of research into aided AAC to increase social-communication functions in children with autism spectrum disorder. *Augmentative & Alternative Communication*, 33, 51-64. doi:10.1080/07434618.2016.1267795
- Mazon, C., Fage, C., & Sauzéon, H. (2019). Effectiveness and usability of technology-based interventions for children and adolescents with ASD: A systematic review of reliability, consistency, generalization and durability related to the effects of intervention. *Computers in Human Behavior*, 93, 235-251. doi:10.1016/j.chb.2018.12.001
- McCoy, A., Holloway, J., Healy, O., Rispoli, M., & Neely, L. (2016). A systematic review and evaluation of video modeling, role-play and computer-based instruction as social skills interventions for children and adolescents with high-functioning autism. *Review Journal of Autism and Developmental Disorders*, 3, 48-67. doi:10.1007/s40489-015-0065-6
- Miguel Cruz, A., Ríos Rincón, A. M., Rodríguez Dueñas, W. R., Quiroga Torres, D. A., & Bohórquez-Heredia, A. F. (2017). What does the literature say about using robots on children with disabilities? *Disability and Rehabilitation: Assistive Technology*, 12, 429-440. doi:10.1080/17483107.2017.1318308

- Moon, S. J., Hwang, J., Hill, H. S., Kervin, R., Birtwell, K. B., Torous, J., . . . Kim, J. W. (2020). Mobile device applications and treatment of autism spectrum disorder: A systematic review and meta-analysis of effectiveness. *Archives of Disease in Childhood*, 105, 458-462. doi:10.1136/archdischild-2019-318258
- Murza, K. A., Schwartz, J. B., Hahs-Vaughn, D. L., & Nye, C. (2016). Joint attention interventions for children with autism spectrum disorder: A systematic review and meta-analysis. *International Journal of Language & Communication Disorders*, 51, 236-251. doi:10.1111/1460-6984.12212
- National Autism Center. (2015). Findings and conclusions: National standards project, phase 2. <https://www.nationalautismcenter.org/national-standards-project/phase-2/>
- Naveed, S., Waqas, A., Amray, A. N., Memon, R. I., Javed, N., Tahir, M. A., . . . Rahman, A. (2019). Implementation and effectiveness of nonspecialist mediated interventions for children with Autism Spectrum Disorder: A systematic review and meta-analysis. *PLoS ONE*, 14(11). doi:10.1371/journal.pone.0224362
- Nevill, R. E., Lecavalier, L., & Stratis, E. A. (2018). Meta-analysis of parent-mediated interventions for young children with autism spectrum disorder. *Autism: The International Journal of Research & Practice*, 22(2), 84-98. doi:10.1177/1362361316677838
- Ona, H. N., Larsen, K., Nordheim, L. V., & Brurberg, K. G. (2020). Effects of pivotal response treatment (PRT) for children with autism spectrum disorders (ASD): A systematic review. *Review Journal of Autism and Developmental Disorders*, 7, 78-90. doi:10.1007/s40489-019-00180-z

- Oono, I. P., Honey, E. J., & McConachie, H. (2013). Parent-mediated early intervention for young children with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews* (4). doi:10.1002/14651858.CD009774.pub2
- Parsons, D., Cordier, R., Vaz, S., & Lee, H. C. (2017). Parent-mediated intervention training delivered remotely for children with autism spectrum disorder living outside of urban areas: Systematic review. *Journal of Medical Internet Research*, 19(8), 1-1. doi:10.2196/jmir.6651
- Parsons, L., Cordier, R., Munro, N., Joosten, A., & Speyer, R. (2017). A systematic review of pragmatic language interventions for children with autism spectrum disorder. *PLoS ONE*, 12(4). doi:10.1371/journal.pone.0172242
- Peters-Scheffer, N., Didden, R., Korzilius, H., & Sturmey, P. (2011). A meta-analytic study on the effectiveness of comprehensive ABA-based early intervention programs for children with autism spectrum disorders. *Research in Autism Spectrum Disorders*, 5, 60-69. doi:10.1016/j.rasd.2010.03.011
- Postorino, V., Sharp, W., McCracken, C., Bearss, K., Burrell, T., Evans, A., . . . Evans, A. N. (2017). A systematic review and meta-analysis of parent training for disruptive behavior in children with autism spectrum disorder. *Clinical Child & Family Psychology Review*, 20, 391-402. doi:10.1007/s10567-017-0237-2
- Reichow, B., Hume, K., Barton, E. E., & Boyd, B. A. (2018). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews* (5). doi:10.1002/14651858.CD009260.pub3

Sandbank, M., Bottema-Beutel, K., Crowley, S., Cassidy, M., Dunham, K., Feldman, J. I., . . .

Wojnaroski, T. G. (2020a). Project AIM: Autism intervention meta-analysis for studies of young children. *Psychological Bulletin*, 146, 1-29.

Sandbank, M., Bottema-Beutel, K., Crowley, S., Cassidy, M., Feldman, J. I., Canihuante, M., &

Wojnaroski, T. (2020b). Intervention effects on language in children with autism: A Project AIM meta-analysis. *Journal of Speech, Language, and Hearing Research*, 63, 1537-1560. doi:10.1044/2020_JSLHR-19-00167

Schaaf, R. C., Dumont, R. L., Arbesman, M., & May-Benson, T. A. (2018). Efficacy of

occupational therapy using Ayres Sensory Integration®: A systematic review. *The American Journal of Occupational Therapy*, 72(1),.

<https://dx.doi.org/10.5014/ajot.2018.028431>

Schoen, S. A., Lane, S. J., Mailloux, Z., May-Benson, T., Parham, L. D., Smith Roley, S., &

Schaaf, R. C. (2019). A systematic review of Ayres Sensory Integration intervention for children with autism. *Autism Research*, 12, 6-19. doi:10.1002/aur.2046

Srinivasan, S. M., Cavagnino, D. T., & Bhat, A. N. (2018). Effects of equine therapy on

individuals with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 5, 156-175. doi:10.1007/s40489-018-0130-z

Steinbrenner, J. R., Hume, K., Odom, S. L., Morin, K., Nowell, S., Tomaszewski, B., . . .

Savage, M. N. (2020). Evidence-based practices for children, youth, and young adults with Autism. *National Clearinghouse on Autism Evidence and Practice*.

<https://ncaep.fpg.unc.edu/sites/ncaep.fpg.unc.edu/files/imce/documents/EBP%20Report%202020.pdf>

- Sutherland, R., Trembath, D., & Roberts, J. (2018). Telehealth and autism: A systematic search and review of the literature. *International Journal of Speech-Language Pathology*, 20, 324-336. doi:10.1080/17549507.2018.1465123
- Tachibana, Y., Miyazaki, C., Mikami, M., Ota, E., Mori, R., Hwang, Y., . . . Kamio, Y. (2018). Meta analyses of individual versus group interventions for pre-school children with autism spectrum disorder (ASD). *PLoS ONE*, 13(5). doi:10.1371/journal.pone.0196272
- Tarver, J., Palmer, M., Webb, S., Scott, S., Slonims, V., Simonoff, E., & Charman, T. (2019). Child and parent outcomes following parent interventions for child emotional and behavioral problems in autism spectrum disorders: A systematic review and meta-analysis. *Autism: The International Journal of Research & Practice*, 23, 1630-1644. doi:10.1177/1362361319830042
- Tiede, G., & Walton, K. M. (2019). Meta-analysis of naturalistic developmental behavioral interventions for young children with autism spectrum disorder. *Autism: The International Journal of Research & Practice*, 23, 2080-2095. doi:10.1177/1362361319836371
- Treurnicht Naylor, K., Kingsnorth, S., Lamont, A., McKeever, P., & Macarthur, C. (2011). The effectiveness of music in pediatric healthcare: A systematic review of randomized controlled trials. *Evidence-Based Complementary and Alternative Medicine*, 2011, 464759. doi:10.1155/2011/464759
- Trzmiel, T., Purandare, B., Michalak, M., Zasadzka, E., & Pawlaczyk, M. (2019). Equine assisted activities and therapies in children with autism spectrum disorder: A systematic review and a meta-analysis. *Complementary Therapies in Medicine*, 42, 104-113. doi:10.1016/j.ctim.2018.11.004

Tupou, J., van der Meer, L., Waddington, H., & Sigafos, J. (2019). Preschool interventions for children with autism spectrum disorder: A review of effectiveness studies. *Review Journal of Autism and Developmental Disorders*, 6, 381-402. doi:10.1007/s40489-019-00170-1

Verschuur, R., Didden, R., Lang, R., Sigafos, J., & Huskens, B. (2014). Pivotal response treatment for children with autism spectrum disorders: A systematic review. *Review Journal of Autism and Developmental Disorders*, 1, 34-61. doi:10.1007/s40489-013-0008-z

Vivanti, G., Kasari, C., Green, J., Mandell, D., Maye, M. and Hudry, K. (2018), Implementing and evaluating early intervention for children with autism: Where are the gaps and what should we do? *Autism Research*, 11: 16-23. <https://doi.org/10.1002/aur.1900>

Virués-Ortega, J. (2010). Applied behavior analytic intervention for autism in early childhood: Meta-analysis, meta-regression and dose-response meta-analysis of multiple outcomes. *Clinical Psychology Review*, 30, 387-399. doi:10.1016/j.cpr.2010.01.008

Waddington, H., van der Meer, L., & Sigafos, J. (2016). Effectiveness of the Early Start Denver Model: A systematic review. *Review Journal of Autism and Developmental Disorders*, 3, 93-106. doi:10.1007/s40489-015-0068-3

Watkins, L., Ledbetter-Cho, K., O'Reilly, M., Barnard-Brak, L., & Garcia-Grau, P. (2019). Interventions for students with autism in inclusive settings: A best-evidence synthesis and meta-analysis. *Psychological Bulletin*, 145, 490-507.

Weitlauf, A. S., Sathe, N., McPheeters, M. L., & Warren, Z. E. (2017). Interventions targeting sensory challenges in autism spectrum disorder: A systematic review. *Pediatrics*, 139(6), 1-22. doi:10.1542/peds.2017-0347

- Weston, L., Hodgekins, J., & Langdon, P. E. (2016). Effectiveness of cognitive behavioural therapy with people who have autistic spectrum disorders: A systematic review and meta analysis. *Clinical Psychology Review*, 49, 41-54. doi:10.1016/j.cpr.2016.08.001
- Wiese, C., Simpson, R., & Kumar, S. (2016). The effectiveness of equine-based therapy in the treatment of social and behavioural aspects of children with autism spectrum disorder: a systematic review. *Internet Journal of Allied Health Sciences and Practice*, 14(3).
- Zagona, A. L., & Mastergeorge, A. M. (2018). An empirical review of peer-mediated interventions: implications for young children with autism spectrum disorders. *Focus on Autism & Other Developmental Disabilities*, 33, 131-141.
doi:10.1177/1088357616671295

In Text Citations

- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders - 5th Edition*. Washington, DC: American Psychiatric Association.
- Aromataris, E., Fernandez, R., Godfrey, C., Holly, C., Khalil, H., & Tungpunkom, P. (2020). Chapter 10: Umbrella Reviews. In E. Aromataris & Z. Munn (Eds.), *JBIManual for Evidence Synthesis*: JBI.
- Aromataris, E., Fernandez, R., Godfrey, C. M., Holly, C., Khalil, H., & Tungpunkom, P. (2015). Summarizing systematic reviews: Methodological development, conduct and reporting of an umbrella review approach. *International Journal of Evidence Based Healthcare*, 13(3), 132-140. doi:10.1097/xe.0000000000000055

- Binns, A. V., & Oram Cardy, J. (2019). Developmental social pragmatic interventions for preschoolers with autism spectrum disorder: A systematic review. *Autism & Developmental Language Impairments*. <https://doi.org/10.1177/2396941518824497>
- Bondy, A., & Frost, L. (2001). The Picture Exchange Communication System. *Behavior Modification*, 25, 725-744. doi:10.1177/0145445501255004
- Boshoff, K., Bowen, H., Paton, H., Cameron-Smith, S., Graetz, S., Young, A., & Lane, K. (2020). Child development outcomes of DIR/Floortime TM-based programs: A systematic review. *Canadian Journal of Occupational Therapy*, 87, 153-164. doi:10.1177/0008417419899224
- Eldevik, S., Hastings, R. P., Hughes, J. C., Jahr, E., Eikeseth, S., & Cross, S. (2009). Meta-analysis of Early Intensive Behavioral Intervention for children with autism. *Journal of Clinical Child & Adolescent Psychology*, 38, 439-450. doi:10.1080/15374410902851739
- Flippin, M., Reszka, S., & Watson, L. R. (2010). Effectiveness of the picture exchange communication system (PECS) on communication and speech for children with autism spectrum disorders: A meta-analysis. *American Journal of Speech-Language Pathology*, 19, 178-195. doi:10.1044/1058-0360(2010/09-0022)
- French, L., & Kennedy, E. M. M. (2018). Annual Research Review: Early intervention for infants and young children with, or at-risk of, autism spectrum disorder: A systematic review. *Journal of Child Psychology and Psychiatry*, 59, 444-456. doi:10.1111/jcpp.12828
- Fuller, E. A., Oliver, K., Vejnoska, S. F., & Rogers, S. J. (2020). The effects of the Early Start Denver Model for children with autism spectrum disorder: A meta-analysis. *Brain Sciences*, 10. doi:<https://dx.doi.org/10.3390/brainsci10060368>

- Gentles, S. J., Nicholas, D. B., Jack, S. M., McKibbin, K. A., & Szatmari, P. (2019). Parent engagement in autism-related care: A qualitative grounded theory study. *Health Psychology and Behavioral Medicine*, 7, 1-18. doi:10.1080/21642850.2018.1556666
- Geretsegger, M., Elefant, C., Mossler, K. A., & Gold, C. (2014). Music therapy for people with autism spectrum disorder. *The Cochrane Database of Systematic Reviews* (6), CD004381. doi:<https://dx.doi.org/10.1002/14651858.CD004381.pub3>
- Grant, N., Rodger, S., & Hoffmann, T. (2016). Intervention decision-making processes and information preferences of parents of children with autism spectrum disorders. *Child Care Health Dev*, 42, 125-134. doi:10.1111/cch.12296
- Griffith, S. F., Hagan, M. B., Heymann, P., Heflin, B. H., & Bagner, D. M. (2020). Apps as learning tools: A systematic review. *Pediatrics*, 145, 1-14. doi:10.1542/peds.2019-1579
- Grzadzinski, R., Janvier, D., & Kim, S. H. (2020). Recent developments in treatment outcome measures for young children with autism spectrum disorder (ASD). *Seminars in Pediatric Neurology*, 34, 100806. doi:<https://doi.org/10.1016/j.spen.2020.100806>
- Hardy, K. K., & Weston, R. N. (2020). Canine-assisted therapy for children with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 7, 197-204. doi:10.1007/s40489-019-00188-5
- Hill, J., Ziviani, J., Driscoll, C., & Cawdell-Smith, J. (2019). Can canine-assisted interventions affect the social behaviours of children on the autism spectrum? A systematic review. *Review Journal of Autism and Developmental Disorders*, 6, 13-25. doi:10.1007/s40489-018-0151-7

- Ho, B. P. V., Stephenson, J., & Carter, M. (2014). Cognitive-behavioral approach for children with autism spectrum disorders: A meta-analysis. *Review Journal of Autism and Developmental Disorders, 1*, 18-33. doi:10.1007/s40489-013-0002-5
- Hoffman, T., Bennett, S., & Del Mar, C. (2013). *Evidence-based practice across the health professions* (2nd ed.). Sydney, NSW: Churchill Livingstone
- Joanna Briggs Institute. (2020). *Checklist for systematic reviews and research syntheses*. Retrieved from https://joannabriggs.org/sites/default/files/2019-05/JBI_Critical_Appraisal-Checklist_for_Systematic_Reviews2017_0.pdf
- Kent, C., Cordier, R., Joosten, A., Wilkes-Gillan, S., Bundy, A., & Speyer, R. (2020). A systematic review and meta-analysis of interventions to improve play skills in children with autism spectrum disorder. *Review Journal of Autism and Developmental Disorders, 7*, 91-118. doi:10.1007/s40489-019-00181-y
- Khan, K., Hall, C. L., Davies, E. B., Hollis, C., & Glazebrook, C. (2019). The effectiveness of web-based interventions delivered to children and young people with neurodevelopmental disorders: Systematic review and meta-analysis. *Journal of Medical Internet Research, 21*(11). doi:10.2196/13478
- Knight, V., McKissick, B., & Saunders, A. (2013). A Review of Technology -Based Interventions to Teach Academic Skills to Students with Autism Spectrum Disorder. *Journal of Autism & Developmental Disorders, 43*(11), 2628-2648. doi:10.1007/s10803-013-1814-y
- Koegel, L. K., Koegel, R. L., Ashbaugh, K., & Bradshaw, J. (2014). The importance of early identification and intervention for children with or at risk for autism spectrum disorders.

International Journal of Speech-Language Pathology, 16, 50-56.

doi:10.3109/17549507.2013.861511

Lai, M. C., Anagnostou, E., Wiznitzer, M., Allison, C., & Baron-Cohen, S. (2020). Evidence-based support for autistic people across the lifespan: Maximising potential, minimising barriers, and optimising the person-environment fit. *The Lancet Neurology*, 19, 434-451. doi:10.1016/S1474-4422(20)30034-X

Lang, R., O'Reilly, M., Healy, O., Rispoli, M., Lydon, H., Streusand, W., . . . Giesbers, S. (2012). Sensory integration therapy for autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, 6, 1004-1018. doi:10.1016/j.rasd.2012.01.006

Logan, K., Iacono, T., & Trembath, D. (2017). A systematic review of research into aided AAC to increase social-communication functions in children with autism spectrum disorder. *AAC: Augmentative & Alternative Communication*, 33, 51-64. doi:10.1080/07434618.2016.1267795

Lord, C., Brugha, T. S., Charman, T., Cusack, J., Dumas, G., Frazier, T., . . . Veenstra-VanderWeele, J. (2020). Autism spectrum disorder. *Nature Reviews Disease Primers*, 6(1), 5. doi:10.1038/s41572-019-0138-4

Makrygianni, M. K., & Reed, P. (2010). A meta-analytic review of the effectiveness of behavioural early intervention programs for children with Autistic Spectrum Disorders. *Research in Autism Spectrum Disorders*, 4, 577-593. doi:10.1016/j.rasd.2010.01.014

Mazon, C., Fage, C., & Sauzéon, H. (2019). Effectiveness and usability of technology-based interventions for children and adolescents with ASD: A systematic review of reliability, consistency, generalization and durability related to the effects of intervention. *Computers in Human Behavior*, 93, 235-251. doi:10.1016/j.chb.2018.12.001

- McConachie, H., Parr, J. R., Glod, M., Hanratty, J., Livingstone, N., Oono, I. P., . . . Williams, K. (2015). Systematic review of tools to measure outcomes for young children with autism spectrum disorder. *Health Technology Assessment*, 19(41), 1-506.
doi:10.3310/hta19410
- McCoy, A., Holloway, J., Healy, O., Rispoli, M., & Neely, L. (2016). A systematic review and evaluation of video modeling, role-play and computer-based instruction as social skills interventions for children and adolescents with high-functioning autism. *Review Journal of Autism and Developmental Disorders*, 3, 48-67. doi:10.1007/s40489-015-0065-6
- Miguel Cruz, A., Ríos Rincón, A. M., Rodríguez Dueñas, W. R., Quiroga Torres, D. A., & Bohórquez-Heredia, A. F. (2017). What does the literature say about using robots on children with disabilities? *Disability and Rehabilitation: Assistive Technology*, 12, 429-440. doi:10.1080/17483107.2017.1318308
- Ministries of Health and Education. (2016). *New Zealand Autism Spectrum Disorder Guideline*. Retrieved from Wellington, New Zealand:
- Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Journal of Clinical Epidemiology*, 62, 1006-1012. doi:10.1016/j.jclinepi.2009.06.005
- Moon, S. J., Hwang, J., Hill, H. S., Kervin, R., Birtwell, K. B., Torous, J., . . . Kim, J. W. (2020). Mobile device applications and treatment of autism spectrum disorder: A systematic review and meta-analysis of effectiveness. *Archives of Disease in Childhood*, 105, 458-462. doi:10.1136/archdischild-2019-318258
- National Autism Center. (2015). *Findings and conclusions: National standards project, phase 2*. Retrieved from

- National Institute for Health and Care Excellence. (2013). *Autism spectrum disorder in under 19s: Support and management Clinical guideline [CG170]*. Retrieved from United Kingdom: <https://www.nice.org.uk/guidance/cg170/resources/autism-spectrum-disorder-in-under-19s-support-and-management-pdf-35109745515205>
- OCEBM Levels of Evidence Working Group. (2011). *The Oxford 2011 Levels of Evidence*. Retrieved from <http://www.cebm.net/index.aspx?o=5653>
- Odom, S., Hume, K., Boyd, B., & Stabel, A. (2012). Moving beyond the intensive behavior treatment versus eclectic dichotomy: Evidence-based and individualized programs for learners with ASD. *Behavior Modification*, 36, 270-297. doi:10.1177/0145445512444595
- Ona, H. N., Larsen, K., Nordheim, L. V., & Brurberg, K. G. (2020). Effects of pivotal response treatment (prt) for children with autism spectrum disorders (asd): A systematic review. *Review Journal of Autism and Developmental Disorders*, 7, 78-90. doi:10.1007/s40489-019-00180-z
- Oono, I. P., Honey, E. J., & McConachie, H. (2013). Parent-mediated early intervention for young children with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews*(4). doi:10.1002/14651858.CD009774.pub2
- Pieper, D., Antoine, S. L., Mathes, T., Neugebauer, E. A., & Eikermann, M. (2014). Systematic review finds overlapping reviews were not mentioned in every other overview. *Journal of Clinical Epidemiology*, 67, 368-375. doi:10.1016/j.jclinepi.2013.11.007
- Reichow, B., Hume, K., Barton, E. E., & Boyd, B. A. (2018). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews* (5). doi:10.1002/14651858.CD009260.pub3

- Roberts, J., & Williams, K. (2016). *Autism Spectrum Disorder: Evidence-based/evidenceinformed good practice for supports provided to preschool children, their families and carers*. Retrieved from <https://www.ndis.gov.au/media/863/download>
- Rodrigues, R., Lai, M.-C., Beswick, A., Gorman, D. A., Anagnostou, E., Szatmari, P., . . . Ameis, S. H. Practitioner Review: Pharmacological treatment of attention-deficit/hyperactivity disorder symptoms in children and youth with autism spectrum disorder: a systematic review and meta-analysis. *Journal of Child Psychology and Psychiatry*. doi:<https://doi.org/10.1111/jcpp.13305>
- Sackett, D. L., Rosenberg, W. M. C., Gray, J. A. M., Haynes, R. B., & Richardson, W. S. (1996). Evidence based medicine: what it is and what it isn't. *BMJ*, *312*(7023), 71-72. doi:10.1136/bmj.312.7023.71
- Sandbank, M., Bottema-Beutel, K., Crowley, S., Cassidy, M., Dunham, K., Feldman, J. I., . . . Woynaroski, T. G. (2020). Project AIM: Autism intervention meta-analysis for studies of young children. *Psychological Bulletin*, *146*, 1-29. doi:10.1037/bul0000215
- Schaaf, R. C., Dumont, R. L., Arbesman, M., & May-Benson, T. A. (2018). efficacy of occupational therapy using Ayres Sensory Integration: A systematic review. *The American Journal of Occupational Therapy*, *72*. doi:<https://dx.doi.org/10.5014/ajot.2018.028431>
- Schoen, S. A., Lane, S. J., Mailloux, Z., May-Benson, T., Parham, L. D., Smith Roley, S., & Schaaf, R. C. (2019). A systematic review of Ayres Sensory Integration intervention for children with autism. *Autism Research*, *12*, 6-19. doi:10.1002/aur.2046
- Siafis, S., Çıray, O., Schneider-Thoma, J., Bighelli, I., Krause, M., Rodolico, A., . . . Leucht, S. (2020). Placebo response in pharmacological and dietary supplement trials of autism

- spectrum disorder (ASD): Systematic review and meta-regression analysis. *Molecular Autism*, 11, 66. doi:10.1186/s13229-020-00372-z
- Srinivasan, S. M., Cavagnino, D. T., & Bhat, A. N. (2018). Effects of equine therapy on individuals with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 5, 156-175. doi:10.1007/s40489-018-0130-z
- Steinbrenner, J. R., Hume, K., Odom, S. L., Morin, K., Nowell, S., Tomaszewski, B., . . . Savage, M. N. (2020). Evidence-based practices for children, youth, and young adults with Autism. *National Clearinghouse on Autism Evidence and Practice*. Retrieved from <https://ncaep.fpg.unc.edu/sites/ncaep.fpg.unc.edu/files/imce/documents/EBP%20Report%202020.pdf>
- Tachibana, Y., Miyazaki, C., Mikami, M., Ota, E., Mori, R., Hwang, Y., . . . Kamio, Y. (2018). Meta-analyses of individual versus group interventions for pre-school children with autism spectrum disorder (ASD). *PLoS ONE*, 13(5). doi:10.1371/journal.pone.0196272
- Tiede, G., & Walton, K. M. (2019). Meta-analysis of naturalistic developmental behavioral interventions for young children with autism spectrum disorder. *Autism: The International Journal of Research & Practice*, 23, 2080-2095. doi:10.1177/1362361319836371
- Treurnicht Naylor, K., Kingsnorth, S., Lamont, A., McKeever, P., & Macarthur, C. (2011). The effectiveness of music in pediatric healthcare: A systematic review of randomized controlled trials. *Evidence-Based Complementary and Alternative Medicine*, 2011, 464759. doi:10.1155/2011/464759
- Trzmiel, T., Purandare, B., Michalak, M., Zasadzka, E., & Pawlaczyk, M. (2019). Equine assisted activities and therapies in children with autism spectrum disorder: A systematic

- review and a meta-analysis. *Complementary Therapies in Medicine*, 42, 104-113.
doi:<https://doi.org/10.1016/j.ctim.2018.11.004>
- Veritas Health Innovation. (2020). *Covidence systematic review software*. Retrieved from www.covidence.org
- Verschuur, R., Didden, R., Lang, R., Sigafos, J., & Huskens, B. (2014). Pivotal response treatment for children with autism spectrum disorders: A systematic review. *Review Journal of Autism and Developmental Disorders*, 1, 34-61. doi:10.1007/s40489-013-0008-z
- Virués-Ortega, J. (2010). Applied behavior analytic intervention for autism in early childhood: Meta-analysis, meta-regression and dose-response meta-analysis of multiple outcomes. *Clinical Psychology Review*, 30, 387-399. doi:10.1016/j.cpr.2010.01.008
- Waddington, H., van der Meer, L., & Sigafos, J. (2016). Effectiveness of the Early Start Denver Model: A systematic review. *Review Journal of Autism and Developmental Disorders*, 3(2), 93-106. doi:10.1007/s40489-015-0068-3
- Weitlauf, A. S., Sathe, N., McPheeters, M. L., & Warren, Z. E. (2017). Interventions targeting sensory challenges in autism spectrum disorder: A systematic review. *Pediatrics*, 139(6), 1-22. doi:10.1542/peds.2017-0347
- Weston, L., Hodgekins, J., & Langdon, P. E. (2016). Effectiveness of cognitive behavioural therapy with people who have autistic spectrum disorders: A systematic review and meta-analysis. *Clinical Psychology Review*, 49. doi:10.1016/j.cpr.2016.08.001
- Whitehouse, A., Varcin, K., Waddington, H., Sulek, R., Bent, C., Ashburner, J., . . . Trembath, D. (2020). *Interventions for children on the autism spectrum: A synthesis of research evidence*. Retrieved from <https://www.autismcrc.com.au/interventions-evidence/register>

- Wiese, C., Simpson, R., & Kumar, S. (2016). The Effectiveness of equine-based therapy in the treatment of social and behavioural aspects of children with autism spectrum disorder: A systematic review. *Internet Journal of Allied Health Sciences and Practice*, 14(3).
- Woods, R. (2017). Exploring how the social model of disability can be re-invigorated for autism: in response to Jonathan Levitt. *Disability & Society*, 32, 1090-1095.
doi:10.1080/09687599.2017.1328157

Table 1 (continued)

	No. of SRs	Core autism characteristics				Related skills and development							Education and participation				Family wellbeing						
		Overall autistic characteristics	Social-communication	Restricted and repetitive interests and behaviours	Sensory behaviours	Communication	Expressive language	Receptive language	Cognition	Motor	Social-emotional/challenging behaviour	Play	Adaptive behaviour	General outcomes	School/learning readiness	Academic skills	Quality of life	Community participation	Caregiver communication and interaction strategies	Caregiver social-emotional wellbeing	Caregiver satisfaction	Caregiver financial wellbeing	Child satisfaction
Developmental Interventions																							
SRs of assorted developmental interventions*	2		+			○													+				
			M			M													H				
Developmental relationship-based treatment	1													?									
														L									
DIR/Floortime	2		+			○				○				○									
			M			M				M				L									
Naturalistic teaching strategies	2		+			+			+	+	+	+	+		+	+							
			LL			LL			L	L	L	L	L		LL	L							
Naturalistic developmental behavioural interventions																							
SRs of assorted NDBIs*	2	○	+	○		+	+	+	+		○	+	○										
		M	M	M		M	M	M	M		M	M	M										
Early Start Denver Model	2	○	○	○		+			+				○	+					+	+	+		
		M	M	M		M			M				M	M					M	M	M		
Pivotal Response Treatment	3		?	+		○	+					+		?	+					?			
			L	L		L	L					L		L	L					L			

Table 1 (continued)

[illegible]

Table 1 (continued)

		Core autism characteristics					Related skills and development							Education and participation				Family wellbeing					
	No. of SRs	Overall autistic characteristics	Social-communication	Restricted and repetitive interests and behaviours	Sensory behaviours	Communication	Expressive language	Receptive language	Cognition	Motor	Social-emotional/challenging behaviour	Play	Adaptive behaviour	General outcomes	School/learning readiness	Academic skills	Quality of life	Community participation	Caregiver communication and interaction strategies	Caregiver social-emotional wellbeing	Caregiver satisfaction	Caregiver financial wellbeing	Child satisfaction
Social cognition intervention	1													O L									
Social communication intervention	1													O L									
Social skills training	1		+ L			+ L			+ L		+ L	+ L	+ L		+ L								
Social thinking intervention	1													O L									
Theory of Mind training	1													? L									

Note: + Positive therapeutic effect; ? Inconsistent therapeutic effect; O Null effect. Blank cell indicates no evidence available.

*Combines assorted interventions practices for this category. Please see page 79 for a full list.

L = Low quality M = Moderate quality H = High quality

Behavioural: Behavioral Parent Training; Behavioural early intervention programmes; Discrete Trial Training with Motor Vocal Imitation Assessment; Early Intensive Behavioral Treatment; Functional Behavior Skills Training Home-based behavioral treatment; Home-based Early Intensive Behavioral Intervention (EIBI); Intensive ABA; Intensive Early Intervention; Low Intensity Behavioral Treatment; Managing Repetitive Behaviors; Peer-Mediated Intervention; Picture Exchange Communication System (PECS); Rapid Motor Imitation Antecedent; Regular Intensive Learning for Young Children with Autism; Schedules, Tools, and Activities for Transitions (STAT); Social Skills Group; Stepping Stones Triple P Positive Parenting Program; Strategies for Teaching Based on Autism Research (STAR).

Developmental: Child Talk; Developmental Individual-Difference Relationship-Based (DIR)/Floortime; Hanen More Than Words; Joint Attention Mediated Learning (JAML); Milton and Ethel Harris Research Initiative Treatment (MEHRIT)-DIR based; Parent-Mediated Communication Focused Treatment; Parent-mediated intervention for autism spectrum disorder in South Asia (PASS); Pediatric Autism and Communication Therapy (PACT); Play and Language for Autistic Youngsters (PLAY) project - DIR based; Scottish Early Intervention Program; Social Communication Intervention for Children with Autism and Pervasive Developmental Disorder; Social communication, emotion regulation, transactional support (SCERTS); Video-feedback Intervention to Promote Positive Parenting adapted to autism (VIPP-AUTI).

Naturalistic developmental behavioural interventions: Advancing Social-Communication and Play (ASAP); Caregiver-based intervention program in community day-care centers; Denver

Model; Early Social Interaction Project (ESI); Early Social Interaction Project (SCERTS); Early Start Denver Model (ESDM); Focus parent training program; Home-based Building Blocks Program; ImPACT Online; Interpersonal Synchrony; Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER); Joint Engagement Intervention with Creative Movement Therapy; Joint Engagement Intervention; Learning Experiences Alternative Program (LEAP); Parent- Early Start Denver Model (P-ESDM); Pivotal Response Treatment (PRT); Reciprocal Imitation Training (RIT); Social ABCs.

Sensory-based: Alternative seating; Blanket or “body sock”; Brushing with a bristle or a feather; Chewing on a rubber tube; Developmental Speech and Language Training through Music; Family-Centered Music Therapy; Joint compression or stretching; Jumping or bouncing; Music Therapy; Playing with a water and sand sensory table; Playing with specially textured toys; Qigong (QST) Massage Treatment; Rhythm Intervention Sensorimotor Enrichment; Sensory Enrichment; Swinging or rocking stimulation; Thai Traditional Massage; Tomatis Sound Therapy; Weighted vests.

Technology-based: ABRACADABRA; Apps; Computer-based interventions; FaceSay; Gaming Open Library for Intervention in Autism at Home (GOLIAH); Gaze-contingent attention training; Robot-based interventions; Serious games; Social Skills Training using a robotic behavioral intervention system; The Transporters animated series; Therapy Outcomes By You (TOBY) App; Transporters DVD; Transporters Program for Children with Autism; Videoconferencing; Virtual environment with playable games; Web-based cognitive behavioural therapy (CBT) intervention.

Animal-assisted: Not specified

TEACCH: Not specified

Cognitive behaviour therapy: Building Confidence Family Cognitive behaviour therapy (FCBT); Cool Kids; Coping Cat CBT program; Facing your fears; Group Cognitive Behaviour Therapy (CBT); Social Skills Training for Children and Adolescents with Asperger Syndrome and Social-Communications Problems; Thinking about you, thinking about me.

Figure 1. PRISMA flow diagram.

Supplementary Material

- S1: Umbrella review study protocol
- S2: Variations to protocol
- S3: Grey literature search strategy
- S4: Consensus on intervention eligibility
- S5: Codebook for data extraction
- S6: Quality appraisal form
- S7: Data synthesis process
- S8: Excluded articles from full-text screening phase
- S9: Articles excluded after Phase 1 extraction
- S10: Characteristics of included reviews
- S11: Summary of findings from practice/category-focused systematic reviews
- S12: Summary of findings from outcome-focused systematic reviews
- S13: Summary of findings from intervention delivery-focused systematic reviews
- S14: Location (by continent) of included studies
- S15: Quality appraisal ratings: item-level and total quality appraisal ratings for each included systematic review
- S16: Appraisal tool(s) used within each included systematic review to assess study quality/risk of bias
- S17: Raw data and summary statements from each included systematic review for all categorised outcomes in the current umbrella review
- S18: Information on adverse effects of interventions that was extracted from the systematic reviews
- S18: Information on adverse effects of interventions that was extracted from the systematic reviews
- S19: Information on the amount of intervention received for all included systematic reviews
- S20: Information on the influence of the amount of intervention on intervention effects
- S21: Information on the influence of different intervention delivery characteristics on intervention effects
- S22: Synthesis of evidence from umbrella review regarding effect of parent-mediated, peer-mediated, and telepractice delivery of interventions on child and family outcomes
- S23: Information on the influence of different child characteristics on intervention effects
- S24: Summary of Member Expertise and Declared Interests

S1: Umbrella review study protocol

Title

An umbrella review of non-pharmacological interventions for children on the autism spectrum.

Study aim

To generate a synthesis of evidence from systematic reviews regarding the therapeutic and other effects of non-pharmacological interventions for children on the autism spectrum.

Review questions

- What non-pharmacological interventions have been examined in systematic reviews?
- What effects do non-pharmacological interventions have on child outcomes?
- What effects do non-pharmacological interventions have on family wellbeing?
- What are the optimal delivery characteristics of non-pharmacological interventions?
- What child characteristics impact on intervention outcomes?

Searches

1. We will conduct electronic searches of the following databases for peer-reviewed systematic reviews published in English.
 - a. PsycINFO
 - b. Education Resources Information Centre (ERIC)
 - c. Medline
 - d. PubMed
 - e. EMBASE
 - f. CINAHL
 - g. Cochrane Database of Systematic Reviews
 - h. Scopus
 - i. EBSCO Education Source
 - j. Epistemonikos
2. We will conduct a search for grey literature by searching:
 - a. Google advanced search (limited to first 100 results per search)
 - b. PROSPERO
 - c. Abstracts submitted to International Society for Autism Research (INSAR) conferences, and identification of corresponding full text publications.
3. We will also conduct ancestral searches using the reference lists of all included systematic reviews and relevant umbrella reviews or “reviews of reviews” identified by the search.

Search terms

We will conduct a search of subject headings (using corresponding MeSH terms related to autism in each database) and keywords using the terms:

Autis* OR ASD* OR Asperger* OR “pervasive developmental disorder*” OR PDD* OR “pervasive child development disorder*” OR “pervasive childhood developmental disorder*” OR PCDD* OR “disintegrative disorder*”

AND

intervention* OR therap* OR treat* OR teach* OR program* OR package*

AND

“systematic review*” OR “systematic literature review*” OR “evidence syntheses*” OR “meta-analysis*” OR “meta-regression*”

It is known that the vast majority of RCTs in this research area have been conducted post 2010 (French & Kennedy, 2018). Because of this (and to ensure currency), we will limit the search to systematic reviews published from 2010 to present.

Types of studies to be included

Inclusion criteria:

Systematic reviews will be included in the umbrella review if they meet the following inclusion criteria:

- The review was a systematic review, with or without meta-analysis. A review will be considered “systematic” if it: (1) includes a clear statement of the purpose of the review; (2) describes the search strategy (i.e., key search terms, multiple relevant databases, specification of search limits); (3) indicates the criteria used to select studies for inclusion; (4) presents all findings relevant to the main purpose of the review, including those that did not favour the intervention; and (5) uses a method of quality appraisal for each included study.
- The systematic review reports on at least one non-pharmacological intervention that targets the acquisition of developmental or educational skills.
- The systematic review includes at least one clinical trial (RCTs), quasi-RCT, and/or controlled clinical trial. Systematic reviews that include studies with other designs will be included only if they also feature at least one randomised controlled trial (RCTs), quasi-RCT, and/or controlled clinical trial.
- The systematic review reports summarised, quantitative data on the impact of the intervention on one or more of the main outcomes of interest (described below).
- The systematic review is published in a peer-reviewed journal or published as a publicly available scientific report.
- The systematic review has full-text copies available in the English language.

Exclusion criteria:

- Systematic reviews that do not meet the criteria to be considered “systematic”.
- Umbrella reviews, rapid reviews, or “reviews of reviews”.
- Systematic reviews that did not include at least one RCTs, quasi-RCT, and/or controlled trial.

- Systematic reviews that did not report on at least one non-pharmacological intervention that targets the acquisition of developmental or educational skills.
- Systematic reviews focussing solely on dietary, sleep, exercise, chiropractic, massage, acupuncture, reflexology, kinesiology, shock therapy, neurofeedback, transcranial magnetic stimulation, or hyperbaric oxygen therapy interventions. While non-pharmacological, these interventions are beyond the scope of the review.
- Systematic reviews focusing solely on techniques (defined as one specific strategy) rather than an intervention (i.e., a collection of techniques).
- Systematic reviews that did not report summarised outcomes of interest relevant to the current umbrella review.
- Systematic reviews that incorporate theoretical studies, text, and opinion as their primary source of evidence.
- Theses, conference papers, newsletters.
- Systematic reviews where full-texts are not available in English.

Conditions or domain being studied

Autism.

Participants

Inclusion criteria:

- Systematic reviews that report on interventions that were trialled in children on the autism spectrum (0-12 years of age). Systematic reviews that include children described as increased likelihood or suspected of autism will be included only if the review also included children on the autism spectrum. Systematic reviews that specify in the aims and/or search criteria that studies including children with developmental conditions other than autism (e.g., Down syndrome, global developmental delay) were specifically targeted, will only be included if outcomes were reported separately for children on the autism spectrum. Data will also be extracted from reviews which report on caregiver outcomes as described in the outcomes section.
- Priority for inclusion will be given to systematic reviews that are either limited to, or report outcomes separately for younger children (within the age range of 0-12 years). Where there are no systematic reviews identified for a specific intervention that meets this criterion, we will include systematic reviews that report outcomes for children both within and beyond the 0-12 age range.

Exclusion criteria:

- Systematic reviews that report on interventions with children with other developmental conditions that are not autism, or where outcomes for children on the autism spectrum

specifically cannot be extracted and those that only include children described as increased likelihood or suspected of autism.

- Systematic reviews that do not involve children ≤ 12 years of age and/or include individuals over 18 without a separate analysis of younger children. If a systematic review for a specific intervention is identified that reports outcome separately for children 0-12 years of age, then we will exclude systematic reviews of the same intervention that involved children over 12 years of age without a separate analysis of younger children.

Intervention(s), Exposure(s)

- This umbrella review will focus on non-pharmacological interventions that target the acquisition of developmental or educational skills, such as developmental (e.g., Preschool Autism Communication Therapy), behavioural (e.g., early intensive behavioural intervention), sensory (e.g., sensory integration therapy), technological (e.g., alternative and augmentative technology), naturalistic developmental and behavioural interventions (e.g., Early Start Denver Model), cognitive behaviour therapy, TEACCH, and animal-assisted interventions (Sandbank et al, 2020a). For the purpose of the umbrella review, an *intervention* is defined as a collection of techniques, applied in combination, in an attempt to support the acquisition of developmental or educational skills. *Intervention* details will be extracted, and findings summarised, based on and using the intervention labels used by the systematic review authors, whether it be for a specific practice or a broader category of practices. There will be no limits on intensity, duration, or setting in which the intervention is provided.

Comparator(s)/controls

Systematic reviews reporting on any comparison/control group will be included.

Comparison/control groups could include:

1. Individuals receiving no intervention (e.g., wait-list control) and/or minimal intervention support (e.g., general parent/caregiver education).
2. Individuals who receive treatment-as-usual (including 'eclectic intervention'/treatment) or another intervention approach.
3. In the case of single case experimental designs within/across participants, control is implicit in the designs.

Outcomes:

The following list includes all outcomes of interest; no additional outcomes will be included in the umbrella review. All measurement tools will be included and there will be no minimum follow-up time.

- Core autism characteristics. Specifically, social-communication skills, restricted and repetitive interests and behaviours, sensory behaviours.

- Related skills and behaviours. Specifically, expressive language, receptive language, cognition, motor, social-emotional/challenging behaviour, play skills.
- Adaptive behaviour.
- Education. Specifically, school/learning readiness, academic skills, placement/support.
- Community participation.
- Parent/caregiver experience. Specifically, caregiver communication and interaction strategies, attrition, caregiver social emotional wellbeing, financial support, caregiver satisfaction with intervention.
- Child experience. Specifically, child satisfaction, child related adverse effects, attrition.

Data extraction

The studies retrieved using the search strategy will be screened for eligibility according to the inclusion criteria based on title and abstract. Titles and abstracts will be screened by two reviewers. Full texts will then be retrieved for all potentially eligible studies and reviewed by two reviewers. Screening of titles and abstracts, and full texts will be managed using Covidence software. The reviewers will independently determine inclusion based on the study meeting all inclusion criteria. The two reviewers will discuss and resolve any discrepancies. If an agreement cannot be reached, a third reviewer will be consulted. Inter-rater reliability for study screening will be calculated using Cohen's kappa coefficient.

The review will follow the PRISMA-style flow chart.

Information relating to specific variables for data extraction is included in Appendix C.

For a randomly selected 20% of included systematic reviews, two authors will independently extract the data into a spreadsheet. For the remaining 80%, one reviewer will extract the data and a second reviewer will crosscheck the extraction. Agreement will be determined by reviewing the systematic review and data entered in the spreadsheet on a cell by cell (e.g., participant characteristics, intervention description) basis. The two reviewers will discuss and resolve any discrepancies. If an agreement cannot be reached, a third reviewer will be consulted. Inter-rater reliability for data extraction will be calculated separately for the independently extracted data and the crosschecked data using Cohen's kappa coefficient.

To determine the degree of overlap between systematic reviews, the specific primary publications included in each review will be presented in a table. The "corrected covered area" will be calculated (Pieper et al., 2014) based on the contents of this table. This will be reported across all systematic reviews, and for each specific practice and broader category of intervention.

Types of studies to be included:

Please refer to inclusion/exclusion criteria above.

Risk of bias (quality) assessment

Two reviewers will independently assess each included systematic review using the Critical Appraisal Checklist for Systematic Reviews and Research Syntheses created by the Joanna Briggs Institute (Aromataris et al., 2015). The two reviewers will discuss and resolve any discrepancies. If an agreement cannot be reached, a third reviewer will be consulted. Inter-rater reliability for risk of bias assessment will be calculated using Cohen's kappa coefficient. All reviews will be included regardless of methodological quality.

Strategy for data synthesis

Systematic narrative review (see data extraction) structured around the current umbrella review's main outcomes for all included intervention practices and/or categories of intervention. Systematic reviews will first be collated into a table providing a broad overview of the study details (author, date, range of diagnoses, age range, number of included studies etc.), along with corresponding

quality assessment ratings. Summary tables will then be created that synthesise the extracted data across systematic reviews and will be structured to focus on the key research questions of the umbrella review.

References

Aromataris, E., Fernandez, R., Godfrey, C. M., Holly, C., Khalil, H., & Tungpunkom, P. (2015). Summarizing systematic reviews: methodological development, conduct and reporting of an umbrella review approach. *International Journal of Evidence-based Healthcare*, 13(3), 132-140.

French, L., & Kennedy, E. M. M. (2018). Annual Research Review: Early intervention for infants and young children with, or at-risk of, autism spectrum disorder: a systematic review. *Journal of Child Psychology and Psychiatry*, 59(4), 444-456. doi:10.1111/jcpp.12828

Pieper, D., Antoine, S. L., Mathes, T., Neugebauer, E. A., & Eikermann, M. (2014). Systematic review finds overlapping reviews were not mentioned in every other overview. *Journal of Clinical Epidemiology*, 67(4), 368-375.

Sandbank, M., Bottema-Beutel, K., Crowley, S., Cassidy, M., Dunham, K., Feldman, J. I., Crank, J., Albarran, S. A., Raj, S., Mahbub, P., & Woynaroski, T. G. (2020). Project AIM: Autism intervention meta-analysis for studies of young children. *Psychol Bull*, 146(1), 1–29. doi.org/10.1037/bul0000215

S2: Variations to protocol

Protocol submitted of Open Science Framework	Variation to protocol	Rationale
Eligibility criteria Not included	Eligibility criteria SRs excluded if: "The SR was limited by geographical region, that is, the search and/or inclusion/exclusion criteria were limited to specific countries, continents, or other geographical areas."	The reviewers determined that it was not appropriate to include SRs limited by geographical region, as it was not possible to draw generalised conclusions about intervention effects.
Outcomes Outcomes were categorised as follows: <ul style="list-style-type: none"> Core autism characteristics. Specifically, social-communication skills, restricted and repetitive interests and behaviours, sensory behaviours. Related skills and behaviours. Specifically, expressive language, receptive language, cognition, motor, social-emotional/challenging behaviour, play skills. Adaptive behaviour. Education. Specifically, school/learning readiness, academic skills, placement/support. Community participation. 	Outcomes Outcomes were categorised as follows: <ul style="list-style-type: none"> Core autism characteristics. Specifically, <u>overall autism characteristics</u>, social-communication, restricted and repetitive interests and behaviours, and sensory behaviours. Related skills and development. Specifically, <u>communication</u>, expressive language, receptive language, cognition, motor, social-emotional and challenging behaviour, <u>play adaptive behaviour</u>, and <u>general outcomes</u>. Education and participation. Specifically, school/ learning readiness, academic skills, <u>child quality of life</u> and community participation <u>Family wellbeing</u>: Specifically, caregiver communication and interaction strategies, caregiver social emotional wellbeing, caregiver satisfaction, <u>caregiver financial wellbeing</u>, and child satisfaction with intervention. 	Outcomes were added, renamed, or re-categorised to align with common terminology or categorical groupings within the extant literature. All outcomes in the original protocol remained in the revised protocol.

<ul style="list-style-type: none"> • Parent/caregiver experience. Specifically, caregiver communication and interaction strategies, attrition, caregiver social emotional wellbeing, <u>financial support</u>, caregiver satisfaction with intervention. • Child experience. Specifically, child satisfaction, child related adverse effects, <u>attrition</u>. 	<ul style="list-style-type: none"> • Adverse effects. 	
Study Selection Not included	Study selection “Immediately after independent title and abstract screening, a document was created in which the reviewers could list interventions requiring a determination of eligibility, including a verbatim description of the intervention from the relevant SR. Four team members (DT, KV, HW, AW) independently determined whether the specific intervention should be included in the umbrella review based on the eligibility criteria. The four team members then met to discuss each question of eligibility and resolved these via consensus.”	“Given the vast number of different intervention techniques and practices reported in the literature, it became apparent that a systematic process was required to determine eligibility for inclusion in cases where it was not clear to the reviewers if the intervention falls within the scope of the categories outlined by Sandbank et al. (2020a).”
Study selection Not included	Study selection “All reviewers (AW, DT, HW, KV) were independently responsible for identifying if a SR should be considered for exclusion on this basis and, if so, to present a rationale to the group. A second reviewer (of the four) then assessed the SR and recommendation, and either endorsed or refuted it. If both reviewers agreed, the SR was excluded from the review. Additional reasons for exclusion at this stage included: (a) the SR had been superseded by an updated version of the same review; (b) The same review had been published in multiple forms (e.g., a report and a scholarly	“At the time of data extraction, it became apparent that additional SRs needed to be excluded to ensure that the umbrella review only contained articles that were not updated versions of earlier SRs and presented findings in a way that was relevant to addressing at least one umbrella review question.”

	<p>article); (c) the authors had categorised interventions in a different way to the current umbrella review, and consequently, it was not possible to map the intervention effects reported within the SR to the categories used in the current review; (d) the review examined the combined intervention effect of a range of intervention practices/categories (meaning it was not possible to attribute intervention effects to the specific intervention categories/practices defined for the current review) and did not provide any information about potential child or intervention characteristics that may influence the intervention effect; and/or (d) closer reading of the SR revealed it indeed violated one or more of the eligibility criteria."</p>	
<p>Corrected covered area</p> <p>"The "corrected covered area" will be calculated (Pieper et al., 2014) based on the contents of this table. This will be reported across all systematic reviews, and <u>for each specific practice and broader category of intervention.</u>"</p>	<p>Corrected covered area</p> <p>CCA was only reported across all SRs and was not reported for each specific practice and broader category.</p>	<p>Many practices were only covered by a single SR, meaning that calculations of CCA at this level were not possible.</p>
<p>Coding of intervention effects</p> <p>Not included</p>	<p>Coding of intervention effects</p> <p>"Data extraction of intervention effects focused on recording one pooled (meta-analysis) or summary (for narrative review) effect for each outcome reported in each SR. On occasions where meta-analyses reported more than one pooled effect for a specific outcome (e.g., main analyses and sensitivity analyses), we extracted the effect that was presented by the SR authors as the main analysis. For meta-analyses, findings were recorded as either a positive pooled effect (90/95% confidence intervals of the pooled effect did not overlap with the null), a negative pooled</p>	<p>It was necessary to categorise intervention effects as there was significant variation in the way in which effects were reported across SRs.</p>

	<p>effect (90/95% confidence intervals of the pooled effect did not overlap with the null), or a null effect (90/95% confidence intervals of the pooled effect overlapped with the null). Where a SR did not include a meta-analysis, the recording of an intervention effect focused on the summary provided by the SR authors in the Results section. Findings were recorded as either a summarised positive effect (60% or more of studies summarised reported a positive intervention effect), a negative summarized effect (60% or more of studies summarised reported a negative intervention effect), a null effect (60% or more of studies summarised reported a null intervention effect) or a summarized inconsistent effect (no direction of intervention effect meeting a 60% threshold)."</p>	
<p>Reliability of extraction</p> <p>Not included</p>	<p>"Each stage of extraction began with consensus coding to help ensure the accurate and consistent use of procedures. For this, those responsible for extracting data (stage 1: AW, DT, HW, KV; stage 2: AW, DT) independently extracted data for a set of SRs (6 for SR level extraction, 2 for practice/category level extraction) and then met to discuss any discrepancies and, if necessary, further clarify aspects of the data extraction sheet."</p>	<p>This was conducted to increase consistency of coding and interpretation of the codebook.</p>
<p>Reliability of extraction</p> <p>"Inter-rater reliability for data extraction will be calculated separately for the independently extracted data and the crosschecked data using Cohen's kappa coefficient."</p>	<p>Reliability of extraction</p> <p>Percentage of agreement between reviewers was calculated instead of Cohen's kappa for both independently extracted data and the crosschecked data.</p>	<p>All four reviewers (AW, DT, HW, KV) participated in data extraction in order to meet the current project's required timeline (as opposed to just to two reviewers). Due to the multiple combinations of reviewer agreement, percentage of agreement was considered a more applicable measure of reliability.</p>

<p>Study quality assessment</p> <p>"Two reviewers will independently assess each included systematic review using the Critical Appraisal Checklist for Systematic Reviews and Research Syntheses created by the Joanna Briggs Institute (Aromataris et al., 2015)."</p>	<p>Study quality assessment</p> <p>"Risk of Bias was assessed using a quality assessment form based on the Critical Appraisal Checklist for SRs and Research Syntheses created by the Joanna Briggs institute (2020). The form, <u>modified in consultation with JBI staff</u>, comprised 11 items..."</p>	<p>The checklist was modified to suit the specific purposes of this umbrella review.</p>
<p>Reliability of study quality assessment</p> <p>"Inter-rater reliability for risk of bias assessment will be calculated using Cohen's kappa coefficient."</p>	<p>Percentage of agreement between reviewers was calculated instead of Cohen's kappa for both independently extracted data and the crosschecked data.</p>	<p>Four reviewers (AW, DT, HW, KV) participated in the assessment of study quality/risk of bias (as opposed to just two reviewers) in order to meet the current project's required timeline. Due to the multiple combinations of reviewer agreement, percentage of agreement was considered a more applicable measure of reliability.</p>

Note: Underlined phrases indicate aspects which were added, altered or removed after submission to Open Science Framework.

S3: Grey literature search strategy

Google search

Using Advanced Search on Chrome platform:

(Autism OR ASD OR Asperger OR Aspergers OR “pervasive developmental disorder” OR PDD OR “pervasive child development disorder” OR “pervasive childhood developmental disorder” OR PCDD OR “disintegrative disorder”) AND (intervention OR interventions OR therapy OR therapies OR treatment OR treatments OR teach OR program OR programs OR package OR packages) AND (“systematic review” OR “systematic reviews” OR “systematic literature review” OR “systematic literature reviews” OR “evidence synthesis” OR “evidence syntheses” OR meta-analysis OR meta-analyses OR meta-regression OR meta-regressions)

Limited to:

- English language
- First 100 results

For google search results, the person conducting the search will review the first 100 search results. Within each page, the website search function will be initially used to identify (a) a relevant document or (b) a citation for a relevant document. If there is no search function, the person completing the search will click a maximum of five times within any one webpage to identify a (a) a relevant document or (b) a citation for a relevant document.

The person responsible for searching these sources will exercise judgement in selecting search results (web pages) to investigate, as well as subsequent pages for review within a website based on the umbrella review eligibility criteria. In each case, the URL of the primary webpage selected for review will be recorded.

The grey literature search will be conducted in duplicate, by two reviewers in real time by screen sharing.

Prospero search

We will search trial Prospero for any potentially relevant completed reviews

<https://www.crd.york.ac.uk/PROSPERO/>.

We will search Prospero using the following MeSH terms and keywords, combined with “OR”:

MeSH DESCRIPTOR Child Development Disorders, Pervasive EXPLODE ALL TREES

Autis* OR ASD* OR Asperger* OR “pervasive developmental disorder*” OR PDD* OR

“pervasive child development disorder*” OR “pervasive childhood developmental disorder*” OR

PCDD* OR “disintegrative disorder*”

Of the search results, protocols marked as ‘Review completed, published’ or ‘Review completed, not published’ will be screened for potential eligibility. Those that pass screening will be followed up to identify a full-text by first reviewing the protocol entry for a reference to the published paper.

Where the reference is not available, a search will be conducted using Advanced Search on the Chrome platform using the following search terms:

[First author’s name] AND "systematic review" OR "meta-analysis" OR "evidence summary" OR "autism" OR "ASD" OR "autistic" OR "pervasive developmental disorders" OR PDD OR intervention OR therapy OR treatment

Where the Advanced Google search does not return any full-text articles, we will then search Google using the exact title from PROSPERO for that particular protocol.

The Google Chrome search will be limited to:

- English language

- First 10 results

Within each page, the website search function will be initially used to identify (a) a relevant document or (b) a citation for a relevant document. If there is no search function, the person completing the search will click a maximum of five times within any one webpage to identify a (a) a relevant document or (b) a citation for a relevant document.

The person responsible for searching these sources will exercise judgement in selecting search results (web pages) to investigate, as well as subsequent pages for review within a website based on the umbrella review eligibility criteria. In each case, the URL of the primary webpage selected for review will be recorded.

In the event that the Google searches (of author's surname and keywords and the exact title search) do not return any full-text results, we will then conduct an author search in Scopus (based on the protocol lead author) for publications for the year of protocol registration up to 2020.

The grey literature search will be conducted in duplicate, by two reviewers.

INSAR Abstract search

Abstracts for presentations at meetings of the International Society for Autism Research (2015-2020) will be searched via online programs available at: <https://www.autism-insar.org/page/MeetingArchives?&hhsearchterms=%22abstracts%22>

The search was limited to the years 2015-2020 to identify only more recent bodies of work that are less likely to be detected in the database searches.

The search terms ("systematic review" OR "meta-analysis" OR "systematic reviews" OR "meta-analyses") will be entered into the search function for each program.

Abstracts will be screened for potential eligibility independently by two reviewers. Any discrepancies will be resolved through discussion. Those that pass the title and abstract screening phase will be followed up to identify a full-text by first cross-checking against the results of the database searches. Where a full-text article is not identified in the database searches, we will complete a Google search using Advanced Search on the Chrome platform using the following search terms:

[First author's surname] AND "systematic review" OR "meta-analysis" OR "evidence summary" OR autism OR ASD OR autistic OR "pervasive developmental disorders" OR PDD OR intervention OR therapy OR treatment

Where the Advanced Google search does not return any full-text articles, we will then search Google using the exact title from the INSAR Program Booklet for a particular abstract.

The Google searches will be limited to:

- English language
- First 10 results

Within each page, the website search function will be initially used to identify (a) a relevant document or (b) a citation for a relevant document. If there is no search function, the person completing the search will click a maximum of five times within any one webpage to identify a (a) a relevant document or (b) a citation for a relevant document.

The person responsible for searching these sources will exercise judgement in selecting search results (web pages) to investigate, as well as subsequent pages for review within a website based on the umbrella review eligibility criteria. In each case, the URL of the primary webpage selected for review will be recorded.

In the event that Google searches (of author's surname and keywords and the exact title search) do not return any full-text results, we will then conduct an author search in Scopus (based on the abstract lead author) for publications for the conference year up to 2020.

S4: Consensus on intervention eligibility

Intervention	Explicitly listed for exclusion	Not an intervention i.e. assessment	Not an intervention i.e. technique	Does not meet eligibility criteria	Include
Acupuncture	✓				
Animal-assisted Therapy					✓
Antecedent-Based Interventions (ABI)			✓		
Art therapy				✓	
Auditory Integration Training					✓
Augmentative and Alternative Communication (AAC)					✓
Behavioral intervention					✓
Behavioral Momentum Intervention (BMI)			✓		
Chelation	✓				
Child-centred play therapy					✓
Chiropractic	✓				
Client Feedback			✓		
Cognitive bias modification				✓	

Cognitive Behavioral/ Instructional Strategies (CBIS)					✓
Comprehensive Behavioral Treatment for Young Children					✓
Computer-based intervention					✓
Concept Mapping			✓		
Creative arts programs				✓	
Dance	✓				
Developmental Relationship-based Treatment					✓
Differential Reinforcement of Alternative, Incompatible, or Other Behavior (DR)			✓		
DIR/Floor Time					✓
Direct Instruction (DI)			✓		
Discrete Trial Training (DTT)					✓
Emotion Recognition Training				✓	
Exercise and Movement (EX)	✓				
Exposure Package					✓
Extinction (EXT)			✓		

Facilitated Communication-					✓
Feeding				✓	
Fluency intervention					✓
Functional Communication Training (FCT)					✓
Functional Behavioral Assessment (FBA)		✓			
Gamification/Serious games					✓
Gluten-free/Casein-free diet	✓				
Holding therapy					✓
Hydrotherapy	✓				
Hyperbaric oxygen therapy interventions	✓				
Imitation-based Intervention					✓
Inclusion of circumscribed/special interests			✓		
Initiation Training					✓
Intensive Interaction					✓
Joint control training/ Joint stimulus control			✓		
Kinesiology	✓				

Language Training (Production & Understanding)					✓
Language Training (Production)					✓
Martial arts	✓				
Massage Therapy	✓				
Matrix training			✓		
Mind-body therapies (yoga, meditation, Nei Yang Gong, acceptance and commitment therapy)	✓				
Mindfulness					✓
Modelling			✓		
Motivating Operations			✓		
Multi-component Package					✓
Music-Mediated Intervention (MMI)					✓
Naturalistic Intervention (NI)					✓
Neurofeedback	✓				
Oral health				✓	
Parent Child Interaction Therapy					✓
Parent verbal responsiveness			✓		

Parent-Implemented Intervention (PII)					✓
Peer-Based Instruction and Intervention (PBII)					✓
Picture Exchange Communication System					✓
Pivotal Response Treatment®					✓
Precision teaching					✓
Prompting (PP)			✓		
Psychodynamic psychotherapy				✓	
Psychomotor therapy					✓
Punishment			✓		
Rapid Prompting Method (RPM)					✓
Reductive Package					✓
Reflexology	✓				
Reinforcement (R)			✓		
Response Interruption/Redirection (RIR)			✓		
Role play			✓		
Schedules			✓		

Scripting			✓		
Self-controlled technology					✓
Self-Management (SM)			✓		
SENSE Theatre Intervention				✓	
Sensory Integration® (SI)					✓
Shared reading					✓
Shock Therapy	✓				
Sign Instruction					✓
Social Behavioral Learning Strategy					✓
Social Cognition Intervention					✓
Social communication intervention					✓
Social Narratives (SN)			✓		
Social Robots					✓
Social Skills Training (SST)					✓
Social Thinking Intervention-					✓
Speaker/Listener instruction					✓
Structured teaching					✓

Systemic therapy					✓
Task Analysis (TA)			✓		
Task interspersal			✓		
Technology-Aided Instruction and Intervention (TAII)					✓
The listening programme					✓
Theory of Mind Training-					✓
Therapeutic surfing	✓				
Time Delay (TD)			✓		
Toileting				✓	
Transcranial magnetic stimulation	✓				
Video Modeling (VM)			✓		
Video-based instruction			✓		
Virtual/augmented/mixed reality					✓
Visual Supports (VS)			✓		
Water Safety				✓	
Weighted vests					✓

S5: Codebook for data extraction

The following variables were extracted from the systematic reviews where available and without further analysis within the systematic review or review of the original study sources. This approach ensured consistency, reliability, and replicability within the data extraction process. Simple addition, subtraction, multiplication, and division was used to synthesise information during extraction (e.g., sum of individual study samples).

Data entry

Survey Question	Variable	Label	Fields/options	Explanation/Rules
Data extracted by	Ext_Name	Extracted by	String	
Date data extracted	Ext_Date	Date extracted	Number	

Variables extracted for the systematic review

Survey Question	Variable	Label	Fields/options	Explanation/Rules
1. Title	SR_Title	Title	String	Copied verbatim from SR.
2. Author(s)	SR_Authors	Authors	String	First name/initial, last name for all authors.
3. Year of publication	SR_Year_Published	Year	Number	Copied verbatim from SR.
4. Type of review	SR_Type_Review	Type of review	1 = Narrative synthesis only 2 = Meta-analysis with narrative synthesis	To be completed based on author description within the SR.
5. Objectives/aims of the review	SR_Aim	Aims/objectives	String, 777 = Not specified	Copied verbatim from abstract only. If not in abstract, then first place in

				article mentioning aim/purpose/objective.
6. Databases searched	SR_Search_Database	Databases searched	String	Copied verbatim from search strategy.
7. Range (years) of search	SR_Search_Year_Start	Search start year	Number Inception – authors explicitly state that there was no limit on search year, 777 = Not specified	Copied verbatim from search strategy.
	SR_Search_Year_End	Search end year	Number 777 = Not specified	
8. Number of included studies	SR_Number_Studies	Number of included studies	Number	Copied from text in abstract/method. This should reflect the number of studies included for analysis rather than the number of studies initially included, if these numbers differ.
9. Type(s) of eligible studies	SR_Eligible_RCT	RCT eligible	1 = Yes, 0 = No, 777 = Not specified	To be completed based on SR inclusion/exclusion criteria. Mark yes if this type of design is mentioned on at least one occasion. If 'yes' for 'Other study types included', list.
	SR_Eligible_NR_cont	Non-randomised with control eligible	1 = Yes, 0 = No, 777 = Not specified	
	SR_Eligible_NR_No_cont	Non-randomised without control eligible	1 = Yes, 0 = No, 777 = Not specified	
	SR_Eligible_SCED	Single case experimental designs eligible	1 = Yes, 0 = No, 777 = Not specified	

	SR_Eligible_Other	Other study types eligible	1 = Yes, 0 = No, 777 = Not specified	
	SR_Eligible_Other_Desc	Other study types eligible description	String, N/A 777 = Not specified	
	SR_Eligible_Spec	Eligible studies specified	1 = Yes, 0 = No,	
10. Type(s) of included studies	SR_Inc_RCT	Included RCT	1 = Yes, 0 = No, 777 = Not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Method • Results (including tables) • Supplementary information <p>Mark yes if this type of design is mentioned on at least one occasion. If 'yes' for 'Other study types included', list.</p> <p>When information can be gained from summary and table will prioritise extraction from the summary.</p>
	SR_Inc_NR_cont	Included non-randomised with control	1 = Yes, 0 = No, 777 = Not specified	
	SR_Inc_NR_No_cont	Included non-randomised without control	1 = Yes, 0 = No, 777 = Not specified	
	SR_Inc_SCED	Included single case experimental designs	1 = Yes, 0 = No, 777 = Not specified	
	SR_Inc_Other	Other study types included	1 = Yes, 0 = No, 777 = Not specified	
	SR_Inc_Other_Desc	Other study types included description	String, 777 = Not specified	
	SR_Inc_NS	Included studies specified	1 = Yes, 0 = No,	

11. Type(s) of comparison groups	SR_Comp_WLC	Included Comparison Wait list control	1 = Yes, 0 = No 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Method (including eligibility criteria) • Results (including tables) • Supplementary information Mark yes if this type of control group is mentioned on at least one occasion. If 'yes' for 'SR Comparison Other', list.
	SR_Comp_TAU	Comparison Treatment-as-usual	1 = Yes, 0 = No, 777 = Not specified	
	SR_Comp_Interv	Comparison Another intervention (includes minimal support and eclectic)	1 = Yes, 0 = No, 777 = Not specified	
	SR_Comp_SCED	Comparison The individual's own baseline (single case experimental designs)	1 = Yes, 0 = No, 777 = Not specified	
	SR_Comp_Other	Comparison Other	1 = Yes, 0 = No, 777 = Not specified	
	SR_Comp_Other_Desc	Comparison Other description	String	
	SR_Comp_None	Comparison No comparison group	1 = Yes, 0 = No, 777 = Not specified	
	SR_Comp_Spec	Comparison specified	1 = Yes, 0 = No	
12. Country of origin of included studies (which continents are represented)	SR_Cont_Africa	Included Africa	1 = Yes, 0 = No, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Method (including eligibility criteria) • Results (including tables) • Supplementary information
	SR_Cont_Asia	Included Asia	1 = Yes, 0 = No, 777 = Not specified	
	SR_Cont_Australia	Included Australia	1 = Yes, 0 = No, 777 = Not specified	

	SR_Cont_Pacific	Included Pacific	1 = Yes, 0 = No, 777 = Not specified	Mark yes if at least one study was identified as being conducted in a country in this continent.
	SR_Cont_Europe	Included Europe	1 = Yes, 0 = No, 777 = Not specified	
	SR_Cont_S_Amer	Included South America/Caribbean	1 = Yes, 0 = No, 777 = Not specified	
	SR_Cont_N_Amer	Included North America	1 = Yes, 0 = No, 777 = Not specified	
	SR_Cont_Spec	Continent specified	1 = Yes, 0 = No	
13. Eligible autism diagnosis/es	SR_Eligible_Diag_Autism	Diagnosed with autism eligible	1 = Yes, 0 = No, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Method (including eligibility criteria) • Results (including tables) • Supplementary information Mark yes if at least one study was identified as including participants meeting the criteria.
	SR_Eligible_Diag_Susp_Autism	Increased likelihood/suspected autism eligible	1 = Yes, 0 = No, 777 = Not specified	
	SR_Eligible_Diag_Spec	Eligible diagnosis specified	1 = Yes, 0 = No	
14. Types of eligible autism diagnosis/es	SR_Eligible_Diag_Type	Eligible autism diagnoses	String, 777 = Not specified	To be completed based on SR:

				<ul style="list-style-type: none"> Method (including eligibility criteria) Supplementary information
15. Eligible autism diagnosis system(s)	SR_Eligible_Diag_System	Eligible autism diagnostic system (e.g. ICD, DSM)	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> Method (including eligibility criteria) Supplementary information
16. Included autism diagnosis/es	SR_Inc_Diag_Autism	Included children diagnosed with autism	1 = Yes, 0 = No, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> Results (including tables) Supplementary information Mark yes if at least one study was identified as including participants meeting the criteria.
	SR_Inc_Diag_Susp_Autism	Included children with increased likelihood of/suspected autism	1 = Yes, 0 = No, 777 = Not specified	
	SR_Inc_Diag_Spec	Diagnosis of included children specified	1 = Yes, 0 = No	
17. Types of included autism diagnosis/es	SR_Inc_Diag_Type	Autism diagnoses of included children	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> Results (including tables) Supplementary information

18. Description of other population groups/diagnoses	SR_Inc_Pop_Oth	Other included population groups	String, 777 = Not specified	To be copied verbatim from: <ul style="list-style-type: none"> Title/abstract Method (inclusion)
	SR_Total_Part	Participants (total sample)	Number, 777 = Not specified	To be completed based on information provided by SR authors in: <ul style="list-style-type: none"> Abstract Results (including tables) Supplementary information Must be reported by study authors. No calculations to occur. If total included in studies, and total included in analyses are both reported, we will select the number included in analysis. Where a study provides a number for pre-test and for analysis, use the pre-test number of participants.
	SR_Total_Part_Int	Participants (total intervention)	Number, 777 = Not specified	
	SR_Total_Part_Cont	Participants (total control)	Number, 777 = Not specified)	
	SR_Total_Part_ASD	Participants (total ASD)	Number, 777 = Not specified	
	SR_Total_Part_Other	Participants (total other populations)	Number (across groups), 777 = Not specified	
20. Participant age range across studies (search)	SR_Age_Min_Search	Minimum search age	Number, 777 = Not specified	To be completed based on search/eligibility criteria
	SR_Age_Min_Search_Unit	Unit for minimum search age	1 = Years; 2 = Months, 777 = Not specified	

	SR_Age_Max_Search	Maximum search age	Number, 777 = Not specified	If reported in years, months in SR, select 'Years' as unit and transfer to extraction form as X(years);Y(months) e.g., 4;2.
	SR_Age_Max_Search_Unit	Unit for maximum search age	1 = Years; 2 = Months, 777 = Not specified	
21. Participant age range across studies (Actual)	SR_Age_Min_Unit	Unit for minimum actual age	1 = Years; 2 = Months, 777 = Not specified	To be completed based on information provided by SR authors in: <ul style="list-style-type: none"> • Abstract • Results (including tables) • Supplementary information
	SR_Age_Max_Unit	Unit for maximum actual age	1 = Years; 2 = Months, 777 = Not specified	
	SR_Age_Min_Actual	Minimum age (total sample)	Number, 777 = Not specified	
	SR_Age_Max_Actual	Maximum age (total sample)	Number, 777 = Not specified	
22. Participant mean age across studies	SR_Age_Mean_Unit	Unit for mean age	1 = Years; 2 = Months, 777 = Not specified	Must be reported by study authors. No calculations during extraction to occur.
	SR_Age_Mean_Int	Mean age intervention ([mean age] (of studies reporting age)	String, 777 = Not specified	
	SR_Age_Mean_Cont	Mean age intervention ([mean age] (of studies reporting age)	String, 777 = Not specified	

	SR_Age_Mean_Comb	Mean age intervention ([mean age] (of studies reporting age))	String, 777 = Not specified	
23. Participant sex across studies	SR_Male_Total	The number of males in the total sample ([number of males] out of total number of participants for which gender is known)	String, 777 = Not specified	<p>To be completed based on information provided by SR authors in:</p> <ul style="list-style-type: none"> • Abstract • Results (including tables) • Supplementary information. <p>Total males and females can be summed from the tables. Do not do any calculations for the number of males or females in intervention or control groups.</p>
	SR_Female_Total	The number of females in the total sample ([number of females] out of total number of participants for which gender is known)	String, 777 = Not specified	
	SR_Male_Int	The number of males receiving intervention	Number, 777 = Not specified	
	SR_Female_Int	The number of females receiving intervention	Number, 777 = Not specified	
	SR_Male_Cont	The number of males in the control groups	Number, 777 = Not specified	
	SR_Female_Cont	The number of females in the control groups	Number, 777 = Not specified	
24. Comorbidities in SR	SR_Comor_ADHD	ADHD included in SR	1 = Yes, 0 = No 777 = Not specified	Included comorbidities extracted from the results section, excluded

	SR_Comor_Sleep	Sleep included in SR	1 = Yes, 0 = No 777 = Not specified	comorbidities extracted from the inclusion/exclusion criteria or when explicitly stated in the results section (e.g. "there were no participants with ADHD").
	SR_Comor_Anxiety	Anxiety included in SR	1 = Yes, 0 = No 777 = Not specified	
	SR_Comor_Depress	Depression included in SR	1 = Yes, 0 = No 777 = Not specified	
	SR_Comor_Lang	Language delay included in SR	1 = Yes, 0 = No 777 = Not specified	
	SR_Comor_MinV	Minimally verbal (descriptive term, used with language delay) included in SR	1 = Yes, 0 = No 777 = Not specified	
	SR_Comor_Cog	Cognitive impairment (including ID, IQ <70) included in SR	1 = Yes, 0 = No 777 = Not specified	
	SR_Comor_GDD	Global developmental delay included in SR	1 = Yes, 0 = No 777 = Not specified	
	SR_Comor_Genetic	Genetic syndrome (e.g. Down Syndrome, Fragile X) included in SR	1 = Yes, 0 = No 777 = Not specified	
	SR_Comor_CBeh	Challenging behaviour included in SR	1 = Yes, 0 = No 777 = Not specified	

	SR_Comor_Physical	Physical disability included in SR	1 = Yes, 0 = No 777 = Not specified	
	SR_Comor_Other	Other comorbidity included in SR	1 = Yes, 0 = No 777 = Not specified	
	SR_Comor_Spec	Comorbidity Specified	1 = Yes, 0 = No	
25. Included categories and practices	SR_Cat_Prac	Included categories and practices	String, 777 = Not specified	<p>To be completed based on information provided by SR authors in:</p> <ul style="list-style-type: none"> • Abstract • Results (including tables) • Supplementary information <p>Name(s) used by SR authors to be copied verbatim.</p>
26. Appraisal instrument	SR_App_Inst	Appraisal instrument used	String, 777 = Not specified	<p>To be completed based on information provided by SR authors in:</p> <ul style="list-style-type: none"> • Abstract • Method • Results • Supplementary information
27. Appraisal ratings	SR_App_Rating	Appraisal ratings	1 = Included low quality/high risk of bias and above	<p>To be completed based on information provided by SR authors in:</p> <ul style="list-style-type: none"> • Abstract

			<p>2 = Included moderate quality/moderate risk of bias and above</p> <p>3 = Included only high quality/low risk of bias</p> <p>777 = Not specified</p>	<ul style="list-style-type: none"> • Method • Results (including tables) • Discussion • Supplementary information <p>Refers to overall quality and risk of bias in included studies.</p>
28. Heterogeneity	SR_Hetero_Clinical	Clinical heterogeneity	<p>1 = Low (age range ≤ 6 years and no comorbidities)</p> <p>2 = Moderate (age range > 6 years OR no comorbidities are identified)</p> <p>3 = High (age range > 6 years AND comorbidities are identified)</p> <p>4 = Insufficient information</p>	<p>To be completed based on information provided by SR authors in:</p> <ul style="list-style-type: none"> • Abstract • Method • Results (including tables) • Discussion • Supplementary information <p>AND after other data has been extracted.</p> <p>Clinical heterogeneity: refers to variability in participants/study populations, interventions, and outcomes. Level to be determined by a combination of participant ages and presence of comorbidities. Assign according to the following:</p>
	SR_Hetero_Method	Methodological heterogeneity	<p>1 = Low (SR included only ONE of the following eligible designs: RCT, Quasi-RCT, or controlled trial)</p>	

			<p>2 = Moderate (SR included TWO or THREE of the following eligible designs: RCT, Quasi-RCT, or controlled trial)</p> <p>3 = High (SR included at least one of the following eligible designs: RCT, Quasi-RCT, or controlled trial AND one or more other study designs)</p> <p>4 = Insufficient information</p>	<ul style="list-style-type: none"> • Low: Age range if less than 6 years and no-comorbidities are specifically identified • Mod: Age range if greater than 6 years OR no-comorbidities are specifically identified • High: Age range is greater than 6 years AND co-morbidities are identified <p>Methodological heterogeneity: refers to variability in study designs, outcome measurements, study quality/risk of bias. Assign according to the following:</p> <ul style="list-style-type: none"> • Low: SR included only ONE of the following eligible designs (RCT, Quasi-RCT, or controlled trial) • Mod: SR included TWO or THREE of the following eligible designs (RCT, Quasi-RCT, or controlled trial) • High: SR included at least one of the following eligible designs (RCT, Quasi-RCT, or controlled trial) AND one or more other study designs
--	--	--	---	--

29. Sources of funding	SR_Funding	Sources of funding	String, 777 = Not specified	To be copied verbatim from SR.
30. Conflict of interest	SR_Conflict	Conflict(s) of interest reported by the author(s)	1 = yes, 0 = No/None 777 = Not specified	To be completed based on information provided by SR authors in: <ul style="list-style-type: none"> Conflict of interest statement
31. PC level extraction	SR_Relevant_Table	Table for extraction	1 = P/C table 2= Outcome table 3= Format/agent/setting table	Practices/categories must be analysed separately within the review, must meet intervention inclusion criteria and contain: <ul style="list-style-type: none"> A relevant design (group with control) – see decision tree Relevant age (no individuals over 18) Only children with autism diagnoses A relevant outcome

Variables extracted separately for each category/practice, or “non specific”/generic category

Survey Question	Variable	Label	Fields/options	Explanation/Rules
1. Author(s)	PC_Authors	Authors	String	Copied verbatim from SR
2. Year of publication	PC_Year_Published	Year	Number	Copied verbatim from SR

3. Name of category	PC_Cat_Name	Name of category (NDBI, Behavioural, Developmental, Sensory, Technology, CBT, Animal-assisted, Other)	String, 777 = Not specified	To be completed based on information provided by SR authors in: <ul style="list-style-type: none"> • Abstract • Method • Results (including tables)
4. Name of practice	PC_Prac_Name	Name of practice	String, 777= Not specified	To be completed based on information provided by SR authors in: <ul style="list-style-type: none"> • Abstract • Method
5. Intervention characteristic	PC_Int_Char	Name of intervention characteristic (e.g., Setting, Delivery Mode, Agent)	String, 777 = Not specified	To be completed based on the information provided by SR authors in: <ul style="list-style-type: none"> • Abstract • Introduction • Method
6. Intervention characteristic detail	PC_Int_Char_Det	Detail of the intervention characteristic	String, 777 = Not specified	To be completed based on the information provided by SR authors in: <ul style="list-style-type: none"> • Abstract • Introduction • Method

7. Number of participants in the practice/category intervention and control group	PC_Total_Part	Total number of participants (specific P/C only)	Number, 777 = Not specified	<p>Only to be completed if there are participant number details provided separately for different categories or practices. To be completed based on information provided by SR authors in:</p> <ul style="list-style-type: none"> • Abstract • Method • Results (including tables) • Supplementary information <p>Must be reported by study authors. No calculations to occur.</p>
	PC_Interv_Part	Number of participants in intervention group (specific P/C only)	Number, 777 = Not specified	
	PC_Control_Part	Number of participants in control group (specific P/C only)	Number, 777 = Not specified	
8. Participant age range across studies for those in the practice/category intervention and control group	PC_Age_Min_Total	Minimum age for total sample (specific P/C only)	Number, 777 = Not specified	<p>Only to be completed if there are participant number details provided separately for different categories or practices. To be completed based on information provided by SR authors in:</p> <ul style="list-style-type: none"> • Abstract • Method
	PC_Age_Min_Interv	Minimum age for intervention group (specific P/C only)	Number, 777 = Not specified	
	PC_Age_Min_Control	Minimum age for control group (specific P/C only)	Number, 777 = Not specified	

	PC_Age_Max_Total	Maximum age for total sample (specific P/C only)	Number, 777 = Not specified	<ul style="list-style-type: none"> Results (including tables) Supplementary information
	PC_Age_Max_Interv	Maximum age for intervention group (specific P/C only)	Number, 777 = Not specified	
	PC_Age_Max_Control	Maximum age for control group (specific P/C only)	Number, 777 = Not specified	
9. Participant mean age for those in the practice/ category intervention and control group	PC_Age_Mean_Total	Mean age for total sample (specific P/C only)	Number, 777 = Not specified	<p>Only to be completed if there are participant number details provided separately for different categories or practices. To be completed based on information provided by SR authors in:</p> <ul style="list-style-type: none"> Abstract Method Results (including tables) Supplementary information <p>Must be reported by study authors. No calculations during extraction to occur.</p>
	PC_Age_Mean_Interv	Mean age for intervention group (specific P/C only)	Number, 777 = Not specified	
	PC_Age_Mean_Control	Mean age for control group (specific P/C only)	Number, 777 = Not specified	
10. Setting/ Context	PC_Setting_Clinic	Included studies conducted in clinics	1 = Yes, 0 = No, 777 = Not specified	To be completed based on SR:

	PC_Setting_Home	Included studies conducted at home	1 = Yes, 0 = No, 777 = Not specified	<ul style="list-style-type: none"> Method (including eligibility criteria) Results (including tables) Supplementary information <p>Mark "yes" if this type of setting is mentioned on at least one occasion.</p>
	PC_Setting_Edu	Included studies conducted in educational settings (schools, early childhood)	1 = Yes, 0 = No, 777 = Not specified	
	PC_Setting_Other	Included studies conducted in other settings	1 = Yes, 0 = No, 777 = Not specified	
	PC_Setting_Other_Desc	Type of other setting(s)	String, N/A	
	PC_Setting_Spec	Setting specified	Yes = 1, 0 = No This is a summary variable based on whether a 1 is present in any of the preceding columns (0 or 777 = 0, 1 = 1)	
11. Delivery format	PC_Format_Indiv	Included therapy delivered to individuals	1 = Yes, 0 = No, 777 = Not specified This is assumed to be 1, unless clearly stated that it was not delivered to individuals (e.g., group only). Therefore, 777 and 1	To be completed based on SR: <ul style="list-style-type: none"> Method (including eligibility criteria) Results (including tables) Supplementary information

			will be converted to 1, 0 to remain as zero	Mark "yes" if this type of delivery format is mentioned on at least one occasion.
	PC_Format_Group	Included therapy delivered to groups	1 = Yes, 0 = No, 777 = Not specified	
	PC_Format_Other	Included therapy delivered in other ways	1 = Yes, 0 = No, 777 = Not specified	
	PC_Format_Other_Desc	Description of other delivery format	String, 777 = Not specified, This is to be changed to a summary variable, identifying if delivery formats other than individual were used. 1 = yes (other formats used - either in addition to, or instead of individual), 0 = no. Not to be used for reliability as dependent on other variables.	
	PC_Format_Spec	Delivery format specified	1 = Yes, 0 = No	
12. Intervention agent	PC_Agent_Parent	Included parent(s)/caregiver(s) as intervention agent	1 = Yes, 0 = No, 777 = Not specified	To be completed based on SR:

	PC_Agent_Peer	Included peer(s)/sibling(s) as intervention agent	1 = Yes, 0 = No, 777 = Not specified	<ul style="list-style-type: none"> • Method (including eligibility criteria) • Results (including tables) • Supplementary information <p>Mark "yes" if this type of intervention agent is mentioned on at least one occasion.</p>
	PC_Agent_School	Included school or early childhood staff as intervention agent (e.g. teacher, TA)	1 = Yes, 0 = No, 777 = Not specified	
	PC_Agent_Clinician	Included clinician/researcher as intervention agent	1 = Yes, 0 = No, 777 = Not specified	
	PC_Agent_Other	Included other individuals as intervention agents	1 = Yes, 0 = No, 777 = Not specified	
	PC_Agent_Other_Desc	Description of other agent	String, 777 = Not specified	
	PC_Agent_Spec	Intervention agent specified	1 = Yes, 0 = No This is summary variable. Mark 1 if a 1 was indicated for preceding variables. Mark 0 if not. It is a summary variable (dependent on others) and so not included in reliability estimate.	

13. Delivery mode	PC_Mode_Face	Included face-to-face delivery	<p>1 = Yes, 0 = No, 777 = Not specified</p> <p>It is assumed intervention is face-to-face, unless otherwise specified. Therefore, to be recoded such that 777 or 1 = 1, 0=0.</p>	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Method (including eligibility criteria) • Results (including tables) • Supplementary information <p>Mark "yes" if this type of delivery mode is mentioned on at least one occasion.</p>
	PC_Mode_Tele	Included telehealth delivery	1 = Yes, 0 = No, 777 = Not specified	
	PC_Mode_Other	Included other delivery modes	1 = Yes, 0 = No, 777 = Not specified	
	PC_Mode_Other_Desc	Description of other delivery modes	String, 777 = Not specified	
	PC_Mode_Spec	Delivery mode specified	<p>1 = Yes, 0 = No</p> <p>This is summary variable. Mark 1 if a 1 was indicated for preceding variables. Mark 0 if not. It is a summary variable (dependent on others)</p>	

			and so not included in reliability estimate.	
14. Dose	PC_Dose_Unit	Unit of measure for dose	1 = Minutes, 2 = Hours, 777 = Not specified	<p><u>Dose</u>: Refers to the amount of time the child spent engaged in intervention sessions, expressed in minutes/hours. Authors may report a per session dose, or a total dose across sessions.</p> <p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Method • Results (including tables) • Supplementary information <p>Must be reported by study authors. No calculations during extraction to occur.</p>
	PC_Dose_Mean	Mean dose	Number 777 = Not specified	
	PC_Dose_Min	Minimum dose	Number, 777 = Not specified	
	PC_Dose_Max	Maximum dose	Number, 777 = Not specified	
	PC_Dose_Sum	Dose summary- free text	String, 777 = Not specified	
	PC_Dose_Spec	Dose specified	1 = Yes, 0 = No	<p>If multiple doses are reported, complete on separate line in data extraction form.</p>
			Mark 1 if information was entered into preceding cells	

			(including free text summary by authors or person extracting) AND/OR If some information regarding dosage was available, even if not provided consistently across studies. This is a summary variable and is not for inclusion in reliability calculations.	
15. Frequency	PC_Freq_Unit	Unit of measure for frequency	1 = per day; 2 = per week, 3 = per month, 4 = per year 777 = Not specified	<u>Frequency</u> : Refers to how often sessions occurred, expressed as ratio of time (e.g., per day, per week, per month). To be completed based on SR: <ul style="list-style-type: none"> • Method • Results (including tables) • Supplementary information
	PC_Freq_Mean	Mean frequency	Number, 777 = Not specified	
	PC_Freq_Min	Minimum frequency	Number, 777 = Not specified	
	PC_Freq_Max	Maximum frequency	Number, 777 = Not specified	
	PC_Freq_Spec	Frequency specified	1 = Yes, 0 = No	

			Mark 1 if (a) data were extracted for preceding variables (not including free text) and/or (b) some information was provided, but not consistently across studies. Otherwise mark 0.	Must be reported by study authors. No calculations during extraction to occur. If multiple frequencies are reported, complete on separate line in data extraction form.
16. Duration	PC_Dur_Unit	Unit of measure for duration	1 = Days, 2 = Weeks, 3 = Months, 4 = Years, 777 = Not specified	<u>Duration</u> : Refers to the total time period in which the intervention was provided, typically the time between pre-post measures, expressed in days, weeks, months, years To be completed based on SR: <ul style="list-style-type: none"> • Method • Results (including tables) • Supplementary information Must be reported by study authors. No calculations during extraction to occur.
	PC_Dur_Mean	Mean duration	Number 777 = Not specified	
	PC_Dur_Min	Minimum duration	Number, 777 = Not specified	
	PC_Dur_Max	Maximum duration	Number, 777 = Not specified	
	PC_Dur_Spec	Duration specified	1 = Yes, 0 = No Mark 1 if (a) data were extracted for preceding variables (not including free text) and/or (b)	

			some information was provided, but not consistently across studies. Otherwise mark 0.	If multiple durations are reported, complete on separate line in data extraction form.
17. Intensity	PC_Intens_Unit	Unit of measure for intensity	1 = Minutes, 2 = Hours, 3 = Days, 4 = Weeks 5 = Months 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Method • Results (including tables) • Supplementary information
	PC_Intens_Min	Minimum intensity	Number, 777 = Not specified	
	PC_Intens_Max	Maximum intensity	Number, 777 = Not specified	Must be reported by study authors. No calculations during extraction to occur. If multiple intensities are reported, complete on separate line in data extraction form.
	PC_Intens_Spec	Intensity specified	1 = Yes, 0 = No	
18. Core autism characteristics a. Autistic behaviours	PC_Autis_Term	Term used by SR to describe autistic behavioural outcome	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Methods
	PC_Autis_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	

	PC_Autis_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified,	<ul style="list-style-type: none"> Results (including tables) Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_Autis_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Autis_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Autis_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Autis_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Autis_Study_No	Number of studies	Number, 777 = Not specified	
	PC_Autis_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	

	PC_Autis_Spec	Autistic behavioural outcome specified	1= Yes, 0 = No	
b. Social communication	PC_Soc_Comm_Term	Term used by SR to describe social communication outcome	String, 777 = Not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_Soc_Comm_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_Soc_Comm_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified,	
	PC_Soc_Comm_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Soc_Comm_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Soc_Comm_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Soc_Comm_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	

	PC_Soc_Comm_Study_No	Number of studies	Number, 777 = Not specified	
	PC_Soc_Comm_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim.	String, 777 = Not specified	
	PC_Soc_Comm_Spec	Social communication outcome specified	1= Yes, 0 = No	
c. Restricted and repetitive interests and activities	PC_RRB_Term	Term used by SR to describe restricted and repetitive behaviours, interests, and activities outcome	String, 777 = Not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_RRB_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_RRB_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified,	
	PC_RRB_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_RRB_ES_Spec	Effect size specified	1 = Yes, 0 = No	

	PC_RRB_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_RRB_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_RRB_Study_No	Number of studies	Number, 777 = Not specified	
	PC_RRB_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim.	String, 777 = Not specified	
	PC_RRB_Spec	Restricted and repetitive behaviours, interests, and activities outcome specified	1= Yes, 0 = No	
d. Sensory behaviours	PC_Sensory_Term	Term used by SR to describe restricted and repetitive behaviours, interests, and activities outcome	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary
	PC_Sensory_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_Sensory_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified,	

PC_Sensory_ES_Dir	Meta-analysis - direction of the therapeutic effect.	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.
PC_Sensory_ES_Spec	Effect size specified	1 = Yes, 0 = No	
PC_Sensory_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
PC_Sensory_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
PC_Sensory_Study_No	Numnber of studies	Number, 777 = Not specified	
PC_Sensory_ author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
PC_Sensory_Spec	Sensory behaviours specified	1= Yes, 0 = No	

19. Related skills and development a. Communication	PC_Comm_Term	Term used by SR to describe overall communication outcome	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.
	PC_Comm_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_Comm_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_Comm_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Comm_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Comm_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Comm_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Comm_Study_No	Number of studies	Number,	

			777 = Not specified	
	PC_Comm_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_Comm_Spec	Overall communication outcome specified	1= Yes, 0 = No	
b. Expressive language	PC_Exp_Lang_Term	Term used by SR to describe expressive language outcome	String, 777 = Not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_Exp_Lang_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_Exp_Lang_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_Exp_Lang_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Exp_Lang_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Exp_Lang_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	

	PC_Exp_Lang_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Exp_Lang_Study_No	Number of studies	Number, 777 = Not specified	
	PC_Exp_Lang_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim.	String, 777 = Not specified	
	PC_Exp_Lang_Spec	Expressive language outcome specified	1= Yes, 0 = No	
c. Receptive language	PC_Rec_Lang_Term	Term used by SR to describe receptive language outcome	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.
	PC_Rec_Lang_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_Rec_Lang_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_Rec_Lang_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified	

			999 = N/A (no meta-analysis)	
	PC_Rec_Lang_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Rec_Lang_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Rec_Lang_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Rec_Lang_Study_No	Number of studies	Number, 777 = Not specified	
	PC_Rec_Lang_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_Rec_Lang_Spec	Receptive language outcome specified	1= Yes, 0 = No	
d. Cognition	PC_Cog_Term	Term used by SR to describe cognition outcome	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> Methods
	PC_Cog_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	

	PC_Cog_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	<ul style="list-style-type: none"> Results (including tables) Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_Cog_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Cog_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Cog_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Cog_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Cog_Study_No	Number of studies	Number, 777 = Not specified	
	PC_Cog_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	

	PC_Cog_Spec	Cognition outcome specified	1= Yes, 0 = No	
e. Motor	PC_Motor_Term	Term used by SR to describe motor outcome	String, 777 = Not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_Motor_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_Motor_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_Motor_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Motor_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Motor_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Motor_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	

	PC_Motor_Study_No	Number of studies	Number, 777 = Not specified	
	PC_Motor_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_Motor_Spec	Motor outcome specified	1= Yes, 0 = No	
f. Social emotional/ challenging behaviour	PC_SECB_Term	Term used by SR to describe social emotional/ challenging behaviour outcome	String, 777 = Not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_SECB_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_SECB_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_SECB_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_SECB_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_SECB_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified	

			999 = N/A (no meta-analysis)	
	PC_SECB_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_SECB_Study_No	Number of studies	Number, 777 = Not specified	
	PC_SECB_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_SECB_Spec	Social-emotional/challenging behaviour outcome specified	1= Yes, 0 = No	
g. Play	PC_Play_Term	Term used by SR to describe play outcome	String, 777 = Not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_Play_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_Play_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_Play_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified	

			999 = N/A (no meta-analysis)	
	PC_Play_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Play_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Play_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Play_Study_No	Number of studies	Number, 777 = Not specified	
	PC_Play_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_Play_Spec	Play outcome specified	1= Yes, 0 = No	
h. Adaptive behaviour	PC_Adap_Term	Term used by SR to describe adaptive behaviour outcome	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> Methods
	PC_Adap_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	

	PC_Adap_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	<ul style="list-style-type: none"> Results (including tables) Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_Adap_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Adap_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Adap_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Adap_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Adap_Study_No	Number of studies	Number, 777 = Not specified	
	PC_Adap_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	

	PC_Adap_Spec	Adaptive outcome specified	1= Yes, 0 = No	
i. General outcomes	PC_General_Term	Term used by SR to describe general outcomes	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary Qualitative data will not involve counting contents of tables and paragraphs in the results.
	PC_General_Outcomes	Outcomes that contributed to the general effect measure	String, 777 = Not specified	
	PC_General_ES	Specify the general effect size including confidence intervals	String, 777 = Not specified	
	PC_General_ES_type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_General_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_General_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_General_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_General_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified	

			999 = N/A (no meta-analysis)	
	PC_General_Study_No	Number of studies	Number, 777 = Not specified	
	PC_General_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_General_Spec	General outcome specified	1= Yes, 0 = No	
20. Education and Participation a. School/Learning readiness	PC_School_Term	Term used by SR to describe school readiness outcome	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.
	PC_School_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_School_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_School_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_School_ES_Spec	Effect size specified	1 = Yes, 0 = No	

	PC_School_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_School_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_School_Study_No	Number of studies	Number, 777 = Not specified	
	PC_School_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_School_Spec	School readiness outcome specified	1= Yes, 0 = No	
b. Academic skills	PC_Academic_Term	Term used by SR to describe academic outcome	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary
	PC_Academic_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_Academic_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	

	PC_Academic_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.
	PC_Academic_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_Academic_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Academic_Study_No	Number of studies	Number, 777 = Not specified	
	PC_Academic_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_Academic_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_Academic_Spec	Academic outcome specified	1= Yes, 0 = No	

c. Quality of Life	PC_QoL_Term	Term used by SR to describe Quality of Life outcome	String, 777 = Not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_QoL_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_QoL_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_QoL_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_QoL_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_QoL_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_QoL_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_QoL_Study_No	Number of studies	Number,	

			Not specified	
	PC_QoL_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_QoL_Spec	Quality of life outcome specified	1= Yes, 0 = No	
21. Community participation	PC_CP_Term	Term used by SR to describe community participation outcome	String, 777 = not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_CP_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_CP_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_CP_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_CP_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_CP_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	

	PC_CP_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_CP_Study_No	Number of studies	Number, 777 = Not specified	
	PC_CP_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_CP_Spec	Community participation outcome specified	1= Yes, 0 = No	
22. Family wellbeing a. Caregiver communication and interaction strategies	PC_PE_Strat_Term	Term used by SR to describe communication and interaction strategies	String, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> • Methods • Results (including tables) • Supplementary Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.
	PC_PE_Strat_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_PE_Strat_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_PE_Strat_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified	

			999 = N/A (no meta-analysis)	
	PC_PE_Strat_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_PE_Strat_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_PE_Strat_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_PE_Study_No	Number of studies	Number, 777 = Not specified	
	PC_PE_Strat_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_PE_Strat_Spec	Communication and interaction strategies outcome specified	1= Yes, 0 = No	
	PC_PE_Att_Det	Attrition details (string)	String, 777 = Not specified	
	PC_PE_AttHighLow_Spec	Caregiver attrition specified	1= Yes, 0 = No	

b. Caregiver social emotional wellbeing	PC_PE_SE_Well_Term	Term used by SR to describe parent social emotional wellbeing	String, 777 = Not specified	<p>To be completed based on SR:</p> <ul style="list-style-type: none"> Results (including tables) Supplementary materials <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_PE_SE_Well_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	
	PC_PE_SE_Well_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_PE_SE_Well_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_PE_SE_Well_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_PE_SE_Well_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_PE_SE_Well_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_PE_SE_Well_Study_No	Number of studies	Number,	

			777 = Not specified	
	PC_PE_SE_Well_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim.	String, 777 = Not specified	
	PC_PE_SE_Well_Spec	Parent social emotional wellbeing specified	1= Yes, 0 = No	
c. Caregiver satisfaction	PC_PE_Satis	Evidence for parent/caregiver satisfaction	1 = Yes, 0 = No, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> Results (including tables) Mark "yes" if this type of satisfaction/dissatisfaction is mentioned on at least one occasion.
	PC_PE_Satis_Desc	Describe the measure of satisfaction	String, 777 = Not specified	
	PC_PE_Satis_Info	Further information about parent satisfaction results	String, 777 = Not specified	
	PC_PE_DisSatis	Evidence for parent/caregiver dissatisfaction	1 = Yes, 0 = No, 777 = Not specified	
	PC_PE_DisSatis_Desc	Describe the measure of dissatisfaction	String, 777 = Not specified	
	PC_PE_DisSatis_Info	Further information about parent dissatisfaction results	String, 777 = Not specified	
	PC_PE_Satis_Spec	Parent/caregiver satisfaction specified	1 = Yes, 0 = No	
	PC_PE_Fin_Well_Term	Term used by SR to describe parent financial wellbeing	String, 777 = Not specified	To be completed based on SR:

d. Caregiver financial wellbeing	PC_PE_Fin_Well_ES	Specify the overall effect size including confidence intervals	String, 777 = Not specified	<ul style="list-style-type: none"> Results (including tables) Supplementary materials <p>Qualitative data <u>will not</u> involve counting contents of tables and paragraphs in the results.</p>
	PC_PE_Fin_Well_ES__type	Specify the types of effect size (e.g. Cohen's <i>d</i> or Hedge's <i>g</i>)	String, 777 = Not specified	
	PC_PE_Fin_Well_ES_Dir	Meta-analysis - direction of the therapeutic effect	1 = Positive 2 = Negative 3 = Null 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_PE_Fin_Well_ES_Spec	Effect size specified	1 = Yes, 0 = No	
	PC_PE_Fin_Well_Hetero_type	Heterogeneity statistic type	String, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_PE_Fin_Well_Hetero_stat	Heterogeneity statistic value	Number, 777 = Not specified 999 = N/A (no meta-analysis)	
	PC_PE_Fin_Well_author_summ	For qualitative studies, copy the author's terminology to describe the summary of outcomes verbatim	String, 777 = Not specified	
	PC_PE_Fin_Well_Spec	Financial wellbeing specified	1 = Yes, 0 = No	

e. Child satisfaction	PC_CE_Satis	Evidence for child satisfaction	1 = Yes, 0 = No, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> Results (including tables) Mark "yes" if this type of satisfaction/dissatisfaction is mentioned on at least one occasion.
	PC_CE_Satis_Desc	Describe the measure of satisfaction	String, 777 = Not specified	
	PC_CE_DisSatis	Evidence for child dissatisfaction	1 = Yes, 0 = No, 777 = Not specified	
	PC_CE_DisSatis_Desc	Describe the measure of child dissatisfaction	String, 777 = Not specified	
	PC_CE_Satis_Spec	Child satisfaction specified	1 = Yes, 0 = No	
f. Adverse events	PC_CE_Harm_Evidence	Evidence for child distress or harm related to the intervention	1 = Yes, 0 = No, 777 = Not specified	To be completed based on SR: <ul style="list-style-type: none"> Results (including tables) Mark "yes" if this type of harm/distress is mentioned on at least one occasion.

Variables extracted separately for each moderator analysis on each outcome in the systematic review.

1. Intervention label	PC_Int_Name	Name for the intervention as defined by the authors verbatim	String, 777 = Not specified	To be completed based on the SR: <ul style="list-style-type: none"> Methods Results (including tables)
------------------------------	-------------	--	--------------------------------	--

				Where possible, copy and paste text verbatim.
2. Moderator	PC_Mod	Variable that was examined as a moderator of a given outcome	String, 777 = Not specified	<p>To be completed based on the SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) <p>Where possible, copy and paste text verbatim.</p>
3. Outcome of moderator analysis	PC_Mod_Outcome	Outcome variable that was the subject of the moderator analysis	String, 777 = Not specified	<p>To be completed based on the SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables) <p>Where possible, copy and paste text verbatim.</p>
4. Finding of moderator analysis	PC_Mod_Outc_Find_Cat	Finding of the moderator analysis	<p>1 = Consistently positive</p> <p>2 = Consistently negative</p> <p>3 = Consistently null;</p>	<p>To be completed based on the SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables)

			<p>4 = Mixed or otherwise unclear</p> <p>For outcomes that don't fit into these categories, provide a short string explanation of the pattern of findings (e.g., 'quadratic')</p>	
5. Number of studies included	PC_Mod_No_Studies	Number of studies included in the moderator analyses	Number, 777 = Not specified	<p>To be completed based on the SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables)
6. Evidence for moderator finding	PC_Mod_Outc_Find_Evidence	Copy the author's terminology to describe the outcome of the moderator analyses verbatim	String, 777 = Not specified	<p>To be completed based on the SR:</p> <ul style="list-style-type: none"> • Methods • Results (including tables)
7. Statement of finding for tables	PC_Mod_Statement	Summary statement regarding the effect of the moderator on the outcome (e.g., "Younger age associated with greater intervention effects on Social communication")	String	To be completed using the template sentences provided by the document "Intermediate Table Instructions."

S6: Quality appraisal form (adapted from the Critical Appraisal Checklist for Systematic Reviews and Research Syntheses created by the Joanna Briggs Institute [2020])

NB: A 'Yes' decision requires all checkboxes under a single item to be met, unless the criteria specifically state otherwise (i.e., use an 'OR' qualifier). If all checkboxes are not met, a 'No' decision should be specified.

1. Is the review question clearly and explicitly stated?

- ☐ The review question(s) or aim(s)/objectives explicitly state(s) the population, intervention, and outcomes of interest PI(C)O.

2. Were the inclusion criteria appropriate for the review question?

- ☐ The PICO elements and design were clearly defined in the inclusion and/or exclusion criteria.
- ☐ The PICO elements were relevant to the objectives of the review and/or the research questions

3. Was the search strategy appropriate?

- ☐ The search strategy included key words and/or index terms that specified PI(C)O
- ☐ Date and language limits appropriate and/or justified

4. Were the sources and resources used for the study adequate?

- ☐ Included at least two major bibliographic databases relevant to the review question, from the following list: Medline, CINAHL, PsycINFO, PubMed, EMBASE, Scopus, Web of Science, and ERIC
- ☐ Attempt to search for grey literature (e.g. websites relevant to the review question, thesis repositories, trial registries)

5. Were criteria for appraising the studies appropriate?

- ☐ Clear statement that critical appraisal was conducted

- ☐ Details of the items that were used to assess the included studies (within methods, appendix, or further reference) were outlined and appropriate for the relevant study design

6. Was critical appraisal conducted by two or more reviewers independently?

- ☐ Critical appraisal was conducted by two reviewers working independently from each other and conferring when needed to make a decision; OR
- ☐ Two reviewers conducted critical appraisal with at least 10% of eligible studies and achieved good agreement (at least 80% or Cohen's kappa = 0.6 or greater), with the remainder extracted by one reviewer.

7. Were there methods to minimise errors in data extraction?

- ☐ All data extraction was conducted by two reviewers working independently OR
- ☐ Two reviewers extracted data with a sample of eligible studies and achieved good agreement (at least 80% or Cohen's kappa = 0.6 or greater), with the remainder extracted by one reviewer.

8. Were the methods used to combine studies appropriate?

- Meta-analyses
 - ☐ A statement about the extent to which the studies were appropriate to be combined
 - ☐ Assessment of heterogeneity
 - ☐ Explanation for heterogeneity that may be present
- Narrative synthesis
 - ☐ Methods for data synthesis are congruent with the stated methodology
 - ☐ Adequate information is provided to support the synthesised findings
- Meta-analyses and narrative synthesis

- ☐ Summary/extraction tables were structured to provide sufficient information to ascertain PICO elements and design for each included study.

9. Was the likelihood of publication bias assessed? (meta-analyses only)

- ☐ Publication bias was assessed (e.g. a funnel plot for 10 or more studies or Egger's test Begg test, Harbord test)
- ☐ N/A

10. Were recommendations for policy and/or practice supported by the reported data?

- ☐ Clear link made between the results of the review and recommendations for policy and practice.
- ☐ The strengths of the findings and the quality of the research considered in the formulation of the review recommendations

11. Were the specific directives for new research appropriate?

- ☐ Indication of directions for further research

S7: Data synthesis process

Data were first summarised through the development of a table presenting the characteristics of included SRs (Appendix M), the development of intermediary tables presenting the findings of each SR (Appendix N-P), and the creation of appendices to summarise raw data (e.g., effect sizes, confidence intervals, and heterogeneity reported for each meta-analysis; verbatim statements of effect reported for each narrative synthesis; Appendix T).

Evidence for intervention effects

Evidence for the effects of different intervention practices and categories was synthesised as follows:

1. Evidence for intervention effects for each category and practice presented in the intermediate tables was mapped to an excel spreadsheet. Each SR occupied one row and the outcomes of interest were listed as columns.
2. A code of 1-4 was inserted in the corresponding cell for piece of evidence for intervention effect: (1) positive pooled/summarised effect, (2) negative pooled/summarised effect, (3) null pooled/summarised effect, or (4) inconsistent pooled/summarised effect. Overall evidence ratings used by the National Autism Center (2015) of 'established' were coded as 1, 'emerging' coded as 4, and 'unestablished' coded as 3. The overall evidence rating used by Steinbrenner et al., (2020) to indicate 'insufficient evidence' was coded as 3. Font colour was used for each outcome to indicate if evidence was based on a meta-analysis or a narrative review. Using this approach, it was possible for more than one piece of evidence to be in each cell (e.g., if an author reported two different measures of adaptive behaviour).
3. A within-SR synthesis of evidence of effect for each outcome was then completed. Where more than one piece of evidence was available, a summary code was allocated as follows:
 - a. Positive was coded where all evidence for intervention effect was positive.
 - b. Null was coded where all evidence for intervention effect was null.
 - c. Inconsistent was coded where there was a mixture (positive, null) of evidence for intervention effect.
 - d. Adverse effects were recorded in Table 7.
4. An across SR synthesis of evidence of effect for each outcome was then completed, at the category and practice level.

- a. Where only one SR provided evidence in relation to a particular outcome, the code applied during the within-SR coding (positive, null, mixed) was transferred to a summary line in the spreadsheet.
- b. Where more than one SR provided evidence for a particular outcome, the evidence for intervention effect from the most recent meta-analysis (where available) was used to determine the code for that outcome. The prioritisation of the most recent meta-analysis occurred irrespective of the number of other meta-analyses and/or narrative reviews. Where there was no meta-analysis but findings from two or more narrative reviews, the findings were synthesised as per the codes specified in step 3 (positive, null, mixed). The code allocated was then transferred to the summary line for the practice/category.

5. Data from all summary lines were then transferred to Table 6.

Evidence for the possible influence of child and intervention characteristics on intervention effects were transferred verbatim from the extraction spreadsheet into Tables 8-10 and summarised descriptively.

S8: Excluded articles from full-text screening phase

Exclusion reason: Duplicate (n=14)

Diggle T. T. J., McConachie. H. (2013). Parent-mediated early intervention for young children with autism spectrum disorder. *Cochrane Database of Systematic Reviews*, 2013(4). doi: 10.1002/14651858.CD003496.pub2

Geretsegger, M., Elefant, C., Mössler, K. A., Gold, C. (2014). Music therapy for people with autism spectrum disorder. *Cochrane Database of Systematic Reviews*, 2014(6). doi: 10.1002/14651858.CD004381.pub3

Hillman, K., Dix, K., Ahmad, K., Lietz, P., Trevitt, J., O'Grady, E., ... & Hedley, D. (2020). Interventions for anxiety in mainstream school-aged children with autism spectrum disorder: A systematic review. *Campbell Systematic Reviews*, 2020(16), e1086. doi: 10.1002/cl2.1086

Ho, B. P., Stephenson, J., & Carter, M. (2015). Cognitive-behavioural approach for children with autism spectrum disorder: A literature review. *Journal of Intellectual and Developmental Disability*, 40, 213-229. doi: 10.3109/13668250.2015.1023181

James, A. C., James, G., Cowdrey, F. A., Soler, A., & Choke, A. (2015). Cognitive behavioural therapy for anxiety disorders in children and adolescents. *Cochrane Database of Systematic Reviews*, 2015(2). doi: 10.1002/14651858.CD004690.pub4

Lake, J., Modica, P. T., Chan, V., Weiss, J. A. (2019). Systematic review comparing efficacy and effectiveness trials of cognitive behavioural therapy among youth with autism. *Journal of Intellectual Disability Research*, 63, 659. <https://doi.org/10.1111/jir.12652>

Oono I.P., Honey E.J., Mcconachie H. (2013). Parent-mediated early intervention for young children with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews*, 2013(4), 1465-1858. doi: 10.1002/14651858.CD009774.pub2

Oono, I., Honey, E., Mcconachie, H. (2013). Parent-mediated early intervention for young children with autism spectrum disorders: A Cochrane systematic review and meta-analyses. *Developmental Medicine and Child Neurology*, 55, 27-28. doi: 10.1111/dmcn.12259

Reichow, B., Barton, E. E., Boyd, B. A., & Hume, K. (2014). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD): A systematic review. *Campbell Systematic Reviews*, 2014(10), 1-116. doi: 10.4073/csr.2014.9

Reichow, B., Steiner, A. M., & Volkmar, F. (2012). Social skills groups for people aged 6 to 21 with autism spectrum disorders (ASD). *Campbell Systematic Reviews*, 2012(8), 1-76. doi: <https://doi.org/10.4073/csr.2012.16>

Shalev, R. A., Lavine, C., & Di Martino, A. (2019). A systematic review of the role of parent characteristics in parent-mediated interventions for children with autism spectrum disorder. *Journal of Developmental and Physical Disabilities*, 32, 1-21. doi: <https://doi.org/10.1007/s10882-018-9641-x>

Zhimin, S., Guihong, L., & Qing, X. (2016). Meta analysis of influence of music therapy on emotion, language, behavior and social skills in children with autism. *Chinese Nursing Research*, 30(3B), 922-926. <https://doi.org/10.3969/j.issn.1009-6493.2016.08.009>

Weitlauf, A. S., McPheeters, M. L., Peters, B., Sathe, N., Travis, R., Aiello, R., ... & Warren, Z. (2014). *Therapies for children with autism spectrum disorder: Behavioral interventions update. AHRQ Comparative Effectiveness Review No. 137*. Rockville (MD): Agency for Healthcare Research and Quality (US). Retrieved from https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/autism-update_research.pdf

Weitlauf, A. S., McPheeters, M. L., Peters, B., Sathe, N., Travis, R., Aiello, R., ... Warren, Z. (2014). No Title. *Agency for Healthcare Research and Quality (AHRQ)*.

Exclusion reason: Not systematic (n=152)

Adnan, N. H., Tunggal, D., & Abdullasim, N. (2018). Systematic review on augmented reality application for autism children. *Journal of Advanced Research in Dynamical and Control Systems*, 10(11), 26-32.

Aguirre, A. A., Valentino, A. L., & LeBlanc, L. A. (2016). Empirical investigations of the intraverbal: 2005–2015. *The Analysis of Verbal Behavior*, 32, 139-153. doi: 10.1007/s40616-016-0064-4

Allan, A. C., Vladescu, J. C., Kisamore, A. N., Reeve, S. A., & Sidener, T. M. (2015). Evaluating the emergence of reverse intraverbals in children with autism. *The Analysis of Verbal Behavior*, 31(1), 59-75.

Al-Oran, H. M., Lee, K., Tan, K. A., & Lim, P. Y. (2019). The effectiveness of educational programs on parenting stress and coping mechanism among parents of children with autism spectrum disorder: A systematic review. *Malaysian Journal of Medicine and Health Sciences*, 15(3), 135-141.

Alzayer, N. M., & Banda, D. R. (2016). All reviews are not the same: A systematic review on requesting skills and speech generating devices is undone by serious methodological issues. *Evidence-Based Communication Assessment and Intervention*, 10(2), 97-100. doi: 10.1080/17489539.2016.1226730

Aresti-Bartolome, N., & Garcia-Zapirain, B. (2014). Technologies as support tools for persons with autistic spectrum disorder: a systematic review. *International Journal of Environmental Research and Public Health*, 11, 7767-7802. doi: 10.3390/ijerph110807767

Banda, D. R. (2018). The results of this systematic review on AAC with adolescents and adults with autism spectrum disorder has promising implications, despite there being a limited number of studies. *Evidence-Based Communication Assessment and Intervention*, 12(3), 81-84. doi: 10.1080/17489539.2018.1504423

Banda, D. R., & Okungu, P. A. (2011). This review suggests that video-based instruction improves skills in persons with autism spectrum disorders: Some limitations in review methodology and the original data set render this conclusion tentative. *Evidence-Based Communication Assessment and Intervention*, 5(3), 144-148. doi: 10.1080/17489539.2011.651908

Banneyer, K. N., Bonin, L., Price, K., Goodman, W. K., & Storch, E. A. (2018). Cognitive behavioral therapy for childhood anxiety disorders: A review of recent advances. *Current Psychiatry Reports*, 20(8), 1-8. doi: <https://doi.org/10.1007/s11920-018-0924-9>

Bellinger, J. M., Perlman, E. H., & DiPerna, J. C. (2011). Social skills interventions for individuals with autism spectrum disorder. *School Psychology Forum*, 5(4), 141-159.

Bene, K., & Lapina, A. (2020). A meta-analysis of sibling-mediated intervention for brothers and sisters who have autism spectrum disorder. *Review Journal of Autism and Developmental Disorders*. doi: 10.1007/s40489-020-00212-z

Bene, K., Banda, D. R., & Brown, D. (2014). A meta-analysis of peer-mediated instructional arrangements and autism. *Review Journal of Autism and Developmental Disorders*, 1(2), 135-142. doi: 10.1007/s40489-014-0014-9

Berg, E. L., & Causey, A. (2014). The life-changing power of the horse: Equine-assisted activities and therapies in the US. *Animal Frontiers*, 4(3), 72-75. doi: 10.2527/af.2014-0025

Berry, A., Borgi, M., Francia, N., Alleva, E., & Cirulli, F. (2013). Use of assistance and therapy dogs for children with autism spectrum disorders: A critical review of the current evidence. *The Journal of Alternative and Complementary Medicine*, 19(2), 73-80. doi: 10.1089/acm.2011.0835

Black, M. E., & Therrien, W. J. (2018). Parent training programs for school-age children with autism: A systematic review. *Remedial and Special Education*, 39, 243-256. doi: 10.1177/0741932517730645

Boesch, M. C., Shukla Mehta, S., & Da Fonte, M. A. (2016). A review comparing AAC intervention components yields a list of studied components, but conclusions regarding comparative effectiveness appear flawed. *Evidence-Based Communication Assessment and Intervention*, 10(1), 13-19. doi: 10.1080/17489539.2016.1200256

Boisvert, M., Lang, R., Andrianopoulos, M., & Boscardin, M. L. (2010). Telepractice in the assessment and treatment of individuals with autism spectrum disorders: A systematic review. *Developmental Neurorehabilitation*, 13, 423-432. doi: 10.3109/17518423.2010.499889

Boster, J. B., McCarthy, J. W., & Benigno, J. P. (2017). Music therapy is beneficial for children with autism spectrum disorders, but more specific clinical guidance is a future need. *Evidence-Based Communication Assessment and Intervention*, 11(1-2), 20-26. doi: 10.1080/17489539.2017.1328731

Bradshaw, J., Steiner, A. M., Gengoux, G., & Koegel, L. K. (2015). Feasibility and effectiveness of very early intervention for infants at-risk for autism spectrum disorder: A systematic review. *Journal of Autism and Developmental Disorders*, 45, 778-794. doi: 10.1007/s10803-014-2235-2

Burns, C., Lang, R., & Ledbetter Cho, K. (2017). Meta-analysis of single-case experimental design studies involving children with or at risk of autism spectrum disorder suggests intervention is effective during first three years of life. *Evidence-Based Communication Assessment and Intervention*, 11(3-4), 119-123. doi: 10.1080/17489539.2017.1401038

Cannella-Malone, H. I. (2018). Augmentative and alternative communication interventions are effective for adolescents and adults with autism spectrum disorder, but more work is needed. *Evidence-Based Communication Assessment and Intervention*, 12(4), 132-134. doi: 10.1080/17489539.2018.1545400

Cannella-Malone, H. I., & Tullis, C. A. (2010). Use of video technology to teach individuals with autism spectrum disorders: a systematic review of the literature still needed. *Evidence-Based Communication Assessment and Intervention*, 4(3), 109-112. doi: 10.1080/17489539.2010.514722

Carruthers, S., Pickles, A., Slonims, V., Howlin, P., & Charman, T. (2020). Beyond intervention into daily life: A systematic review of generalisation following social communication interventions for young children with autism. *Autism Research*, 13, 506-522. doi: 10.1002/aur.2264

Carter, E. W., Sisco, L. G., Chung, Y. C., & Stanton-Chapman, T. L. (2010). Peer interactions of students with intellectual disabilities and/or autism: A map of the intervention literature. *Research and Practice for Persons with Severe Disabilities*, 35(3-4), 63-79. doi: 10.2511/rpsd.35.3-4.63

Carter, M. (2010). Evidence appears limited for group-based social skills training for school-age children with Autism Spectrum Disorders, but this review may not tell the whole story. *Evidence-based Communication Assessment and Intervention*, 4(1), 11-13. doi: 10.1080/174895390903503738

Carter, M. (2011). Many social skills interventions for individuals with ASD have some supporting evidence, but this review is illustrative rather than comprehensive. *Evidence-Based Communication Assessment and Intervention*, 5(2), 67-69. doi: 10.1080/17489539.2011.602588

Carter, M. (2012). Behaviors associated with joint attention can be taught to children with autism but questions remain about the function of these behaviors. *Evidence-Based Communication Assessment and Intervention*, 6(4), 171-173. doi: 10.1080/17489539.2012.759725

- Carter, M. (2014). Social skill group interventions may assist adolescents with autism spectrum disorder, but significant questions remain. *Evidence-Based Communication Assessment and Intervention*, 8(3), 113-115. doi: 10.1080/17489539.2014.1001546
- Charry-Sánchez, J. D., Pradilla, I., & Talero-Gutiérrez, C. (2018). Effectiveness of animal-assisted therapy in the pediatric population: Systematic review and meta-analysis of controlled studies. *Journal of Developmental & Behavioral Pediatrics*, 39, 580-590. doi: 10.1097/DBP.0000000000000594
- Clendon, S. A. (2011). Literacy interventions for students who use aided augmentative and alternative communication: More work to be done. *Evidence-Based Communication Assessment and Intervention*, 5(3), 138-143. doi: 10.1080/17489539.2011.650919
- Contreras, B. P., Cooper, A. J., & Kahng, S. (2020). Recent research on the relative efficiency of speaker and listener instruction for children with autism spectrum disorder. *Journal of Applied Behavior Analysis*, 53, 584-589. doi: 10.1002/jaba.543
- Davis, T. N., Scalzo, R., Butler, E., Stauffer, M., Farah, Y. N., Perez, S., ... & Coviello, L. (2015). Animal assisted interventions for children with autism spectrum disorder: A systematic review. *Education and Training in Autism and Developmental Disabilities*, 50, 316-329.
- De Vries, D., Beck, T., Stacey, B., Winslow, K., & Meines, K. (2015). Music as a therapeutic intervention with autism: A systematic review of the literature. *Therapeutic Recreation Journal*, 49, 220-237.
- DeFilippis, M., & Wagner, K. D. (2016). Treatment of autism spectrum disorder in children and adolescents. *Psychopharmacology Bulletin*, 46(2), 18-41.
- Den Brok, W. L. J. E., & Sterkenburg, P. S. (2015). Self-controlled technologies to support skill attainment in persons with an autism spectrum disorder and/or an intellectual disability: A systematic literature review. *Disability and Rehabilitation: Assistive Technology*, 10(1), 1-10. doi: <http://dx.doi.org/10.3109/17483107.2014.921248>
- Didden, R. (2012). Participant and intervention characteristics influence the effectiveness of the picture exchange communication system (PECS) for children with ASD1. *Evidence-Based Communication Assessment and Intervention*, 6(4), 174-176. doi: 10.1080/17489539.2013.771885
- Doehring, P., Reichow, B., Palka, T., Phillips, C., & Hagopian, L. (2014). Behavioral approaches to managing severe problem behaviors in children with autism spectrum and related developmental disorders: A descriptive analysis. *Child and Adolescent Psychiatric Clinics*, 23(1), 25-40. doi: <https://doi.org/10.1016/j.chc.2013.08.001>
- Edmunds, S. R., Kover, S. T., & Stone, W. L. (2019). The relation between parent verbal responsiveness and child communication in young children with or at risk for autism spectrum disorder: A systematic review and meta-analysis. *Autism Research*, 12, 715-731. doi: <https://doi.org/10.1002/aur.2100>
- Ehsan, H., Rispoli, M., Lory, C., & Gregori, E. (2018). A systematic review of STEM instruction with students with autism spectrum disorders. *Review Journal of Autism and Developmental Disorders*, 5, 327-348. doi: 10.1007/s40489-018-0142-8
- El Zein, F., Solis, M., Vaughn, S., & McCulley, L. (2014). Reading comprehension interventions for students with autism spectrum disorders: A synthesis of research. *Journal of Autism and Developmental Disorders*, 44, 1303-1322. doi: 10.1007/s10803-013-1989-2
- Factor, R. S., Ollendick, T. H., Cooper, L. D., Dunsmore, J. C., Rea, H. M., & Scarpa, A. (2019). All in the family: A systematic review of the effect of caregiver-administered autism spectrum disorder interventions on family functioning and relationships. *Clinical Child and Family Psychology Review*, 22, 433-457. doi: 10.1007/s10567-019-00297-x
- Fernandes, F. D. M., & Amato, C. A. D. L. H. (2013). Applied behavior analysis and autism spectrum disorders: Literature review. *CoDAS*, 25, 289-96.

- Fernandes, F. D. M., Amato, C. A. D. L. H., Cardoso, C., Navas, A. L. G. P., & Molini-Avejonas, D. R. (2015). Reading in autism spectrum disorders: A literature review. *Folia Phoniatrica et Logopaedica*, 67(4), 169-177. doi: 10.1159/000442086
- Fitzpatrick, S. E., Srivorakiat, L., Wink, L. K., Pedapati, E. V., & Erickson, C. A. (2016). Aggression in autism spectrum disorder: Presentation and treatment options. *Neuropsychiatric Disease and Treatment*, 12, 1525-1538. doi: 10.2147/NDT.S84585
- Fleury, V. P., Thompson, J. L., & Wong, C. (2015). Learning how to be a student: An overview of instructional practices targeting school readiness skills for preschoolers with autism spectrum disorder. *Behavior Modification*, 39, 69-97. doi: 10.1177/0145445514551384
- Forbes, H. J., Travers, J. C., & Johnson, J. V. (2020). A systematic review of linguistic and verbal behavior outcomes of pivotal response treatment. *Journal of Autism and Developmental Disorders*, 50, 766-778. doi: 10.1007/s10803-019-04307-3
- French, L., & Kennedy, E. M. (2018). Annual Research Review: Early intervention for infants and young children with, or at-risk of, autism spectrum disorder: A systematic review. *Journal of Child Psychology and psychiatry*, 59, 444-456. doi: 10.1111/jcpp.12828
- Frolek Clark, G. J., & Schlabach, T. L. (2013). Systematic review of occupational therapy interventions to improve cognitive development in children ages birth–5 years. *American Journal of Occupational Therapy*, 67, 425-430. doi: 10.5014/ajot.2013.006163
- Gates, J. A., Kang, E., & Lerner, M. D. (2017). Efficacy of group social skills interventions for youth with autism spectrum disorder: A systematic review and meta-analysis. *Clinical Psychology Review*, 52, 164-181. doi: 10.1016/j.cpr.2017.01.006
- Geoffray, M. M., Thevenet, M., & Georgieff, N. (2016). News in early intervention in autism. *Psychiatria Danubina*, 28, 66-70.
- Gilroy, S. P., McCleery, J. P., & Leader, G. (2017). Systematic review of methods for teaching social and communicative behavior with high-tech augmentative and alternative communication modalities. *Review Journal of Autism and Developmental Disorders*, 4, 307-320. doi: 10.1007/s40489-017-0115-3
- Hajjar, D. J., & McCarthy, J. W. (2014). Music has positive effects for individuals with neurological speech and language disorders but questions remain regarding type, timing, and fidelity of treatment. *Evidence-Based Communication Assessment and Intervention*, 8(3), 116-123. doi: 10.1080/17489539.2014.1001548
- Hampton, L. H., Stern, Y., & Roberts, M. Y. (2018). Meta-analysis suggests early intervention for infants and toddlers at risk for autism may be effective for improving developmental outcomes. *Evidence-Based Communication Assessment and Intervention*, 12(4), 144-146. doi: 10.1080/17489539.2018.1545398
- Heidlage, J. K., Cunningham, J. E., Kaiser, A. P., Trivette, C. M., Barton, E. E., Frey, J. R., & Roberts, M. Y. (2020). The effects of parent-implemented language interventions on child linguistic outcomes: A meta-analysis. *Early Childhood Research Quarterly*, 50, 6-23. doi: <https://doi.org/10.1016/j.ecresq.2018.12.006>
- Hemsley, B. (2016). Evidence does not support the use of Rapid Prompting Method (RPM) as an intervention for students with autism spectrum disorder and further primary research is not justified. *Evidence-Based Communication Assessment and Intervention*, 10(3-4), 122-130. doi: 10.1080/17489539.2016.1265639
- Hoagwood, K. E., Acri, M., Morrissey, M., & Peth-Pierce, R. (2017). Animal-assisted therapies for youth with or at risk for mental health problems: A systematic review. *Applied Developmental Science*, 21(1), 1-13. doi: 10.1080/10888691.2015.1134267
- Horne-Moyer H. L., Moyer B. H., Messer D. C., & Messer E. S. (2014). The use of electronic games in therapy: A review with clinical implications. *Current Psychiatry Reports*, 16, 1-9. doi: 10.1007/s11920-014-0520-6

Horner, R. H. (2011). Examining the interaction between behavior and language difficulties. *Evidence-Based Communication Assessment and Intervention*, 5(3), 135-137. doi: 10.1080/17489539.2011.650918

Hunsche, M. C., & Kerns, C. M. (2019). Update on the effectiveness of psychotherapy for anxiety disorders in children and adolescents with ASD. *Bulletin of the Menninger Clinic*, 83, 326-352. doi:10.1521/bumc.2019.83.3.326

Jellison, J. A., & Draper, E. A. (2015). Music research in inclusive school settings: 1975 to 2013. *Journal of Research in Music Education*, 62, 325-331. doi: <http://dx.doi.org/10.1177/0022429414554808>

Jouaiti, M., & Henaff, P. (2019). Robot-based motor rehabilitation in autism: A systematic review. *International Journal of Social Robotics*, 11, 753-764. doi: 10.1007/s12369-019-00598-9

Jung, S., & Sainato, D. M. (2013). Teaching play skills to young children with autism. *Journal of Intellectual and Developmental Disability*, 38, 74-90. doi: 10.3109/13668250.2012.732220

Kagohara, D. M., van der Meer, L., Ramdoss, S., O'Reilly, M. F., Lancioni, G. E., Davis, T. N., ... & Green, V. A. (2013). Using iPods® and iPads® in teaching programs for individuals with developmental disabilities: A systematic review. *Research in developmental disabilities*, 34, 147-156. doi: <https://doi.org/10.1016/j.ridd.2012.07.027>

Kashinath, S. P. (2012). Meta-analysis finds that peer-mediated and video-modeling social skills interventions are effective for children with autism, but caution is urged in interpreting the results. *Evidence-Based Communication Assessment and Intervention*, 6(2), 58-62. doi: 10.1080/17489539.2012.724201

Khowaja, K., & Salim, S. S. (2013). A systematic review of strategies and computer-based intervention (CBI) for reading comprehension of children with autism. *Research in Autism Spectrum Disorders*, 7, 1111-1121. doi: 10.1016/j.rasd.2013.05.009

Knutsen, J., Wolfe, A., Burke, B. L., Hepburn, S., Lindgren, S., & Coury, D. (2016). A systematic review of telemedicine in autism spectrum disorders. *Review Journal of Autism and Developmental Disorders*, 3, 330-344. doi: 10.1007/s40489-016-0086-9

Koegel, L. K., Bryan, K. M., Su, P. L., Vaidya, M., & Camarata, S. (2020). Parent education in studies with nonverbal and minimally verbal participants with autism spectrum disorder: A systematic review. *American Journal of Speech-Language Pathology*, 29, 890-902. doi: 10.1044/2019_AJSLP-19-00007

Koegel, L. K., Bryan, K. M., Su, P., Vaidya, M., & Camarata, S. (2019). Intervention for non-verbal and minimally-verbal individuals with autism: A systematic review. *International Journal of Pediatric Research*, 5, 056. doi: 10.23937/2469-5769/1510056

Kose, L. K., Fox, L., & Storch, E. A. (2018). Effectiveness of cognitive behavioral therapy for individuals with autism spectrum disorders and comorbid obsessive-compulsive disorder: A review of the research. *Journal of Developmental and Physical Disabilities*, 30, 69-87. doi: 10.1007/s10882-017-9559-8

LaMarca, V., & LaMarca, J. (2018). Designing receptive language programs: Pushing the boundaries of research and practice. *Behavior Analysis in Practice*, 11, 479-495. doi: 10.1007/s40617-018-0208-1

Landa, R. J. (2018). Efficacy of early interventions for infants and young children with, and at risk for, autism spectrum disorders. *International Review of Psychiatry*, 30, 25-39. doi: 10.1080/09540261.2018.1432574

Lang, R., Delgado-Gonzalez, K. D., Phinney, A., Kelly, E. M., & Hrabal, J. (2019). Meta-analysis suggests family-implemented interventions have moderate effects on social and communication skills of people with developmental disabilities. *Evidence-Based Communication Assessment and Intervention*, 13, 166-170. doi: 10.1080/17489539.2019.1643064

- Laugeson, E. A. (2013). Review: Social skills groups may improve social competence in children and adolescents with autism spectrum disorder. *Evidence-Based Mental Health*, 16, 11-11. doi: 10.1136/eb-2012-100985
- Lee, S. A. S., & McElroy, S. (2012). Telepractice is a new method for providing services to children with Autism Spectrum Disorder (ASD): This scoping review summarizes existing research and identifies research gaps. *Evidence-Based Communication Assessment and Intervention*, 6, 177-180. doi: 10.1080/17489539.2013.780377
- Lentini, J. A., & Knox, M. S. (2015). Equine-facilitated psychotherapy with children and adolescents: An update and literature review. *Journal of Creativity in Mental Health*, 10, 278-305. doi: 10.1080/15401383.2015.1023916
- Lewis, A. S., & van Schalkwyk, G. I. (2020). Systematic review: Distribution of age and intervention modalities in therapeutic clinical trials for autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 50, 2208–2216. doi: <https://doi.org/10.1007/s10803-019-03942-0>
- Lima Antão, J. Y. F. D., Oliveira, A. S. B., Almeida Barbosa, R. T. D., Crocetta, T. B., Guarnieri, R., Arab, C., ... & Abreu, L. C. D. (2018). Instruments for augmentative and alternative communication for children with autism spectrum disorder: A systematic review. *Clinics*, 73, e497. doi: 10.6061/clinics/2017/e497
- Luiselli, J. K. (2016). Systematic review of train the trainer effectiveness in behavioral intervention for individuals with autism is inconclusive and requires greater specificity. *Evidence-Based Communication Assessment and Intervention*, 10, 89-92. doi: 10.1080/17489539.2016.1205865
- Lydon, S., Healy, O., O’Callaghan, O., Mulhern, T., & Holloway, J. (2015). A systematic review of the treatment of fears and phobias among children with autism spectrum disorders. *Review Journal of Autism and Developmental Disorders*, 2, 141-154. doi: 10.1007/s40489-014-0043-4
- Makrygianni, M. K., Gena, A., Katoudi, S., & Galanis, P. (2018). The effectiveness of applied behavior analytic interventions for children with Autism Spectrum Disorder: A meta-analytic study. *Research in Autism Spectrum Disorders*, 51, 18-31. doi: 10.1016/j.rasd.2018.03.006
- Mandr, PP, Moretti, TCDF, Avezum, LA, & Kuroishi, RCS (2019). Animal-assisted therapy: Systematic literature review. *CoDAS*, 31, e20180243. doi: 10.1590/2317-1782/20182018243
- Manwaring, S. S., & Stevens, A. L. (2017). Does teaching joint attention improve language in children with autism spectrum disorder? *Perspectives of the ASHA Special Interest Groups*, 2(1), 11-26. doi: 10.1044/persp2.SIG1.11
- Marchi, A. R. (2015). The importance of early intensive behavioural intervention in autism spectrum disorder. *Journal of Psychiatry*, 18, 1-3. doi: 10.4172/2378-5756.1000317
- Marsh, A., Spagnol, V., Grove, R., & Eapen, V. (2017). Transition to school for children with autism spectrum disorder: A systematic review. *World Journal of Psychiatry*, 7, 184-196. doi: 10.5498/wjp.v7.i3.184
- Marto A., Almeida H.A., Gonçalves A. (2019) Using augmented reality in patients with autism: A systematic review. In J. M. R. S Tavares, & R. M. Natal Jorge (Eds.), *VipIMAGE 2019: Proceedings of the VII ECCOMAS Thematic Conference on Computational Vision and Medical Image Processing, October 16–18, 2019, Porto, Portugal* (vol 34, pp. 454 – 463). Springer, Cham. https://doi.org/10.1007/978-3-030-32040-9_46
- McDaniel Peters, B. C. M., & Wood, W. (2017). Autism and equine-assisted interventions: A systematic mapping review. *Journal of Autism and Developmental Disorders*, 47, 3220-3242. doi: 10.1007/s10803-017-3219-9
- Mercer, J. (2013). Holding therapy: A harmful mental health intervention. *Focus on Alternative and Complementary Therapies an Evidence-based Approach*, 18, 70-76. doi: 10.1111/fct.12024
- Mesa-Gresa, P., Gil-Gmez, H., Lozano-Quilis, J. A., & Gil-Gmez, J. A. (2018). Effectiveness of virtual reality for children and adolescents with autism spectrum disorder: An evidence-based systematic review. *Sensors*, 18, 2486. doi: 10.3390/s18082486

- Miller Kuhaneck, H. M., Madonna, S., Novak, A., & Pearson, E. (2015). Effectiveness of interventions for children with autism spectrum disorder and their parents: A systematic review of family outcomes. *American Journal of Occupational Therapy*, 69, 6905180040p1-6905180040p14. doi: 10.5014/ajot.2015.017855
- Mirzaei, S. S., Pakdaman, S., Alizadeh, E., & Pouretmad, H. (2020). A systematic review of program circumstances in training social skills to adolescents with high-functioning autism. *International Journal of Developmental Disabilities*, 1-10. doi: 10.1080/20473869.2020.1748802
- Mostert, M. P. (2012). Facilitated communication: The empirical imperative to prevent further professional malpractice. *Evidence-Based Communication Assessment and Intervention*, 6(1), 18-27. doi: 10.1080/17489539.2012.693840
- Muharib, R., & Lang, R. (2020). Systematic review suggests social-communication interventions can be effective when implemented in inclusive schools with children with autism spectrum disorders. *Evidence-Based Communication Assessment and Intervention*, 14(3), 109-112. doi: 10.1080/17489539.2020.1764204
- Nahmias, A. S., Pellicchia, M., Stahmer, A. C., & Mandell, D. S. (2019). Effectiveness of community-based early intervention for children with autism spectrum disorder: A meta-analysis. *Journal of Child Psychology and Psychiatry*, 60, 1200-1209. doi: 10.1111/jcpp.13073
- Narzisi, A., Costanza, C., Umberto, B., & Filippo, M. (2014). Non-pharmacological treatments in autism spectrum disorders: An overview on early interventions for pre-schoolers. *Current Clinical Pharmacology*, 9, 17-26. doi: 10.2174/15748847113086660071
- Neely, L., Rispoli, M., Gerow, S., Hong, E. R., & Hagan-Burke, S. (2017). Fidelity outcomes for autism-focused interventionists coached via telepractice: A systematic literature review. *Journal of Developmental and Physical Disabilities*, 29, 849-874. doi: 10.1007/s10882-017-9550-4
- O'Haire, M. E. (2013). Animal-assisted intervention for autism spectrum disorder: A systematic literature review. *Journal of Autism and Developmental Disorders*, 43, 1606-1622. doi: 10.1007/s10803-012-1707-5
- Olde Dubbelink, L. M. O., & Geurts, H. M. (2017). Planning skills in autism spectrum disorder across the lifespan: A meta-analysis and meta-regression. *Journal of Autism and Developmental Disorders*, 47, 1148-1165. doi: http://dx.doi.org/10.1007/s10803-016-3013-0
- Omar, S., & Bidin, A. (2015). The impact of multimedia graphic and text with autistic learners in reading. *Universal Journal of Educational Research*, 3, 989-996. doi: 10.13189/ujer.2015.031206
- Ostryn, C. (2016). Research on the effectiveness of teaching individuals with autism spectrum disorder to ask questions demonstrates clear methodology of intervention, but further research is required to promote generalization of these skills. *Evidence-Based Communication Assessment and Intervention*, 10, 74-78. doi: 10.1080/17489539.2016.1204770
- Otero, T. L., Schatz, R. B., Merrill, A. C., & Bellini, S. (2015). Social skills training for youth with autism spectrum disorders: A follow-up. *Child and Adolescent Psychiatric Clinics*, 24, 99-115. doi: 10.1016/j.chc.2014.09.002
- Parker-McGowan, Q., Chen, M., Reichle, J., Pandit, S., Johnson, L., & Kreibich, S. (2014). Describing treatment intensity in milieu teaching interventions for children with developmental disabilities: A review. *Language, Speech, and Hearing Services in Schools*, 45, 351-364. doi: 10.1044/2014_LSHSS-13-0087
- Parr, J. (2010). Autism. *BMJ Clinical Evidence*.
- Parsons, S., Guldberg, K., MacLeod, A., Jones, G., Prunty, A., & Balfe, T. (2011). International review of the evidence on best practice in educational provision for children on the autism spectrum. *European Journal of Special Needs Education*, 26, 47-63. doi: 10.1080/08856257.2011.543532
- Paynter, J. M., Keen, D., & Rose, V. J. (2016). Systematic review documents limited empirical support for the practical application of the Theory of Mind model of ASD. *Evidence-Based Communication Assessment and Intervention*, 10, 131-139. doi: 10.1080/17489539.2016.1265698

- Pennisi, P., Tonacci, A., Tartarisco, G., Billeci, L., Ruta, L., Gangemi, S., & Pioggia, G. (2016). Autism and social robotics: A systematic review. *Autism Research*, 9, 165-183. doi: 10.1002/aur.1527
- Pierson, L. M., & Ganz, J. B. (2019). Does use of the Picture Exchange Communication System (PECS) and Focused Playtime Intervention (FPI) improve the communication of children with autism spectrum disorder who are minimally verbal? *Evidence-Based Communication Assessment and Intervention*, 13, 200-203. doi: 10.1080/17489539.2019.1670443
- Ploog, B. O., Scharf, A., Nelson, D., & Brooks, P. J. (2013). Use of computer-assisted technologies (CAT) to enhance social, communicative, and language development in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 43, 301-322. doi: 10.1007/s10803-012-1571-3
- Raaymakers, C., Garcia, Y., Cunningham, K., Krank, L., & Nemer-Kaiser, L. (2019). A systematic review of derived verbal behavior research. *Journal of Contextual Behavioral Science*, 12, 128-148. doi: <https://doi.org/10.1016/j.jcbs.2019.02.006>
- Randi, J., Newman, T., & Grigorenko, E. L. (2010). Teaching children with autism to read for meaning: Challenges and possibilities. *Journal of Autism and Developmental Disorders*, 40, 890-902. doi: 10.1007/s10803-010-0938-6
- Reichle, J. (2018). Explicit joint attention interventions for young children with autism spectrum disorders are successful: But determining a specific strategy requires further evidence. *Evidence-Based Communication Assessment and Intervention*, 12 (1-2), 1-6. doi: 10.1080/17489539.2018.1459161
- Reschke-Hernández, A. E. (2011). History of music therapy treatment interventions for children with autism. *Journal of Music Therapy*, 48, 169-207. doi: <https://doi.org/10.1093/jmt/48.2.169>
- Retzlaff, R., von Sydow, K., Beher, S., Haun, M. W., & Schweitzer, J. (2013). The efficacy of systemic therapy for internalizing and other disorders of childhood and adolescence: A systematic review of 38 randomized trials. *Family Process*, 52, 619-652. doi: 10.1111/famp.12041
- Rispoli, K. M., Mathes, N. E., & Malcolm, A. L. (2019). Characterizing the parent role in school-based interventions for autism: A systematic literature review. *School Psychology*, 34, 444-457. doi: <https://doi.org/10.1037/spq0000283>
- Rivers, J., & Nye, C. (2010). The conclusion that ABI has inconclusive effects for children with autism may stem from the fact that there are few high quality studies. *Evidence-based Communication Assessment and Intervention*, 4, 62-64. doi: 10.1080/17489531003802590
- Robinson, N. L., Cottier, T. V., & Kavanagh, D. J. (2019). Psychosocial health interventions by social robots: Systematic review of randomized controlled trials. *Journal of Medical Internet Research*, 21, e13203. doi: 10.2196/13203
- Rotheram-Fuller, E., & MacMullen, L. (2011). Cognitive-behavioral therapy for children with autism spectrum disorders. *Psychology in the Schools*, 48, 263-271. doi: <https://doi.org/10.1002/pits.20552>
- Ryberg, K. H. (2015). Evidence for the implementation of the Early Start Denver Model for young children with autism spectrum disorder. *Journal of the American Psychiatric Nurses Association*, 21, 327-337. doi:10.1177/1078390315608165
- Sartini, E., Knight, V. F., Spriggs, A. D., & Allday, R. A. (2018). Generalization strategies to promote text comprehension skills by students with ASD in core content areas. *Focus on Autism and Other Developmental Disabilities*, 33, 150-159. doi: 10.1177/1088357617735815
- Schlosser, R. W., Balandin, S., Hemsley, B., Iacono, T., Probst, P., & Von Tetzchner, S. (2014). Facilitated communication and authorship: A systematic review. *Augmentative and Alternative Communication*, 30, 359-368. doi: <http://dx.doi.org/10.3109/07434618.2014.971490>
- Schreiber, C. (2011). Social skills interventions for children with high-functioning autism spectrum disorders. *Journal of Positive Behavior Interventions*, 13(1), 49-62. doi: <https://doi.org/10.1177%2F1098300709359027>

Schwartz, J. B., Lieberman, R. J., & Nye, C. (2015). Insufficient methodologically-sound evidence exists for the use of computer-based interventions to teach communication skills to individuals with autism. *Evidence-Based Communication Assessment and Intervention*, 9, 51-56. doi: 10.1080/17489539.2015.1061228

Semple, R. J. (2019). Yoga and mindfulness for youth with autism spectrum disorder: Review of the current evidence. *Child and Adolescent Mental Health*, 24, 12-18. doi: 10.1111/camh.12295

Shalev, R. A., Lavine, C., & Di Martino, A. (2019). A systematic review of the role of parent characteristics in parent-mediated interventions for children with autism spectrum disorder. *Journal of Developmental and Physical Disabilities*, 32, 1-21. doi: 10.1007/s10882-018-9641-x

Shivers, C. M., & Plavnick, J. B. (2015). Sibling involvement in interventions for individuals with autism spectrum disorders: A systematic review. *Journal of Autism and Developmental Disorders*, 45, 685-696. doi: 10.1007/s10803-014-2222-7

Simpson, K., & Keen, D. (2011). Music interventions for children with autism: Narrative review of the literature. *Journal of Autism and Developmental Disorders*, 41, 1507-1514. doi: 10.1007/s10803-010-1172-y

Siregar, N. C., Rosli, R., Maat, S. M., Alias, A., Toran, H., Mottan, K., & Nor, S. M. (2020). The impacts of mathematics instructional strategy on students with autism: A systematic literature review. *European Journal of Educational Research*, 9, 729-741. doi: 10.12973/eu-jer.9.2.729

Spencer, T. D. (2010). This review on the efficacy of communication-based treatments for children with autism spectrum disorders is limited. *Evidence-Based Communication Assessment and Intervention*, 4, 173-177. doi: 10.1080/17489539.2011.566798

Steinbrenner, J. D. (2015). Enhancing engagement in the classroom for students with ASD. *Perspectives on Language Learning and Education*, 22(1), 22-30. doi: 10.1044/1le22.1.22

Stephenson, J. (2016). We need to know more about providing effective support for communication partners of children who use augmentative and alternative communication. *Evidence-Based Communication Assessment and Intervention*, 10, 1-6. doi: 10.1080/17489539.2016.1157917

Subramanian, A., & Wendt, O. (2010). PECS has empirical support, but limitations in the systematic review process require this conclusion to be interpreted with caution. *Evidence-Based Communication Assessment and Intervention*, 4, 22-26. doi: 10.1080/1748953903550341

Tanner, K., Hand, B. N., O'Toole, G., & Lane, A. E. (2015). Effectiveness of interventions to improve social participation, play, leisure, and restricted and repetitive behaviors in people with autism spectrum disorder: A systematic review. *American Journal of Occupational Therapy*, 69, 1-12. doi: 10.5014/ajot.2015.017806

Tincani, M., Miller, J., Lorah, E. R., & Nepo, K. (2020). Systematic review of verbal operants in speech generating device research from Skinner's analysis of verbal behavior. *Perspectives on Behavior Science*, 1-27. doi: 10.1007/s40614-020-00243-1

Tomeny, K. R., McWilliam, R. A., & Tomeny, T. S. (2020). Caregiver-implemented intervention for young children with autism spectrum disorder: A systematic review of coaching components. *Review Journal of Autism and Developmental Disorders*, 7, 168-181. doi: 10.1007/s40489-019-00186-7

Trembath, D., Mahler, N., & Hudry, K. (2016). Evidence from systematic review indicates that parents can learn to implement naturalistic interventions leading to improved language skills in their children with disabilities. *Evidence-Based Communication Assessment and Intervention*, 10, 101-107. doi: 10.1080/17489539.2016.1231387

Tsikinas, S., & Xinogalos, S. (2019). Studying the effects of computer serious games on people with intellectual disabilities or autism spectrum disorder: A systematic literature review. *Journal of Computer Assisted Learning*, 35(1), 61-73. doi: 10.1111/jcal.12311

Turner, H.M., (2010). Plenty of evidence but no clear answers to what therapies improve symptoms associated with autism spectrum disorders. *Evidence-Based Communication Assessment and Intervention*, 4(1), 18-21. doi: 10.1080/17489531003691043

U.S. Department of Education, Institute of Education Sciences, What Works Clearinghouse. (2016). *Children and Students with an Autism Spectrum Disorder intervention report: Pivotal Response Training*. Retrieved from <http://whatworks.ed.gov>

Vaiouli, P., & Andreou, G. (2018). Communication and language development of young children with autism: A review of research in music. *Communication Disorders Quarterly*, 39, 323-329. doi: 10.1177/1525740117705117

Valencia, K., Rusu, C., Quiñones, D., & Jamet, E. (2019). The impact of technology on people with autism spectrum disorder: A systematic literature review. *Sensors*, 19, 1-22. doi: 10.3390/s19204485

Vargas, S., & Lucker, J. R. (2016). A quantitative summary of The Listening Program (TLP) efficacy studies: What areas were found to improve by TLP intervention? *Occupational Therapy International*, 23, 206-217. doi: 10.1002/oti.1425

Vasquez, E., Nagendran, A., Welch, G. F., Marino, M. T., Hughes, D. E., Koch, A., & Delisio, L. (2015). Virtual learning environments for students with disabilities: A review and analysis of the empirical literature and two case studies. *Rural Special Education Quarterly*, 34(3), 26-32. doi: 10.1177/875687051503400306

Velazquez, R., & Nye, C. (2011). Systematic review offers cautious support for positive effects from ABA-based early intervention programs for children with autism spectrum disorder. *Evidence-Based Communication Assessment and Intervention*, 5(2), 70-73. doi: 10.1080/17489539.2011.604260

Vetter, J. A. (2018). Parent-child interaction therapy for autism spectrum and attention-deficit/hyperactivity disorders: A review of the literature. *Child & Family Behavior Therapy*, 40, 204-232. doi: 10.1080/07317107.2018.1487740

Waddington, H. (2018). Meta-analysis provides support for the use of high tech speech-generating devices for teaching a range of communication skills to children with autism spectrum disorders. *Evidence-Based Communication Assessment and Intervention*, 12(1-2), 7-11. doi: 10.1080/17489539.2018.1472903

Wass, S. V., & Porayska-Pomsta, K. (2014). The uses of cognitive training technologies in the treatment of autism spectrum disorders. *Autism*, 18, 851-871. doi: 10.1177/1362361313499827

Watling, R., & Hauer, S. (2015). Effectiveness of Ayres Sensory Integration® and sensory-based interventions for people with autism spectrum disorder: A systematic review. *American Journal of Occupational Therapy*, 69(5), 1-12. doi: <https://doi.org/10.5014/ajot.2015.018051>

Wendt, O., & Rindskopf, D. (2020). Exploring new directions in statistical analysis of single-case experimental designs. *Evidence-Based Communication Assessment and Intervention*, 14 (1-2), 1-5. doi: 10.1080/17489539.2020.1741842

White, P. J., O'Reilly, M., Streusand, W., Levine, A., Sigafoos, J., Lancioni, G., ... & Aguilar, J. (2011). Best practices for teaching joint attention: A systematic review of the intervention literature. *Research in Autism Spectrum Disorders*, 5, 1283-1295. doi: 10.1016/j.rasd.2011.02.003

Whyte, E. M., Smyth, J. M., & Scherf, K. S. (2015). Designing serious game interventions for individuals with autism. *Journal of Autism and Developmental Disorders*, 45, 3820-3831. doi: 10.1007/s10803-014-2333-1

Will, M. N., Currans, K., Smith, J., Weber, S., Duncan, A., Burton, J., ... & Luebrecht, A. (2018). Evidenced-based interventions for children with autism spectrum disorder. *Current Problems in Pediatric and Adolescent Health Care*, 48, 234-249. doi: <https://dx.doi.org/10.1016/j.cppeds.2018.08.014>

Witmer, S. E., Nasamran, A., Parikh, P. J., Schmitt, H. A., & Clinton, M. C. (2015). Using parents and teachers to monitor progress among children with ASD: A review of intervention research. *Focus on Autism and Other Developmental Disabilities*, 30, 67-85. doi: 10.1177/1088357614525659

- Yoder, P. J. (2010). Although there is variability in response to early intensive behavioral intervention (EIBI), EIBI tends to facilitate IQ in children with autism. *Evidence-Based Communication Assessment and Intervention*, 4, 14-17. doi: 10.1080/17489530903523306
- Zarafshan, H., Salmanian, M., Aghamohammadi, S., Mohammadi, M. R., & Mostafavi, S. A. (2017). Effectiveness of non-pharmacological interventions on stereotyped and repetitive behaviors of pre-school children with autism: A systematic review. *Basic and Clinical Neuroscience*, 8, 95-104. doi: 10.18869/nirp.bcn.8.2.95
- Zwaigenbaum, L., Bauman, M. L., Choueiri, R., Kasari, C., Carter, A., Granpeesheh, D., ... & Pierce, K. (2015). Early intervention for children with autism spectrum disorder under 3 years of age: Recommendations for practice and research. *Pediatrics*, 136, S60-S81. doi: <https://doi.org/10.1542/peds.2014-3667E>
- Exclusion reason: No relevant design (n=62)
- Abdo, M., & Al Osman, H. (2019). Technology impact on reading and writing skills of children with autism: A systematic literature review. *Health and Technology*, 9, 725-735. doi: 10.1007/s12553-019-00317-4
- Aldabas, R. (2020). Effectiveness of peer-mediated interventions (PMIs) on children with autism spectrum disorder (ASD): A systematic review. *Early Child Development and Care*, 190, 1586-1603. doi: 10.1080/03004430.2019.1580275
- Asaro-Saddler, K. (2016). Writing instruction and self-regulation for students with autism spectrum disorders. *Topics in Language Disorders*, 36, 266-283. doi: 10.1097/TLD.0000000000000093
- Banda, D. R., Griffin-Shirley, N., Okungu, P. A., Ogot, O. P., & Meeks, M. K. (2014). A review of intervention studies conducted with individuals with autism and sensory impairments. *Journal of Visual Impairment & Blindness*, 108, 299-309.
- Barnett, J. H., Frankel, A. J., & Fisher, K. W. (2018). Systematic review of evidence-based interventions in science for students with autism spectrum disorders. *Education and Training in Autism and Developmental Disabilities*, 53, 128-145.
- Borders, C. M., Jones Bock, S., & Probst, K. M. (2016). A review of educational practices for deaf/hard of hearing students with comorbid autism. *Deafness & Education International*, 18, 189-205. doi: 10.1080/14643154.2016.1255416
- Bowman, J. A., McDonnell, J., Ryan, J. H., & Fudge-Coleman, O. (2019). Effective mathematics instruction for students with moderate and severe disabilities: A review of the literature. *Focus on Autism and Other Developmental Disabilities*, 34, 195-204. doi: 10.1177/1088357619827932
- Boyle, S. A., McNaughton, D., & Chapin, S. E. (2019). Effects of shared reading on the early language and literacy skills of children with autism spectrum disorders: A systematic review. *Focus on Autism and Other Developmental Disabilities*, 34, 205-214. doi: 10.1177/1088357619838276
- Brady, R., Maccarrone, A., Holloway, J., Gunning, C., & Pacia, C. (2020). Exploring interventions used to teach friendship skills to children and adolescents with high-functioning autism: A systematic review. *Review Journal of Autism and Developmental Disorders*, 1-11. doi: 10.1007/s40489-019-00194-7
- Brock, M. E., & Carter, E. W. (2013). A systematic review of paraprofessional-delivered educational practices to improve outcomes for students with intellectual and developmental disabilities. *Research and Practice for Persons with Severe Disabilities*, 38, 211-221. doi: <https://doi.org/10.1177/154079691303800401>
- Cachia, R. L., Anderson, A., & Moore, D. W. (2016). Mindfulness in individuals with autism spectrum disorder: A systematic review and narrative analysis. *Review Journal of Autism and Developmental Disorders*, 3, 165-178.
- Chung, Y. C., Carter, E. W., & Sisco, L. G. (2012). A systematic review of interventions to increase peer interactions for students with complex communication challenges. *Research and Practice for Persons with Severe Disabilities*, 37, 271-287.

- Dart, E. H., Radley, K. C., Mason, B. A., & Allen, J. P. (2018). Addressing escape-maintained behavior for students with developmental disabilities: A systematic review of school-based interventions. *Psychology in the Schools*, 55, 295-304.
- DeSouza, A. A., Akers, J. S., & Fisher, W. W. (2017). Empirical application of Skinner's verbal behavior to interventions for children with autism: A review. *The Analysis of Verbal Behavior*, 33, 229-259. doi: <http://dx.doi.org/10.1007/s40616-017-0093-7>
- Falcomata, T. S., & Wacker, D. P. (2013). On the use of strategies for programming generalization during functional communication training: A review of the literature. *Journal of Developmental and Physical Disabilities*, 25, 5-15. doi: 10.1007/s10882-012-9311-3
- Ganz, J. B., Davis, J. L., Lund, E. M., Goodwyn, F. D., & Simpson, R. L. (2012). Meta-analysis of PECS with individuals with ASD: Investigation of targeted versus non-targeted outcomes, participant characteristics, and implementation phase. *Research in Developmental Disabilities*, 33, 406-418.
- Ganz, J. B., Mason, R. A., Goodwyn, F. D., Boles, M. B., Heath, A. K., & Davis, J. L. (2014). Interaction of participant characteristics and type of AAC with individuals with ASD: A meta-analysis. *American Journal on Intellectual and Developmental Disabilities*, 119, 516-535. doi: <http://dx.doi.org/10.1352/1944-7558-119.6.516>
- Gerow, S., Hagan-Burke, S., Rispoli, M., Gregori, E., Mason, R., & Ninci, J. (2018). A systematic review of parent-implemented functional communication training for children with ASD. *Behavior Modification*, 42, 335-363. doi: 10.1177/0145445517740872
- Gevarter, C., Bryant, D. P., Bryant, B., Watkins, L., Zamora, C., & Sammarco, N. (2016). Mathematics interventions for individuals with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 3, 224-238. doi: 10.1007/s40489-016-0078-9
- Goo, M., Maurer, A. L., & Wehmeyer, M. L. (2019). Systematic review of using portable smart devices to teach functional skills to students with intellectual disability. *Education and Training in Autism and Developmental Disabilities*, 54, 57-68.
- Guerra, B. T., Santo, L. A. A. D. E., Barros, R. D. S., & Almeida-Verdu, A. C. M. (2019). Teaching of echoic in people with autism spectrum disorders: Systematic review of literature. *Revista Brasileira de Educação Especial*, 25, 691-708. doi: 10.1590/s1413-65382519000400010
- Gunning, C., Breathnach, Ó., Holloway, J., McTiernan, A., & Malone, B. (2019). A systematic review of peer-mediated interventions for preschool children with autism spectrum disorder in inclusive settings. *Review Journal of Autism and Developmental Disorders*, 6, 40-62. doi: 10.1007/s40489-018-0153-5
- Gunning, C., Holloway, J., Fee, B., Breathnach, Ó., Bergin, C. M., Greene, I., & Bheoláin, R. N. (2019). A systematic review of generalization and maintenance outcomes of social skills intervention for preschool children with autism spectrum disorder. *Review Journal of Autism and Developmental Disorders*, 6, 172-199. doi: 10.1007/s40489-019-00162-1
- Hartley, M., Dorstyn, D., & Due, C. (2019). Mindfulness for children and adults with autism spectrum disorder and their caregivers: A meta-analysis. *Journal of Autism and Developmental Disorders*, 49, 4306-4319. doi: 10.1007/s10803-019-04145-3
- Hillman, H. (2018). Child-centered play therapy as an intervention for children with autism: A literature review. *International Journal of Play Therapy*, 27, 198-204. doi: 10.1037/pla0000083
- Hong, E. R., Ganz, J. B., Ninci, J., Neely, L., Gilliland, W., & Boles, M. (2015). An evaluation of the quality of research on evidence-based practices for daily living skills for individuals with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 45, 2792-2815. doi: 10.1007/s10803-015-2444-3
- Hong, E. R., Neely, L., Gerow, S., & Gann, C. (2018). The effect of caregiver-delivered social-communication interventions on skill generalization and maintenance in ASD. *Research in Developmental Disabilities*, 74, 57-71. doi: 10.1016/j.ridd.2018.01.006

- Howley, M. (2015). Outcomes of structured teaching for children on the autism spectrum: does the research evidence neglect the bigger picture? *Journal of Research in Special Educational Needs*, 15, 106-119.
- Hughes, E. M., & Yakubova, G. (2019). Addressing the mathematics gap for students with ASD: An evidence-based systematic review of video-based mathematics interventions. *Review Journal of Autism and Developmental Disorders*, 6, 147-158. doi: 10.1007/s40489-019-00160-3
- Hutchinson, N., & Bodicoat, A. (2015). The effectiveness of intensive interaction, a systematic literature review. *Journal of Applied Research in Intellectual Disabilities*, 28, 437-454. doi:10.1111/jar.12138
- Hwang, Y. S., & Kearney, P. (2013). A systematic review of mindfulness intervention for individuals with developmental disabilities: Long-term practice and long lasting effects. *Research in Developmental Disabilities*, 34, 314-326.
- Kane, M., Connell, J. E., & Pellecchia, M. (2010). A quantitative analysis of language interventions for children with autism. *The Behavior Analyst Today*, 11, 128-144.
- King, S. A., Lemons, C. J., & Davidson, K. A. (2016). Math interventions for students with autism spectrum disorder: A best-evidence synthesis. *Exceptional Children*, 82, 443-462. doi: <http://dx.doi.org/10.1177/0014402915625066>
- Kurtz, P. F., Boelter, E. W., Jarmolowicz, D. P., Chin, M. D., & Hagopian, L. P. (2011). An analysis of functional communication training as an empirically supported treatment for problem behavior displayed by individuals with intellectual disabilities. *Research in Developmental Disabilities*, 32, 2935-2942. doi: 10.1016/j.ridd.2011.05.009
- Lang, R., Didden, R., Machalicek, W., Rispoli, M., Sigafos, J., Lancioni, G., ... & Kang, S. (2010). Behavioral treatment of chronic skin-picking in individuals with developmental disabilities: A systematic review. *Research in Developmental Disabilities*, 31, 304-315. doi: 10.1016/j.ridd.2009.10.017
- Lang, R., Kuriakose, S., Lyons, G., Mulloy, A., Boutot, A., Britt, C., ... & Lancioni, G. (2011). Use of school recess time in the education and treatment of children with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, 5, 1296-1305. doi: 10.1016/j.rasd.2011.02.012
- Lang, R., Machalicek, W., Rispoli, M., & Regehr, A. (2009). Training parents to implement communication interventions for children with autism spectrum disorders (ASD): A systematic review. *Evidence-Based Communication Assessment and Intervention*, 3, 174-190.
- Lang, R., Mulloy, A., Giesbers, S., Pfeiffer, B., Delaune, E., Didden, R., ... & O'Reilly, M. (2011). Behavioral interventions for rumination and operant vomiting in individuals with intellectual disabilities: A systematic review. *Research in Developmental Disabilities*, 32, 2193-2205. doi: 10.1016/j.ridd.2011.06.011
- Ledbetter-Cho, K., O'Reilly, M., Lang, R., Watkins, L., & Lim, N. (2018). Meta-analysis of tablet-mediated interventions for teaching academic skills to individuals with autism. *Journal of Autism and Developmental Disorders*, 48, 3021-3036. doi: 10.1007/s10803-018-3573-2
- Lequia, J., Wilkerson, K. L., Kim, S., & Lyons, G. L. (2015). Improving transition behaviors in students with autism spectrum disorders: A comprehensive evaluation of interventions in educational settings. *Journal of Positive Behavior Interventions*, 17, 146-158. doi: 10.1177/1098300714548799
- Lorah, E. R., Parnell, A., Whitby, P. S., & Hantula, D. (2015). A systematic review of tablet computers and portable media players as speech generating devices for individuals with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 45, 3792-3804. doi:10.1007/s10803-014-2314-4
- Lory, C., Mason, R. A., Davis, J. L., Wang, D., Kim, S. Y., Gregori, E., & David, M. (2020). A meta-analysis of challenging behavior interventions for students with developmental disabilities in inclusive school settings. *Journal of Autism and Developmental Disorders*, 50, 1221-1237.

May-Benson, T. A., & Koomar, J. A. (2010). Systematic review of the research evidence examining the effectiveness of interventions using a sensory integrative approach for children. *American Journal of Occupational Therapy*, 64, 403-414. doi: 10.5014/ajot.2010.09071

Morin, K. L., Ganz, J. B., Gregori, E. V., Foster, M. J., Gerow, S. L., Genç-Tosun, D., & Hong, E. R. (2018). A systematic quality review of high-tech AAC interventions as an evidence-based practice. *Augmentative and Alternative Communication*, 34, 104-117. doi: <http://dx.doi.org/10.1080/07434618.2018.1509530>

Mrachko, A. A., & Kaczmarek, L. A. (2017). Examining paraprofessional interventions to increase social communication for young children with ASD. *Topics in Early Childhood Special Education*, 37, 4-15. doi: 10.1177/0271121416662870

Neely, L., Gerow, S., Rispoli, M., Lang, R., & Pullen, N. (2016). Treatment of echolalia in individuals with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 3, 82-91. doi: 10.1007/s40489-015-0067-4

O'Donoghue, M., O'Dea, A., O'Leary, N., Kennedy, N., Forbes, J., & Murphy, C. A. (2020). Systematic review of peer-mediated intervention for children with autism who are minimally verbal. *Review Journal of Autism and Developmental Disorders*, 1-16. doi: 10.1007/s40489-020-00201-2

Ramdoss, S., Lang, R., Mulloy, A., Franco, J., O'Reilly, M., Didden, R., & Lancioni, G. (2011). Use of computer-based interventions to teach communication skills to children with autism spectrum disorders: A systematic review. *Journal of Behavioral Education*, 20(1), 55-76.

Raulston, T., Carnett, A., Lang, R., Tostanoski, A., Lee, A., Machalicek, W., ... & Lancioni, G. E. (2013). Teaching individuals with autism spectrum disorder to ask questions: A systematic review. *Research in Autism Spectrum Disorders*, 7, 866-878. doi: 10.1016/j.rasd.2013.03.008

Rispoli, M., Neely, L., Lang, R., & Ganz, J. (2011). Training paraprofessionals to implement interventions for people autism spectrum disorders: A systematic review. *Developmental Neurorehabilitation*, 14, 378-388. doi: 10.3109/17518423.2011.620577

Rosen, T. E., Connell, J. E., & Kerns, C. M. (2016). A review of behavioral interventions for anxiety-related behaviors in lower-functioning individuals with autism. *Behavioral Interventions*, 31, 120-143. doi: 10.1002/bin.1442

Sherlock, P., Chezan, L. C., Wolfe, K., Drasgow, E., & Habing, B. (2018). Using linear mixed effects models: A single-case experimental design meta-analysis of functional communication training. *Evidence-Based Communication Assessment and Intervention*, 12(1-2), 31-53. doi: 10.1080/17489539.2018.1460902

Still, K., Rehfeldt, R. A., Whelan, R., May, R., & Dymond, S. (2014). Facilitating requesting skills using high-tech augmentative and alternative communication devices with individuals with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, 8, 1184-1199. doi: 10.1016/j.rasd.2014.06.003

Sutton, B. M., Webster, A. A., & Westerveld, M. F. (2019). A systematic review of school-based interventions targeting social communication behaviors for students with autism. *Autism*, 23, 274-286. doi: 10.1177/1362361317753564

Taylor, C. J., Spriggs, A. D., Ault, M. J., Flanagan, S., & Sartini, E. C. (2017). A systematic review of weighted vests with individuals with autism spectrum disorder. *Research in Autism Spectrum Disorders*, 37, 49-60. doi: 10.1016/j.rasd.2017.03.003

Therrien, M. C., Light, J., & Pope, L. (2016). Systematic review of the effects of interventions to promote peer interactions for children who use aided AAC. *Augmentative and Alternative Communication*, 32, 81-93. doi: 10.3109/07434618.2016.1146331

van der Meer, L., Sigafoos, J., O'Reilly, M. F., & Lancioni, G. E. (2011). Assessing preferences for AAC options in communication interventions for individuals with developmental disabilities: A review of the literature. *Research in Developmental Disabilities*, 32, 1422-1431. doi: 10.1016/j.ridd.2011.02.003

- von der Embse, N., Brown, A., & Fortain, J. (2011). Facilitating inclusion by reducing problem behaviors for students with autism spectrum disorders. *Intervention in School and Clinic*, 47, 22-30.
- Watkins, L., O'Reilly, M., Kuhn, M., Gevarter, C., Lancioni, G. E., Sigafoos, J., & Lang, R. (2015). A review of peer-mediated social interaction interventions for students with autism in inclusive settings. *Journal of Autism and Developmental Disorders*, 45, 1070-1083. doi: 10.1007/s10803-014-2264-x
- Weaver, L. L. (2015). Effectiveness of work, activities of daily living, education, and sleep interventions for people with autism spectrum disorder: A systematic review. *American Journal of Occupational Therapy*, 69(5), 1-11. doi: 10.5014/ajot.2015.017962
- Wolfe, K., Slocum, T. A., & Kunnavatana, S. S. (2014). Promoting behavioral variability in individuals with autism spectrum disorders: A literature review. *Focus on Autism and Other Developmental Disabilities*, 29, 180-190. doi: 10.1177/1088357614525661
- Zajic, M. C., & Wilson, S. E. (2020). Writing research involving children with autism spectrum disorder without a co-occurring intellectual disability: A systematic review using a language domains and mediational systems framework. *Research in Autism Spectrum Disorders*, 70, 1-27. doi: 10.1016/j.rasd.2019.101471
- Exclusion reason: No (separate analysis of) ASD (n=38)
- Adair, B., Ullenhag, A., Keen, D., Granlund, M., & Imms, C. (2015). The effect of interventions aimed at improving participation outcomes for children with disabilities: a systematic review. *Developmental Medicine & Child Neurology*, 57, 1093-1104. doi: 10.1111/dmcn.12809
- Ahn, S., & Hwang, S. (2017). Cognitive rehabilitation with neurodevelopmental disorder: A systematic review. *NeuroRehabilitation*, 41, 707-719. doi: 10.3233/NRE-172146
- Almalki, N. (2016). What is the best strategy" evidence-based practice" to teach literacy skills for students with multiple disabilities? A systematic review. *World Journal of Education*, 6(6), 18-30.
- Alsayedhassan, B., Banda, D. R., & Griffin-Shirley, N. (2016). A review of picture exchange communication interventions implemented by parents and practitioners. *Child & Family Behavior Therapy*, 38, 191-208. doi: 10.1080/07317107.2016.1203135
- Alzrayer, N., Banda, D. R., & Koul, R. K. (2014). Use of iPad/iPods with individuals with autism and other developmental disabilities: A meta-analysis of communication interventions. *Review Journal of Autism and Developmental Disorders*, 1, 179-191. doi: 10.1007/s40489-014-0018-5
- Apanasionok, M. M., Hastings, R. P., Grindle, C. F., Watkins, R. C., & Paris, A. (2019). Teaching science skills and knowledge to students with developmental disabilities: A systematic review. *Journal of Research in Science Teaching*, 56, 847-880.
- Arbesman, M., Bazyk, S., & Nochajski, S. M. (2013). Systematic review of occupational therapy and mental health promotion, prevention, and intervention for children and youth. *American Journal of Occupational Therapy*, 67(6), e120-e130. doi: 10.5014/ajot.2013.008359
- Barlow, J., Bergman, H., Kornør, H., Wei, Y., & Bennett, C. (2016). Group-based parent training programmes for improving emotional and behavioural adjustment in young children. *Cochrane Database of Systematic Reviews*, 2016 (8). doi: 10.1002/14651858.CD003680.pub3
- Barlow, J., Smailagic, N., Huband, N., Roloff, V., Bennett, C. (2014). Group based parent training programmes for improving parental psychosocial health. *Cochrane Database of Systematic Reviews*, 2014 (5). doi: 10.1002/14651858.CD002020.pub4
- Barton, E. E., Reichow, B., Schnitz, A., Smith, I. C., & Sherlock, D. (2015). A systematic review of sensory-based treatments for children with disabilities. *Research in Developmental Disabilities*, 37, 64-80. doi: 10.1016/j.ridd.2014.11.006
- Brooks, H. L., Rushton, K., Lovell, K., Bee, P., Walker, L., Grant, L., & Rogers, A. (2018). The power of support from companion animals for people living with mental health problems: A systematic review and narrative synthesis of the evidence. *BMC Psychiatry*, 18(1), 1-12. doi: 10.1186/s12888-018-1613-2

- Brown, L. S., & Jellison, J. A. (2012). Music research with children and youth with disabilities and typically developing peers: A systematic review. *Journal of Music Therapy*, 49, 335-364.
- Bunge, E. L., Dickter, B., Jones, M. K., Alie, G., Spear, A., & Perales, R. (2016). Behavioral intervention technologies and psychotherapy with youth: A review of the literature. *Current Psychiatry Reviews*, 12, 14-28. doi: 10.2174/1573400511666150930232254
- Comer, J. S., Chow, C., Chan, P. T., Cooper-Vince, C., & Wilson, L. A. (2013). Psychosocial treatment efficacy for disruptive behavior problems in very young children: A meta-analytic examination. *Journal of the American Academy of Child & Adolescent Psychiatry*, 52, 26-36. doi: 10.1016/j.jaac.2012.10.001
- Donne, V. (2013). Technology to support sign language for students with disabilities. *Rural Special Education Quarterly*, 32(4), 24-37. doi: 10.1177/875687051303200404
- Fernandez-Sotos, P., Torio, I., Fernandez-Caballero, A., Navarro, E., Gonzalez, P., Dompablo, M., & Rodriguez-Jimenez, R. (2019). Social cognition remediation interventions: A systematic mapping review. *PloS one*, 14, 1-20. doi: 10.1371/journal.pone.0218720
- Furlong, M., McGilloy, S., Bywater, T., Hutchings, J., Smith, S. M., & Donnelly, M. (2012). Behavioural and cognitive-behavioural group-based parenting programmes for early-onset conduct problems in children aged 3 to 12 years. *Campbell Systematic Reviews*, 2012 (8), 1-239. doi: 10.1002/14651858.CD008225.pub2
- Goddard, A. T., & Gilmer, M. J. (2015). The role and impact of animals with pediatric patients. *Pediatric Nursing*, 41(2), 65-71.
- Jonsson, U., Alaie, I., Parling, T., & Arnberg, F. K. (2014). Reporting of harms in randomized controlled trials of psychological interventions for mental and behavioral disorders: A review of current practice. *Contemporary Clinical Trials*, 38(1), 1-8. doi: 10.1016/j.cct.2014.02.005
- Lichtlé, J., Downes, N., Engelberg, A., & Cappe, E. (2020). The effects of parent training programs on the quality of life and stress levels of parents raising a child with autism spectrum disorder: A systematic review of the literature. *Review Journal of Autism and Developmental Disorders*, 7, 242-262. doi: 10.1007/s40489-019-00190-x
- Losinski, M., Sanders, S. A., & Wiseman, N. M. (2016). Examining the use of deep touch pressure to improve the educational performance of students with disabilities: A meta-analysis. *Research and Practice for Persons with Severe Disabilities*, 41, 3-18. doi: 10.1177/1540796915624889
- Metzner, F., Wichmann, M. L. Y., & Mays, D. (2020). Educational transition outcomes of children and adolescents with clinically relevant emotional or behavioural disorders: Results of a systematic review. *British Journal of Special Education*, 47, 230-257. doi: 10.1111/1467-8578.12310
- Mulhern, T., Lydon, S., Healy, O., Mollaghan, G., Ramey, D., & Leoni, M. (2017). A systematic review and evaluation of procedures for the induction of speech among persons with developmental disabilities. *Developmental Neurorehabilitation*, 20, 207-227. doi: 10.3109/17518423.2016.1150360
- Pennington, L., Akor, W. A., Laws, K., & Goldbart, J. (2018). Parent-mediated communication interventions for improving the communication skills of preschool children with non-progressive motor disorders. *Cochrane Database of Systematic Reviews*, 2018 (7). doi: 10.1002/14651858.CD012507.pub2
- Pfeiffer, B., Clark, G. F., & Arbesman, M. (2018). Effectiveness of cognitive and occupation-based interventions for children with challenges in sensory processing and integration: A systematic review. *American Journal of Occupational Therapy*, 72, 1-9. doi: 10.5014/ajot.2018.028233
- Polatajko, H. J., & Cantin, N. (2010). Exploring the effectiveness of occupational therapy interventions, other than the sensory integration approach, with children and adolescents experiencing difficulty processing and integrating sensory information. *American Journal of Occupational Therapy*, 64, 415-429. doi: 10.5014/ajot.2010.09072
- Ramdoss, S., Lang, R., Fragale, C., Britt, C., O'Reilly, M., Sigafoos, J., ... & Lancioni, G. E. (2012). Use of computer-based interventions to promote daily living skills in individuals with

- intellectual disabilities: A systematic review. *Journal of Developmental and Physical Disabilities*, 24, 197-215. doi: 10.1007/s10882-011-9259-8
- Reichow, B., Lemons, C. J., Maggin, D. M., & Hill, D. R. (2019). Beginning reading interventions for children and adolescents with intellectual disability. *Cochrane Database of Systematic Reviews*, 12. doi: 10.1002/14651858.CD011359.pub2
- Reynolds, S., Wilson, C., Austin, J., & Hooper, L. (2012). Effects of psychotherapy for anxiety in children and adolescents: A meta-analytic review. *Clinical Psychology Review*, 32, 251-262. doi: 10.1016/j.cpr.2012.01.005
- Saxena, S., Mitchell, J., Ehsan, A., Majnemer, A., Shikako-Thomas, K. (2020). Online peer mentorship programs for children and adolescents with neurodevelopmental disabilities: A systematic review. *Child: Care, Health and Development*, 46, 132-148. doi: 10.1111/cch.12726
- Sievers, S. B., Trembath, D., & Westerveld, M. (2018). A systematic review of predictors, moderators, and mediators of augmentative and alternative communication (AAC) outcomes for children with autism spectrum disorder. *Augmentative and Alternative Communication*, 34, 219-229. doi: 10.1080/07434618.2018.1462849
- Spooner, F., Root, J. R., Saunders, A. F., & Browder, D. M. (2019). An updated evidence-based practice review on teaching mathematics to students with moderate and severe developmental disabilities. *Remedial and Special Education*, 40, 150-165. doi: 10.1177/0741932517751055
- Stephenson, J., & Limbrick, L. (2015). A review of the use of touch-screen mobile devices by people with developmental disabilities. *Journal of Autism and Developmental Disorders*, 45), 3777-3791.
- Tomlinson, S. R., Gore, N., & McGill, P. (2018). Training individuals to implement applied behavior analytic procedures via telehealth: A systematic review of the literature. *Journal of Behavioral Education*, 27, 172-222. doi: 10.1007/s10864-018-9292-0
- Unholz-Bowden, E., McComas, J. J., McMaster, K. L., Girtler, S. N., Kolb, R. L., & Shipchandler, A. (2020). Caregiver training via telehealth on behavioral procedures: A systematic review. *Journal of Behavioral Education*, 29, 246-281. doi: 10.1007/s10864-020-09381-7
- Valmaggia, L. R., Latif, L., Kempton, M. J., & Rus-Calafell, M. (2016). Virtual reality in the psychological treatment for mental health problems: A systematic review of recent evidence. *Psychiatry Research*, 236, 189-195. doi: 10.1016/j.psychres.2016.01.015
- Weedle, S. (2016). The use of Intensive Interaction with people with severe-profound intellectual disability. *Learning Disability Practice*, 19(9), 27-34. doi: 10.7748/ldp.2016.e1780
- Yunus, F. W., Liu, K. P., Bissett, M., & Penkala, S. (2015). Sensory-based intervention for children with behavioral problems: A systematic review. *Journal of Autism and Developmental Disorders*, 45, 3565-3579.
- Exclusion reason: No relevant (summary of) outcomes (n=36)
- Adams, D., Young, K., & Keen, D. (2019). Anxiety in children with autism at school: A systematic review. *Review Journal of Autism and Developmental Disorders*, 6, 274-288. doi: 10.1007/s40489-019-00172-z
- Brignell, A., Chenausky, K. V., Song, H., Zhu, J., Suo, C., & Morgan, A. T. (2018). Communication interventions for autism spectrum disorder in minimally verbal children. *Cochrane Database of Systematic Reviews*, 11. doi: 10.1002/14651858.CD012324.pub2
- Cadogan, S., & McCrimmon, A. W. (2015). Pivotal response treatment for children with autism spectrum disorder: A systematic review of research quality. *Developmental Neurorehabilitation*, 18, 137-144. doi: 10.3109/17518423.2013.845615
- Caron, V., Berube, A., & Paquet, A. (2017). Implementation evaluation of early intensive behavioral intervention programs for children with autism spectrum disorders: A systematic review of studies in the last decade. *Evaluation and Program Planning*, 62, 1-8. doi: 10.1016/j.evalprogplan.2017.01.004

- DeJong, H., Bunton, P., & Hare, D. J. (2014). A systematic review of interventions used to treat catatonic symptoms in people with autistic spectrum disorders. *Journal of Autism and Developmental Disorders*, 44, 2127-2136. doi: 10.1007/s10803-014-2085-y
- Gould, K. M., Collier-Meek, M., DeFouw, E. R., Silva, M., & Kleinert, W. (2019). A systematic review of treatment integrity assessment from 2004 to 2014: Examining behavioral interventions for students with autism spectrum disorder. *Contemporary School Psychology*, 23, 220–230. doi: <https://doi.org/10.1007/s40688-019-00233-4>
- Harrop, C. (2015). Evidence-based, parent-mediated interventions for young children with autism spectrum disorder: The case of restricted and repetitive behaviors. *Autism*, 19, 662-672. doi: 10.1177/1362361314545685
- Hillman, K., Dix, K., Ahmad, K., Lietz, P., Trevitt, J., O'Grady, E., ... & Hedley, D. (2020). Interventions for anxiety in mainstream school-aged children with autism spectrum disorder: A systematic review. *Campbell Systematic Reviews*, 16(2), e1086. doi: <https://doi.org/10.1002/cl2.1086>
- Huber, H. B., & Carter, E. W. (2016). Data-driven individualization in peer-mediated interventions for students with ASD: A literature review. *Review Journal of Autism and Developmental Disorders*, 3, 239-253. doi: 10.1007/s40489-016-0079-8
- Imms, C., Adair, B., Keen, D., Ullenhag, A., Rosenbaum, P., & Granlund, M. (2016). 'Participation': A systematic review of language, definitions, and constructs used in intervention research with children with disabilities. *Developmental Medicine & Child Neurology*, 58, 29-38. doi: 10.1111/dmcn.12932
- James, A. C., James, G., Cowdrey, F. A., Soler, A., & Choke, A. (2013). Cognitive behavioural therapy for anxiety disorders in children and adolescents. *Cochrane Database of Systematic Reviews*, 2013 (6). doi: <https://doi.org/10.1002/14651858.CD004690.pub3>
- Jonsson, U., Choque Olsson, N., & Bölte, S. (2016). Can findings from randomized controlled trials of social skills training in autism spectrum disorder be generalized? The neglected dimension of external validity. *Autism*, 20, 295-305. doi: 10.1177/1362361315583817
- Kaat, A. J., & Lecavalier, L. (2014). Group-based social skills treatment: A methodological review. *Research in Autism Spectrum Disorders*, 8, 15-24. doi: 10.1016/j.rasd.2013.10.007
- Kester, K. R., & Lucyshyn, J. M. (2018). Cognitive behavior therapy to treat anxiety among children with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, 52, 37-50. doi: 10.1016/j.rasd.2018.05.002
- Kreslins, A., Robertson, A. E., & Melville, C. (2015). The effectiveness of psychosocial interventions for anxiety in children and adolescents with autism spectrum disorder: A systematic review and meta-analysis. *Child and Adolescent Psychiatry and Mental Health*, 9(1), 1-12. doi: 10.1186/s13034-015-0054-7
- Lake, J. K., Tablon Modica, P., Chan, V., & Weiss, J. A. (2020). Considering efficacy and effectiveness trials of cognitive behavioral therapy among youth with autism: A systematic review. *Autism*. doi: 10.1177/1362361320918754
- Lane, J. D., Lieberman-Betz, R., & Gast, D. L. (2016). An analysis of naturalistic interventions for increasing spontaneous expressive language in children with autism spectrum disorder. *The Journal of Special Education*, 50, 49-61. doi: <http://dx.doi.org/10.1177/0022466915614837>
- Lang, R., Regester, A., Lauderdale, S., Ashbaugh, K., & Haring, A. (2010). Treatment of anxiety in autism spectrum disorders using cognitive behaviour therapy: A systematic review. *Developmental Neurorehabilitation*, 13, 53-63. doi: 10.3109/17518420903236288
- Lemmon, K. (2013). Alleviating anxiety in children and adolescents with autism spectrum disorders: exploring the effectiveness of cognitive-behaviour therapy. *New Zealand Journal of Teachers' Work*, 10(1), 67-85.

Lopata, C., Donnelly, J. P., Rodgers, J. D., & Thomeer, M. L. (2019). Systematic review of data analyses and reporting in group-based social skills intervention RCTs for youth with ASD. *Research in Autism Spectrum Disorders*, 59, 10-21. doi: 10.1016/j.rasd.2018.11.008

Odom, S. L., Boyd, B. A., Hall, L. J., & Hume, K. (2010). Evaluation of comprehensive treatment models for individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 40, 425-436. doi: 10.1007/s10803-009-0825-1

Perihan, C., Burke, M., Bowman-Perrott, L., Bicer, A., Gallup, J., Thompson, J., & Sallese, M. (2020). Effects of cognitive behavioral therapy for reducing anxiety in children with high functioning ASD: A systematic review and meta-analysis. *Journal of Autism and Developmental Disorders*, 50, 1958-1972. doi: 10.1007/s10803-019-03949-7

Reichow, B., & Volkmar, F. R. (2010). Social skills interventions for individuals with autism: Evaluation for evidence-based practices within a best evidence synthesis framework. *Journal of Autism and Developmental Disorders*, 40, 149-166. doi: 10.1007/s10803-009-0842-0

Rumney, H. L., & MacMahon, K. (2017). Do social skills interventions positively influence mood in children and young people with autism? A systematic review. *Mental Health & Prevention*, 5, 12-20. doi: 10.1016/j.mhp.2016.12.001

Schlosser, R. W., Hemsley, B., Shane, H., Todd, J., Lang, R., Lilienfeld, S. O., ... & Odom, S. (2019). Rapid prompting method and autism spectrum disorder: systematic review exposes lack of evidence. *Review Journal of Autism and Developmental Disorders*, 6, 403-412. doi: 10.1007/s40489-019-00175-w

Spain, D., Sin, J., Paliokosta, E., Furuta, M., Prunty, J. E., Chalder, T., ... & Happe, F. G. (2017). Family therapy for autism spectrum disorders. *Cochrane Database of Systematic Reviews*, 2017(5). doi: 10.1002/14651858.CD011894.pub2

Sukhodolsky, D. G., Bloch, M. H., Panza, K. E., & Reichow, B. (2013). Cognitive-behavioral therapy for anxiety in children with high-functioning autism: a meta-analysis. *Pediatrics*, 132, e1341-e1350. doi: 10.1542/peds.2013-1193

Tait, K. (2013). Cognitive behaviour therapy for reducing anxiety in school-aged children diagnosed with autism spectrum disorders. *New Zealand Journal of Teachers' Work*, 10, 44-65.

Trembath, D., Gurm, M., Scheerer, N. E., Trevisan, D. A., Paynter, J., Bohadana, G., ... & Iarocci, G. (2019). Systematic review of factors that may influence the outcomes and generalizability of parent-mediated interventions for young children with autism spectrum disorder. *Autism Research*, 12, 1304-1321. doi: 10.1002/aur.2168

Trevisan, D. F., Becerra, L., Benitez, P., Higbee, T. S., & Gois, J. P. (2019). A review of the use of computational technology in applied behavior analysis. *Adaptive Behavior*, 27, 183-196. doi: <http://dx.doi.org/10.1177/1059712319839386>

Ung, D., Selles, R., Small, B. J., & Storch, E. A. (2015). A systematic review and meta-analysis of cognitive-behavioral therapy for anxiety in youth with high-functioning autism spectrum disorders. *Child Psychiatry & Human Development*, 46, 533-547. doi: 10.1007/s10578-014-0494-y

Vasa, R. A., Carroll, L. M., Nozzolillo, A. A., Mahajan, R., Mazurek, M. O., Bennett, A. E., ... & Bernal, M. P. (2014). A systematic review of treatments for anxiety in youth with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 44, 3215-3229. doi: 10.1007/s10803-014-2184-9

Walters, S., Loades, M., & Russell, A. (2016). A systematic review of effective modifications to cognitive behavioural therapy for young people with autism spectrum disorders. *Review Journal of Autism and Developmental Disorders*, 3, 137-153. doi: 10.1007/s40489-016-0072-2

Warwick, H., Reardon, T., Cooper, P., Murayama, K., Reynolds, S., Wilson, C., & Creswell, C. (2017). Complete recovery from anxiety disorders following Cognitive Behavior Therapy in children and adolescents: A meta-analysis. *Clinical Psychology Review*, 52, 77-91. doi: 10.1016/j.cpr.2016.12.002

Wieckowski, A. T., Flynn, L. T., Richey, J. A., Gracanin, D., & White, S. W. (2020). Measuring change in facial emotion recognition in individuals with autism spectrum disorder: A systematic review. *Autism*. doi: 10.1177/1362361320925334

Zapata, B. C., Fernández-Alemán, J. L., Idri, A., & Toval, A. (2015). Empirical studies on usability of mHealth apps: A systematic literature review. *Journal of Medical Systems*, 39(2), 1-29. doi: 10.1007/s10916-014-0182-2

Exclusion reason: Excluded publication type (n=29)

Bishop, J. C., & Pangelinan, M. (2018). Motor skills intervention research of children with disabilities. *Research in Developmental Disabilities*, 74, 14-30. doi: 10.1016/j.ridd.2017.11.002

Bloch, M. H. (2017). 6.3 Repetitive behaviors and obsessive-compulsive symptoms in autism spectrum disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, 56(10), S9. doi: 10.1016/j.jaac.2017.07.035

Castro, S. (2019). Translating the outcomes of robotics-based versus virtual reality-based interventions for children and young people with autism into everyday functioning: A systematic review. *Developmental Medicine and Child Neurology*, 61. doi: 10.1111/dmcn.14244

Edwards, B. M., Smart, E., King, G., Curran, C. J., & Kingsnorth, S. (2020). Performance and visual arts-based programs for children with disabilities: a scoping review focusing on psychosocial outcomes. *Disability and Rehabilitation*, 42, 574-585. doi: 10.1080/09638288.2018.1503734

Eldevik, S., Hastings, R. P., Hughes, J. C., Jahr, E., Eikeseth, S., & Cross, S. (2009). Meta-analysis of early intensive behavioral intervention for children with autism. *Journal of Clinical Child & Adolescent Psychology*, 38, 439-450.

Elliott, S. J., McMahon, B. M., & Leech, A. M. (2018). Behavioural and cognitive behavioural therapy for obsessive compulsive disorder (OCD) in individuals with autism spectrum disorder (ASD). *The Cochrane Database of Systematic Reviews*, 2018 (11). doi: 10.1002/14651858.CD013173

Ferretti, A., Kim, S.J., Haushalter, J.L., Hopkin, G. (2018). A systematic review of the effectiveness of mobile apps for common mental health disorders: policy implications and future recommendations. *European Psychiatry*, 48S, S141-S358. doi: 10.1016/j.eurpsy.2017.12.016

Goh, A. E., Drogan, R. R., & Papay, C. K. (2017). Function-based interventions for children with autism spectrum disorders in schools: A review. *International Journal of Special Education*, 32, 115-133.

Howlin, P., Magiati, I., & Charman, T. (2009). Systematic review of early intensive behavioral interventions for children with autism. *American Journal on Intellectual and Developmental Disabilities*, 114, 23-41.

James, A. C., Reardon, T., Soler, A., James, G., & Creswell, C. (2018). Cognitive behavioural therapy for anxiety disorders in children and adolescents. *The Cochrane Database of Systematic Reviews*, 2018 (10). doi: <https://doi.org/10.1002/14651858.CD013162>

Kuhaneck, H., Spitzer, S. L., & Bodison, S. C. (2020). A systematic review of interventions to improve the occupation of play in children with autism. *OTJR: Occupation, Participation and Health*, 40(2), 83-98. doi: 10.1177/1539449219880531

Kulasinghe, K., Whittingham, K., Mitchell, A., Boyd, R. (2020). Efficacy of psychological interventions for mothers of children with Autism Spectrum Disorder in improving the mother-child relationship and mental health. *Developmental Medicine and Child Neurology*, 62 (Supp 2), 4-59. doi: 10.1111/dmcn.14469

Levinson, J., Kohl, K., Baltag, V., & Ross, D. A. (2019). Investigating the effectiveness of school health services delivered by a health provider: A systematic review of systematic reviews. *PloS one*, 14(6), e0212603. doi: 10.1371/journal.pone.0212603

Loucas, C., Pennant, M., Whittington, C., Naqvi, S., Sealey, C., Stockton, S., ... & Kendall, T. (2014). E-therapies for mental health problems in children and young people: A systematic review

and focus group investigation. *Archives of Disease in Childhood*, 99, A58-A58. doi: 10.1136/archdischild-2014-306237.138

Ma, T., Sharifi, H., & Chattopadhyay, D. (2019). Virtual humans in health-related interventions: A meta-analysis. *CHI EA '19: Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing*, 1-6. doi: 10.1145/3290607.3312853

Memon, R. I., Jahan, N., Cheema, Z., Javed, N., Zeshan, M., Naveed, S., & Waqas, A. (2019). Implementation and effectiveness of non-specialist mediated interventions for children with ASD: A systematic review and meta-analysis. *Journal of the American Academy of Child and Adolescent Psychiatry*, 58(10), S156-S157. doi: 10.1016/j.jaac.2019.08.053

Muir, A., Ziviani, J., Boyd, R., & Sakzewski, L. (2018). Treatment fidelity in provider-supported parent implemented intervention studies for infants with/at risk of developmental delay or disability: Systematic review. *Developmental Medicine and Child Neurology*, 60, 14-14.

Novak, I. (2016). Effectiveness of occupational therapy intervention for children with disabilities: Systematic review. *Developmental Medicine & Child Neurology*, 58, 29-30.

Ogundele, M. O., & Ayyash, H. F. (2019). Evidence-based multidisciplinary assessment and management of children and adolescents with neurodevelopmental disorders. *Archives of Disease in Childhood*, 104, A268. doi: 10.1136/archdischild-2019-rcpch.638

Parham, D., & Goldman, R. (2016). Effectiveness of somatosensory-based interventions for children with autism: A systematic review. *American Journal of Occupational Therapy*, 70, 1-1. doi: 10.5014/ajot.2016.70S1-RP201B

Paul R. (2017). What works for treating language disorders in children. *Journal of the American Academy of Child and Adolescent Psychiatry*, 56, S127. doi: 10.1016/j.jaac.2017.07.495

Schlosser, R. W., & Koul, R. K. (2015). Speech output technologies in interventions for individuals with autism spectrum disorders: A scoping review. *Augmentative and Alternative Communication*, 31, 285-309. doi: 10.3109/07434618.2015.1063689

Seeber II, R. E., Spieler, G. S., Moon, S. J., & Kim, J. W. (2019). 1.34 Wearable technology and ASD: A review. *Journal of the American Academy of Child & Adolescent Psychiatry*, 58(10), S157-S158. doi: 10.1016/j.jaac.2019.08.056

Shinday, N., Yeh, G., Wayne, P. (2016). Systematic review of mind-body interventions for impulsivity during pre-adolescence through young adulthood. *Journal of Alternative and Complementary Medicine*, 22(6), A87-A88. doi: 10.1089/acm.2016.29003.abstracts

Stegemann, T., Geretsegger, M., Phan Quoc, E., Riedl, H., & Smetana, M. (2019). Music therapy and other music-based interventions in pediatric health care: An overview. *Medicines*, 6(1), 25.

Tannous, J., & Hetzroni, O. (2012). Evaluation of practice within intervention strategies among students with ASD: A meta-analysis. *Journal of Intellectual Disability Research*, 56(7-8).

Vasa, R. A. (2018). Assessment and management of anxiety in youth with ASD. *Journal of the American Academy of Child and Adolescent Psychiatry*, 57, S134-S135. doi: 10.1016/j.jaac.2018.07.888

Yakkundi, A., Dillenburger, K., Goodman, L., & Dounavi, K. (2017). User centered reading intervention for individuals with autism and intellectual disability. *Studies in Health Technology & Informatics*, 242, 249-256. doi: 10.3233/978-1-61499-798-6-249

Yinger, O. (2017). Music therapy in child and adolescent mental health treatment. *Journal of the American Academy of Child & Adolescent Psychiatry*, 56, S57. doi: 10.1016/j.jaac.2017.07.222

Exclusion reason: No separate analysis < 18 years (n=22)

Barton, E. E., Pustejovsky, J. E., Maggin, D. M., & Reichow, B. (2017). Technology -aided instruction and intervention for students with ASD: A meta-analysis using novel methods of estimating effect sizes for single-case research. *Remedial & Special Education*, 38, 371-386. doi: <https://doi.org/10.1177/0741932517729508>

Bodison, S. C., & Parham, L. D. (2018). Specific sensory techniques and sensory environmental modifications for children and youth with sensory integration difficulties: A systematic review.

American Journal of Occupational Therapy, 72(1), 1–11. doi: <https://doi.org/10.5014/ajot.2018.029413>

Brondino, N., Fusar-Poli, L., Rocchetti, M., Provenzani, U., Barale, F., & Politi, P. (2015). Complementary and alternative therapies for autism spectrum disorder. *Evidence-Based Complementary & Alternative Medicine (eCAM)*, 1–31. doi: <https://doi.org/10.1155/2015/258589>

Case-Smith, J., Weaver, L. L., & Fristad, M. A. (2015). A systematic review of sensory processing interventions for children with autism spectrum disorders. *Autism: The International Journal of Research & Practice*, 19, 133–148. doi: <https://doi.org/10.1177/1362361313517762>

Grynszpan, O., Weiss, P. L. (Tamar), Perez-Diaz, F., & Gal, E. (2014). Innovative technology-based interventions for autism spectrum disorders: A meta-analysis. *Autism: The International Journal of Research & Practice*, 18, 346–361. doi: <https://doi.org/10.1177/1362361313476767>

Hourston, S., & Atchley, R. (2017). Autism and mind-body therapies: A systematic review. *Journal of Alternative & Complementary Medicine*, 23, 331–339. doi: <https://doi.org/10.1089/acm.2016.0336>

James, R., Sigafoos, J., Green, V. A., Lancioni, G. E., O'Reilly, M. F., Lang, R., ... Marschik, P. B. (2015). Music therapy for individuals with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 2(1), 39–54. doi: <https://doi.org/10.1007/s40489-014-0035-4>

Khowaja, K., Salim, S. S., Asemi, A., Ghulamani, S., & Shah, A. (2020). A systematic review of modalities in computer-based interventions (CBIs) for language comprehension and decoding skills of children with autism spectrum disorder (ASD). *Universal Access in the Information Society*, 19, 213–243. doi: <https://doi.org/10.1007/s10209-019-00646-1>

Lau, H.M., Smit, J.H., Fleming, T.M., Riper, H. (2017). Serious games for mental health: Are they accessible, feasible, and effective? A systematic review and meta-analysis. *Frontiers in Psychiatry*, 7. doi: <https://doi.org/10.3389/fpsy.2016.00209>

Lee, C. S. C., Lam, S. H. F., Tsang, S. T. K., Yuen, C. M. C., & Ng, C. K. M. (2018). The effectiveness of technology-based intervention in improving emotion recognition through facial expression in people with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 5(2), 91–104. doi: <https://doi.org/10.1007/s40489-017-0125-1>

McCoy, A., & McNaughton, D. (2019). Training education professionals to use the picture exchange communication system: A review of the literature. *Behavior Analysis in Practice*, 12, 667–676. doi: <https://doi.org/https://dx.doi.org/10.1007/s40617-018-00296-4>

O'Haire, M. E. (2017). Research on animal-assisted intervention and autism spectrum disorder, 2012–2015. *Applied Developmental Science*, 21, 200–216.

Ramdoss, S., Mulloy, A., Lang, R., O'Reilly, M., Sigafoos, J., ... El Zein, F. (2011). Use of computer-based interventions to improve literacy skills in students with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, 5, 1306–1318. doi: <https://doi.org/10.1016/j.rasd.2011.03.004>

Ramdoss, S., Machalicek, W., Rispoli, M., Mulloy, A., Lang, R., & O'Reilly, M. (2012). Computer-based interventions to improve social and emotional skills in individuals with autism spectrum disorders: A systematic review. *Developmental Neurorehabilitation*, 15, 119–135. doi: <https://doi.org/10.3109/17518423.2011.651655>

Reichow, B., AM, S., & Volkmar, F. (2012). Social skills groups for people aged 6 to 21 with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews*, 2012 (7).

Rivera, G., Gerow, S., & Kirkpatrick, M. (2019). A review of school-based interventions to reduce challenging behavior for adolescents with ASD. *Journal of Developmental & Physical Disabilities*, 31(1), 1–21. doi: <https://doi.org/10.1007/s10882-018-9626-9>

Root, J., Stevenson, B., Davis, L., Geddes-Hall, J., & Test, D. (2017). Establishing computer-assisted instruction to teach academics to students with autism as an evidence-based practice.

Journal of Autism & Developmental Disorders, 47, 275–284. doi: <https://doi.org/10.1007/s10803-016-2947-6>

Sinha, Y., Silove, N., Hayen, A., & Williams, K. (2011). Auditory integration training and other sound therapies for autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews*.
Tang J.S.Y., Chen, N.T.M., Falkmer, M., Blte, S., Girdler, S. (2019). A systematic review and meta-analysis of social emotional computer based interventions for autistic individuals using the serious game framework. *Research in Autism Spectrum Disorders*, 66. doi: <https://doi.org/10.1016/j.rasd.2019.101412>

Virues-Ortega, J., Julio, F.M., Pastor-Barriuso, R. (2013). The TEACCH program for children and adults with autism: A meta-analysis of intervention studies. *Clinical Psychology Review*, 33, 940–953. doi: <https://doi.org/10.1016/j.cpr.2013.07.005>

Wolstencroft, J., Robinson, L., Srinivasan, R., Kerry, E., Mandy, W., & Skuse, D. (2018). A systematic review of group social skills interventions, and meta-analysis of outcomes, for children with high functioning ASD. *Journal of Autism & Developmental Disorders*, 48, 2293–2307. doi: <https://doi.org/10.1007/s10803-018-3485-1>

Woodcock, K.A., Blackwell, S. (2020). Psychological treatment strategies for challenging behaviours in neurodevelopmental disorders: What lies beyond a purely behavioural approach? *Current Opinion in Psychiatry*, 33(2), 92–109. doi: <https://doi.org/10.1097/YCO.0000000000000571>

Exclusion reason: No relevant intervention (n=13)

Ampuero, M. E., & Miklos, M. (2019). The effect of joint control training on the performance of multiply controlled behavior: A systematic literature review relevant to children with autism spectrum disorder and other developmental disabilities. *Analysis of Verbal Behavior*, 35, 149–171. doi: <https://doi.org/http://dx.doi.org/10.1007/s40616-019-00116-y>

Bottini, S., Vetter, J., McArdeLL, L., Wiseman, K., & Gillis, J. (2018). Task interspersal: A meta-analytic review of effective programming. *Review Journal of Autism and Developmental Disorders*, 5, 119–128. doi: <https://doi.org/10.1007/s40489-018-0127-7>

Curiel, E. S. L., Axe, J. B., Sainato, D. M., & Goldstein, H. (2020). Systematic review of matrix training for individuals with autism spectrum disorder. *Focus on Autism & Other Developmental Disabilities*, 35, 55–64. doi: <https://doi.org/10.1177/1088357619881216>

DeJesus, B.M., Oliveira, R.C., de Carvalho, F.O., de Jesus Mari, J., Arida, R.M., Teixeira-Machado, L. (2020). Dance promotes positive benefits for negative symptoms in autism spectrum disorder (ASD): A systematic review. *Complementary Therapies in Medicine*, 49. doi: <https://doi.org/10.1016/j.ctim.2020.102299>

Dunst, C.J., Trivette, C.M., Hamby, D.W. (2012). Meta-analysis of studies incorporating the interests of young children with autism spectrum disorders into early intervention practices. *Autism Research and Treatment*, 2012, 462531. doi: <https://doi.org/10.1155/2012/462531>

Finnegan, E., & Accardo, A. L. (2018). Written expression in individuals with autism spectrum disorder: A meta-analysis. *Journal of Autism & Developmental Disorders*, 48, 868–882. doi: <https://doi.org/10.1007/s10803-017-3385-9>

Gilroy, S. P., Kaplan, B. A., & Leader, G. (2018). A systematic review of applied behavioral economics in assessments and treatments for individuals with developmental disabilities. *Review Journal of Autism and Developmental Disorders*, 5, 247–259. doi: <https://doi.org/10.1007/s40489-018-0136-6>

Harrop, C., Amsbary, J., Towner-Wright, S., Reichow, B., Boyd, B.A. (2019). That's what I like: The use of circumscribed interests within interventions for individuals with autism spectrum disorder. A systematic review. *Research in Autism Spectrum Disorders*, 57, 63–86. doi: <https://doi.org/10.1016/j.rasd.2018.09.008>

Koch, S.C., Riege, R.F.F., Tisborn, K., Biondo, J., Martin, L., & Beelmann, A. (2019). Effects of dance movement therapy and dance on health-related psychological outcomes. A meta-analysis update. *Frontiers in Psychology*, 10, 1806. doi: <https://doi.org/10.3389/fpsyg.2019.01806>

Mortimer, R., Privopoulos, M., Kumar, S. (2014). The effectiveness of hydrotherapy in the treatment of social and behavioral aspects of children with autism spectrum disorders: A systematic review. *Journal of Multidisciplinary Healthcare*, 7, 93–103. doi: <https://doi.org/10.2147/JMDH.S55345>

Munandar, V. D., Morningstar, M. E., & Carlson, S. R. (2020). A systematic literature review of video-based interventions to improve integrated competitive employment skills among youth and adults with Autism Spectrum Disorder. *Journal of Vocational Rehabilitation*, 53(1), 29–41. doi: <https://doi.org/10.3233/JVR-201083>

Ramey, D., Lydon, S., Healy, O., McCoy, A., Holloway, J., & Mulhern, T. (2016). A systematic review of the effectiveness of precision teaching for individuals with developmental disabilities. *Review Journal of Autism and Developmental Disorders*, 3, 179–195. doi: <https://doi.org/10.1007/s40489-016-0075-z>

Schmidt, N.B., Vereenoghe, L. (2020). Inclusiveness of cognitive bias modification research toward children and young people with neurodevelopmental disorders: A systematic review. *International Journal of Developmental Disabilities*. doi: <https://doi.org/10.1080/20473869.2020.1720156>

Exclusion reason: No children ≤ 12 years ($n=10$)

Baxter, S., Enderby, P., Evans, P., & Judge, S. (2012). Interventions using high-technology communication devices: A state of the art review. *Folia Phoniatrica et Logopaedica*, 64(3), 137–144. doi: <https://doi.org/10.1159/000338250>

Camargo, M. C., Barros, R. M., Brancher, J. D., Barros, V. T. O., & Santana, M. (2019). Designing gamified interventions for autism spectrum disorder: A systematic review. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 341–352. doi: https://doi.org/10.1007/978-3-030-34644-7_28

Hallyburton, A., & Hinton, J. (2017). Canine-assisted therapies in autism: a systematic review of published studies relevant to recreational therapy. *Therapeutic Recreation Journal*, 51, 127–142. doi: <https://doi.org/10.18666/trj-2017-v51-i2-7969>

Kasari, C., Shire, S., Factor, R., McCracken, C. (2014). psychosocial treatments for individuals with autism spectrum disorder across the lifespan: New developments and underlying mechanisms. *Current Psychiatry Reports*, 16). doi: <https://doi.org/10.1007/s11920-014-0512-6>

Ke, F., Whalon, K., & Yun, J. (2018). social skill interventions for youth and adults with autism spectrum disorder: A systematic review. *Review of Educational Research*, 88, 3–42.

Khowaja, K., Banire, B., Al-Thani, D., Sqalli, M. T., Aqle, A., Shah, A., & Salim, S. S. (2020). Augmented reality for learning of children and adolescents with autism spectrum disorder (ASD): A systematic review. *IEEE Access*, 8, 78779–78807. doi: <https://doi.org/10.1109/ACCESS.2020.2986608>

Koumpouros, Y., Kafazis, T. (2019). Wearables and mobile technologies in Autism Spectrum Disorder interventions: A systematic literature review. *Research in Autism Spectrum Disorders*, 66. doi: <https://doi.org/10.1016/j.rasd.2019.05.005>

Maujean, A., Pepping, C. A., & Kendall, E. (2015). A systematic review of randomized controlled trials of animal-assisted therapy on psychosocial outcomes. *Anthrozoos*, 28(1), 23–36. doi: <https://doi.org/10.2752/089279315x14129350721812>

Miller, A., Vernon, T., Wu, V., & Russo, K. (2014). Social skill group interventions for adolescents with autism spectrum disorders: A systematic review. *Review Journal of Autism and Developmental Disorders*, 1, 254–265. doi: <https://doi.org/10.1007/s40489-014-0017-6>

Shire, S. Y., & Kasari, C. (2014). Train the trainer effectiveness trials of behavioral intervention for individuals with autism: a systematic review. *American Journal on Intellectual & Developmental Disabilities*, 119, 436–451. doi: <https://doi.org/10.1352/1944-7558-119.5.436>

Exclusion reason: No full-text in English (n=12)

Bourgeois, M., Sénéchal, C., Larivée, S., Lepore, F. (2019). Effects of cognitive-behavioral intervention and cognitive training programs on executive function (EF) in people with autism spectrum disorder (ASD): A systematic review. *Annales Medico-Psychologiques*, 177, 749–757. doi: <https://doi.org/10.1016/j.amp.2018.12.012>

Cardoso, N. R., & Blanco, M. B. (2019). Sensory integration therapy and autistic spectrum disorder: A systematic review of literature. *Revista Conhecimento Online*, 1, 108–125. doi: <https://doi.org/10.25112/rco.v1i0.1547>

Cruveiller, V., & Crespin, G. C. (2017). Early intensive behavioral interventions with autistic children: A critical review of the literature (2009-2012). *La Psychiatrie de l'Enfant*, 60, 197–212. doi: <http://dx.doi.org/10.3917/psy.601.0197>

de Lima, A. F. C., Gehres, A. de F., Lorenzini, A. R., & Brasileiro, L. T. (2017). The influence of non-verbal educational and therapeutic practices in autism spectrum disorder: The possibilities for physical education professionals. *Motricidade*, 13(Supp 1), 87–96.

de Oliveira Ribeiro, F., Cunha Pimentel, G., Pantoja Moraes, N. O., & dos Santos Blois, L. V. (2019). Os efeitos da equoterapia em crianças com autismo. *Fisioterapia Brasil*, 20, 684–691. <https://doi.org/10.33233/fb.v20i5.2703>

de Souza Zamo, R., & Trentini, C. M. (2016). Psychological assessment and therapeutic riding: A systematic review. *Psicologia: Teoria E Pratica*, 18(3), 81–97.

Fernández Martínez, M. E., & Liébana Presa, C. (2018). La música como cuidado enfermero. Revisión sistemática. *Revista Rol de Enfermería*, 41, 588–586.

Fernández-García, D., Campa-Menéndez, E., Gómez-Salgado, J., & Navarro-Abal, Y. (2018). Efectos de la musicoterapia en las habilidades de comunicación de niños con autismo. *Revista Rol de Enfermería*, 41, 374–383.

Gonçalves, C. A. B., & Castro, M. S. J. de. (2013). Proposals for speech therapy for autistic children: a systematic review of literature. *Distúrbios da Comunicação*, 25.

Liesa Orús, M., Latorre Cosculluela, C., & Vázquez Toledo, S. (2018). Peer support systems with children with autism spectrum disorders in inclusive schools. A systematic review. *Revista Complutense de Educacion*, 29(1), 97–111. doi: <https://doi.org/10.5209/RCED.52032>

Lima, A. F. C. de, Gehres, A. de F., Lorenzini, A. R., & Brasileiro, L. T. (2017). A Influência de práticas pedagógicas e terapêuticas não verbais no transtorno do espectro autista: As possibilidades para o profissional de educação física. *Motricidade*, 13, 87–96. doi: <https://doi.org/10.6063/motricidade.12867>

Söchting, E. (2014). Evidenz zur Wirksamkeit der Sensorischen Integrationstherapie bei 3 - bis 12-jährigen Kindern mit sensorischen Verarbeitungsstörungen -- Eine systematische Forschungsübersicht 2007 bis 2013. *Ergoscience*, 9(4), 144–154. doi: <https://doi.org/10.2443/skv-s-2014-54020140402>

Exclusion reason: No full-text available (n=4)

Freitag, C. M., Jensen, K., Teufel, K., Luh, M., Todorova, A., Lalk, C., Vllasaliu, L. (2020). Empirically based developmental and behavioral intervention programs targeting the core symptoms and language development in toddlers and preschool children with autism spectrum disorder. *Zeitschrift Fur Kinder- Und Jugendpsychiatrie Und Psychotherapie*, 48, 224–243. doi: <https://doi.org/10.1024/1422-4917/a000714>

Löffler-Idel, I., & Schuh, D. (2015). For SI - Is there any proof? *Ergotherapie Und Rehabilitation*, 54(2), 11–16. doi: <https://doi.org/10.2443/skv-s-2015-51020150201>

Medved, K., & Begovac, I. (2013). Home intervention in children with autism spectrum disorder. *Paediatrica Croatica*, 57(1), 73–78.

Watling, R., & Lane, A. E. (n.d.). Navigating the evidence for sensory-based therapies. *OT Practice*, 5–7.

Exclusion reason: Geographically specific (n=1)

Shi, Z.-M., Lin, G.-H., & Xie, Q. (2016). Effects of music therapy on mood, language, behavior, and social skills in children with autism: A meta-analysis. *Chinese Nursing Research*, 3, 137–141. doi: <https://doi.org/10.1016/j.cnre.2016.06.018>

S9: Articles excluded after Phase 1 extraction

Articles excluded after Phase 1 extraction

Exclusion reason: No relevant moderators (n=10)

Ameis, S. H., Kasee, C., Corbett-Dick, P., Cole, L., Dadhwal, S., Lai, M. C., ... & Correll, C. U. (2018). Systematic review and guide to management of core and psychiatric symptoms in youth with autism. *Acta Psychiatrica Scandinavica*, 138, 379-400. doi: 10.1111/acps.12918

Bond, C., Symes, W., Hebron, J., Humphrey, N., Morewood, G., & Woods, K. (2016). Educational interventions for children with ASD: A systematic literature review 2008–2013. *School Psychology International*, 37, 303-320. doi: 10.1177/0143034316639638

Dubin, A. H., & Lieberman-Betz, R. G. (2020). Naturalistic interventions to improve prelinguistic communication for children with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders*, 1-17. doi: oi.org/10.1007/s40489-019-00184-9

Goldstein, H., Lackey, K. C., & Schneider, N. J. (2014). A new framework for systematic reviews: Application to social skills interventions for preschoolers with autism. *Exceptional Children*, 80, 262-286. doi: 10.1177/0014402914522423

Kossyvak, L., & Papoudi, D. (2016). A review of play interventions for children with autism at school. *International Journal of Disability, Development and Education*, 63, 45-63. doi: 10.1080/1034912X.2015.1111303

Morgan, L. J., Rubin, E., Coleman, J. J., Frymark, T., Wang, B. P., & Cannon, L. J. (2014). Impact of social communication interventions on infants and toddlers with or at-risk for autism: A systematic review. *Focus on Autism and Other Developmental Disabilities*, 29, 246-256. doi: 10.1177/1088357614539835

Odeh, C. E., Martell, R., Griffin, S., Johnson, E. R., & Gladfelter, A. L. (2020). Motor-based interventions improve language outcomes in children with autism: A systematic review. *Clinical Archives of Communication Disorders*, 5(1), 1-7. doi: [10.21849/cacd.2020.00192](https://doi.org/10.21849/cacd.2020.00192)

Ruggeri, A., Dancel, A., Johnson, R., & Sargent, B. (2020). The effect of motor and physical activity intervention on motor outcomes of children with autism spectrum disorder: A systematic review. *Autism*, 24, 544-568. doi: 10.1177/1362361319885215

Schertz, H. H., Reichow, B., Tan, P., Vaiouli, P., & Yildirim, E. (2012). Interventions for toddlers with autism spectrum disorders: An evaluation of research evidence. *Journal of Early Intervention*, 34(3), 166-189. doi: 10.1177/1053815112470721

Yoder, P.J., Bottema-Beutel, K., Woynaroski, T., Chandrasekhar, R., Sandbank, M. (2013). Social communication intervention effects vary by dependent variable type in preschoolers with autism spectrum disorders. *Evidence-Based Communication Assessment and Intervention*, 7(4), 150-174. doi: 10.1080/17489539.2014.917780

Exclusion reason: Incompatible categorisation of interventions (n=6)

Fletcher-Watson, S., McConnell, F., Manola, E., & McConachie, H. (2014). Interventions based on the Theory of Mind cognitive model for autism spectrum disorder (ASD). *Cochrane Database of Systematic Reviews*, 2014(3). doi: 10.1002/14651858.CD008785.pub2

Maw, S. S., & Haga, C. (2018). Effectiveness of cognitive, developmental, and behavioural interventions for Autism Spectrum Disorder in preschool-aged children: A systematic review and meta-analysis. *Heliyon*, 4(9), e00763. doi: 10.1016/j.heliyon.2018.e00763

Reichow, B., Servili, C., Yasamy, M. T., Barbui, C., & Saxena, S. (2013). Non-specialist psychosocial interventions for children and adolescents with intellectual disability or lower-functioning autism spectrum disorders: A systematic review. *PLoS Med*, 10(12), e1001572. doi: 10.1371/journal.pmed.1001572

Tachibana, Y., Miyazaki, C., Ota, E., Mori, R., Hwang, Y., Kobayashi, E., ... & Kamio, Y. (2017). A systematic review and meta-analysis of comprehensive interventions for pre-school children with autism spectrum disorder (ASD). *PloS one*, 12(12), e0186502. doi: 10.1371/journal.pone.0186502

Weitlauf, A. S., McPheeters, M. L., Peters, B., Sathe, N., Travis, R., Aiello, R., ... & Warren, Z. (2014). *Therapies for children with autism spectrum disorder: Behavioral interventions update*. AHRQ Comparative Effectiveness Reviews. Rockville (MD): Agency for Healthcare Research and Quality (US).

Yu, Q., Li, E., Li, L., & Liang, W. (2020). Efficacy of interventions based on applied behavior analysis for autism spectrum disorder: A meta-analysis. *Psychiatry Investigation*, 17, 432. doi: 10.30773/pi.2019.0229

Exclusion reason: Previous version of included review (n=5)

Reichow, B., Barton, E. E., Boyd, B. A., & Hume, K. (2012). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews*, 2012(10). doi: 10.1002/14651858.CD009260.pub3

Reichow, B., Barton, E. E., Boyd, B. A., & Hume, K. (2014). Early intensive behavioral intervention (EIBI) for young children with Autism Spectrum Disorders (ASD): A systematic review. *Campbell Systematic Reviews*, 2014(9). doi: 10.4073/csr.2014.9

Warren, Z., McPheeters, M. L., Sathe, N., Foss-Feig, J. H., Glasser, A., & Veenstra-VanderWeele, J. (2011). A systematic review of early intensive intervention for autism spectrum disorders. *Pediatrics*, 127, e1303-e1311. doi: 10.1542/peds.2011-0426

Warren, Z., Veenstra-VanderWeele, J., Stone, W., Bruzek, J. L., Nahmias, A. S., Foss-Feig, J. H., & McPheeters, M. L. (2011). Therapies for children with autism spectrum disorders. Comparative effectiveness review no. 26. *Agency for Healthcare Research and Quality (US)*.

Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., ... & Schultz, T. R. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of Autism and Developmental Disorders*, 45, 1951-1966. doi: 10.1007/s10803-014-2351-z

Exclusion reason: No (useable) summary of outcomes (n=3)

Baril, E. M., & Humphreys, B. P. (2017). An evaluation of the research evidence on the Early Start Denver Model. *Journal of Early Intervention, 39*, 321-338. doi: 10.1177/1053815117722618

Hoffman, F. (2013). Evidence-based classroom strategies for reducing anxiety in primary aged children with high-functioning autism. *New Zealand Journal of Teachers' Work, 10*(1), 25-43.

Miller-Kuhaneck, H., & Watling, R. (2018). Parental or teacher education and coaching to support function and participation of children and youth with sensory processing and sensory integration challenges: A systematic review. *American Journal of Occupational Therapy, 72*(1), 1-11. doi: 10.5014/ajot.2018.029017

Exclusion reason: Included pharmacological intervention (n=1)

Romagnoli, G., Leone, A., Romagnoli, G., Sansoni, J., Tofani, M., De Santis, R., ... & Galeoto, G. (2019). Occupational Therapy's efficacy in children with Asperger's syndrome: A systematic review of randomized controlled trials. *Clinical Therapeutics, 170*, 382-387. doi: 10.7417/CT.2019.2164.

Exclusion reason: Geographically specific (n=1)

Althoff, C. E., Dammann, C. P., Hope, S. J., & Ausderau, K. K. (2019). Parent-mediated interventions for children with autism spectrum disorder: A systematic review. *American Journal of Occupational Therapy, 73*(3), 1-13. doi: 10.5014/ajot.2019.030015

Exclusion reason: Publication corresponding to included review (n=1)

Weitlauf, A. S., Sathe, N., McPheeters, M. L., & Warren, Z. E. (2017). Interventions targeting sensory challenges in autism spectrum disorder: a systematic review. *Pediatrics, 139*(6), e20170347. doi: 10.1542/peds.2017-0347

S10: Characteristics of included reviews

Author (year)	Characteristics of Systematic Review	Characteristics of Included Studies
Akemoglu et al. (2020)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to systematically review the literature researching telepractice and parent-implemented language and communication interventions.”</p> <p>Number of included studies: 12</p> <p>Search limit (years): Not specified – 2019</p> <p>Study designs: Randomised controlled trials, single-case experimental designs</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participating children: 76</p> <p>Age: 16 – 76 months</p> <p>Sex: 47/63 males, 16/63 females</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Parent-implemented telehealth interventions – Communication intervention; Early Start Denver Model (ESDM); Parents Early Start Denver Model (P-ESDM); Reciprocal Imitation Training (RIT); Decide, Arrange, Now, Count, and Enjoy (DANCE); Improving Parents as Communication Teachers (imPACT); Internet-based Parent-implemented Communication Strategies (i-PICS); Prepare, Offer, Wait, and Respond (POWR).</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication; caregiver communication and interaction (parents’ use of strategies).</p>
Bejarano-Martín et al. (2020)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: “to ascertain the overall effectiveness of [focused intervention practices] in children with [autism spectrum disorder] 6 years of age and younger.”</p> <p>Number of included studies: 43</p> <p>Search limit (years): 2000 - 2018</p> <p>Study designs: Randomised controlled trials, non-randomised with control, single-case experimental designs (inclusion criteria)</p>	<p>Participant characteristics</p> <p>Number of participating children: 1402 (785 intervention, 617 control)</p> <p>Age: 25 – 72 months, M = 41.6 months</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder (inclusion criteria)</p> <p>Increased likelihood of ASD: Not eligible (inclusion criteria)</p> <p>Other conditions: None</p> <p>Intervention(s): Focused intervention practices - Discrete trial training</p>

	<p>Quality of studies: Included high quality/low risk of bias only</p> <p>Sources of funding: Specified - Funded</p> <p>Conflict of interest: Specified - No conflicts</p>	<p>(DTT); Pivotal Response Training (PRT), Contingent imitation; discrete trial training (DTT) plus social interaction, mediated learning with active engagement; picture exchange communication system (PECS); video modelling; prompting and reinforcement; physical and verbal cues; token economy and prompting; photographic schedules.</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (social-communication, imitation, joint attention, play).</p>
Binns & Oram Cardy (2019)	<p>Type: Narrative synthesis only</p> <p>Objectives: to "systematically review studies examining the impact of developmental social pragmatic interventions in supporting (a) foundational social communication and language skills of preschool children with autism spectrum disorder and (b) caregiver interaction style."</p> <p>Number of included studies: 10</p> <p>Search limit (years): Database inception - 2018</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified - Funded</p> <p>Conflict of interest: Specified - No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 716</p> <p>Age: 1 year, 3 months - 6 years, M = 37.8 months</p> <p>Sex: 443/546 males, 103/546 females</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Developmental social pragmatic interventions - Child Talk; Hanen More than Words; Developmental Individual-Difference Relationship-Based (DIR); Milton and Ethel Harris Research Initiative Treatment (MEHRIT) - DIR based; Pediatric Autism and Communication Therapy (PACT); Joint attention mediated learning; Play and Language for Autistic Youngsters (PLAY) project - DIR based; Social communication, emotion regulation, transactional support (SCERTS).</p> <p>Comparison: Wait list control, treatment as usual, another intervention.</p> <p>Outcomes: Social-communication (social interaction and social communication); Communication (language capacities); Caregiver communication and interaction (parental responsiveness and directiveness).</p>
Boshoff et al. (2020)	<p>Type: Narrative synthesis only</p> <p>Objectives: to examine "the documented developmental outcomes for children who participated in Developmental Individual-Difference Relationship-</p>	<p>Participant characteristics</p> <p>Number of participating children: 392</p> <p>Age: 2 – 12 years</p> <p>Sex: Not specified</p>

	<p>Based (DIR)/Floortime™-based interventions.”</p> <p>Number of included studies: 9</p> <p>Search limit (years): 2000 - 2019</p> <p>Study designs: Randomised controlled trials, non-randomised without control group, single-case experimental designs, other</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Not specified</p>	<p>Description: Autism spectrum disorder including autism, Asperger’s syndrome, pervasive developmental disorder not otherwise specified</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Developmental Individual-Difference Relationship-Based (DIR)/Floortime™ model and interventions based on the principles of the DIR/Floortime™ Model- Milton and Ethel Harris Research Initiative Treatment (MEHRIT); Floor time play (FTP); Play and Language for Autistic Youngsters (PLAY); the PLAY Project Home Consultation Program.</p> <p>Comparison: Treatment as usual, another intervention, the individual’s own baseline, no comparison group</p> <p>Outcomes: Social-communication (social and emotional development); Communication (language); Motor skills (motor and fine motor).</p>
Case & Yun, (2019)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: “to analyse the effect of different intervention approaches on gross motor outcomes among children with autism spectrum disorder using meta-analysis.”</p> <p>Number of included studies: 18</p> <p>Search limit (years): Database inception - 2018</p> <p>Study designs: Not specified</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participating children: 287</p> <p>Age: 3 – 12 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Fundamental motor skills including fundamental motor skills instruction, adapted physical education instruction, physical activities and fitness exercises, young athletes motor program, multisport camp training, adaptive soccer program, physical education program with fundamental motor skill instruction, intensive fundamental motor skill instruction, Sports, Play, and Active Recreation for Kids (SPARK); equestrian assisted training; technology interventions including sports active video game participation, video-based makota arena training, robot imitation and movement activities, simulated developmental horse riding; physical activity interventions including physical activity/table tennis, rhythm training and</p>

		<p>movement-based games, aquatic exercise training.</p> <p>Comparison: Not specified</p> <p>Outcomes: Motor (gross motor).</p>
Chang & Locke (2016)	<p>Type: Narrative synthesis only</p> <p>Objectives: to examine "[peer-mediated interventions] for children and adolescents with [autism spectrum disorder] conducted using group designs."</p> <p>Number of included studies: 5</p> <p>Search limit (years): Database inception – 2015</p> <p>Study designs: Randomised controlled trials, non-randomised without control</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participating children: 260</p> <p>Age: 3 – 17 years (of studies reporting age range)</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not eligible (inclusion criteria)</p> <p>Other conditions: None</p> <p>Intervention(s): Peer-mediated interventions.</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (social initiations, social responses, social communications).</p>
Ferguson et al. (2019)	<p>Type: Narrative synthesis only</p> <p>Objectives: "to systematically review the literature researching telehealth and [applied behaviour analysis to individuals with autism spectrum disorder]."</p> <p>Number of included studies: 28</p> <p>Search limit (years): Not specified – 2018</p> <p>Study designs: Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs, other</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 307 (231 intervention, 76 control)</p> <p>Age: 1.75 - 16 years, M = 4.73 years (of studies reporting age)</p> <p>Sex: 93/154 males, 61/154 females</p> <p>Description: Autism spectrum disorder, pervasive developmental disorder not otherwise specified</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Telehealth interventions with behavioural principles- functional analysis (FA); functional communication training (FCT); naturalistic and incidental teaching; behaviour support strategies (e.g., positive behaviour support); preference assessments; Early Start Denver Model (ESDM); Improving Parents as Communication Teachers (imPACT).</p>

		<p>Comparison: Wait list control, treatment as usual, another intervention, the individual's own baseline, no comparison group</p> <p>Outcomes: General outcomes (efficacy outcomes).</p>
Flippin et al. (2010)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to review "the current empirical evidence for [Picture Exchange Communication System] in affecting communication and speech outcomes for children with [autism spectrum disorder]."</p> <p>Number of included studies: 11</p> <p>Search limit (years): 1994 – 2009</p> <p>Study designs: Randomised controlled trials, non-randomised with control, single-case experimental designs</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participating children: 178</p> <p>Age: 3 – 12 years</p> <p>Sex: Not specified</p> <p>Description: Autism, autism spectrum disorder, pervasive developmental disorder not otherwise specified (inclusion criteria)</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: Not specified</p> <p>Intervention(s): Picture exchange communication system (PECS).</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (communicative behaviours, communication outcomes); Expressive language (speech or vocalisation, speech outcomes).</p>
Fuller & Kaiser (2020)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to examine "the effects of early interventions on social communication outcomes for young children with autism spectrum disorder."</p> <p>Number of included studies: 29</p> <p>Search limit (years): Not specified – 2016</p> <p>Study designs: Randomised controlled trials, non-randomised without control (inclusion criteria)</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 1442 (786 intervention; 656 control)</p> <p>Age range (mean age): 0 – 8 years (inclusion criteria), M = 3.55 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder (inclusion criteria)</p> <p>Increased likelihood of ASD: Eligible (inclusion criteria)</p> <p>Other conditions: None</p> <p>Intervention(s): "Early interventions" – Not specified</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication.</p>

Fuller, Oliver et al. (2020)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to examine “the effects of the Early Start Denver Model (ESDM) for young children with autism on developmental outcome measures.”</p> <p>Number of included studies: 12</p> <p>Search limit (years): Not specified – 2019</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – Conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 640 (286 intervention, 354 control)</p> <p>Age: 9 months – 5 years, M = 2.51 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder (inclusion criteria)</p> <p>Increased likelihood of ASD: Eligible (inclusion criteria)</p> <p>Other conditions: None</p> <p>Intervention(s): Early Start Denver Model (ESDM).</p> <p>Comparison: Wait list control, treatment as usual, another intervention</p> <p>Outcomes: Overall autism characteristics (autism symptoms); Social-communication; RRB (repetitive behaviours); Communication (language); Cognition; Adaptive behaviour (adaptive functioning).</p>
Geretsegger et al. (2014)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: “to review the effects of music therapy, or music therapy added to standard care, for individuals with [autism spectrum disorder].”</p> <p>Number of included studies: 10</p> <p>Search limit (years): Database inception – 2013</p> <p>Study designs: Randomised controlled trials, non-randomised with control (inclusion criteria)</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 165</p> <p>Age: 2 – 12 years</p> <p>Sex: 148/170 males, 22/170 females</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Music therapy.</p> <p>Comparison: Treatment as usual, another intervention, other comparison group</p> <p>Outcomes: Social-communication (social adaptation-overall); Communication (nonverbal-overall; verbal-overall); Quality of life (joy); Caregiver social emotional wellbeing (quality of family relationships).</p>
Griffith et al. (2020)	<p>Type: Narrative synthesis only</p> <p>Objectives: to “present a narrative synthesis of studies examining whether children < 6 years can learn</p>	<p>Participant characteristics</p> <p>Number of participating children: 4639 (164 ASD)</p> <p>Age range (mean age): 0 - 71 months (inclusion criteria)</p>

	<p>from interactive apps.”</p> <p>Number of included studies: 35</p> <p>Search limit (years): 2008 – 2019</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: Not specified</p> <p>Intervention(s): Interactive apps.</p> <p>Comparison: Treatment as usual, another intervention</p> <p>Outcomes: Social-communication.</p>
Hampton & Kaiser (2016)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to examine “the effects of early interventions on spoken language in children with [autism spectrum disorder].”</p> <p>Number of included studies: 26</p> <p>Search limit (years): Not specified – 2014</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participating children: 1738</p> <p>Age: 1.75 – 4.18 years, M = 3.33 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Early interventions- Early Intensive Behavioural Intervention (EIBI); Early Intervention Preschool (EIP); Early Start Denver Model (ESDM); Joint Attention Mediated Learning (JAML); Joint Attention; Structured Play Engagement; and Regulation (JAML); Learning Experiences and Alternative Program (LEAP); Milton and Ethel Harris Research Initiative Treatment (MEHRIT); More Than Words (MTW); Pediatric Autism and Communication Therapy (PACT); Play and Language for Autistic Youngsters; PRT, Pivotal Response Training (Play and Language for Autistic Youngsters); Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH); Scottish Early Intervention Preschool; Parent training model (PSwA); Focused playtime (FPI); Speech remediation; Teach Town basics; Early Social Interaction (ESI); Parent training, Behaviour analytic.</p> <p>Comparison: Not specified</p> <p>Outcomes: Expressive language (spoken language).</p>

Hardy & Weston (2020)	<p>Type: Narrative synthesis only</p> <p>Objectives: to examine “the current state of literature on canine-assisted therapy (CAT) for children with [autism spectrum disorder] based on peer-reviewed articles.”</p> <p>Number of included studies: 5</p> <p>Search limit (years): Not specified – 2017</p> <p>Study designs: Not specified</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 66</p> <p>Age: 3 – 14 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Canine-assisted therapy.</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (social behaviour).</p>
Hill et al. (2019)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to systematically review the current literature exploring the impact of canine-assisted interventions on the social behaviours of children (< 18 years) diagnosed on the autism spectrum.”</p> <p>Number of included studies: 13</p> <p>Search limit (years): 1987 – 2017</p> <p>Study designs: Non-randomised with control, non-randomised without control, single-case experimental designs, other</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 113</p> <p>Age: 3 – 18 years</p> <p>Sex: 93/113 males, 20/113 females</p> <p>Description: Autism spectrum disorder, autism, autistic disorder, moderate autism, mild autism, Asperger syndrome, pervasive developmental disorder, pervasive developmental disorder not otherwise specified, early childhood autism, atypical autism</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Canine-assisted therapy- animal-assisted therapy; animal-assisted activities; animal-assisted education; animal-assisted play therapy.</p> <p>Comparison: Another intervention, the individual’s own baseline, no comparison group</p> <p>Outcomes: Social-communication (verbal, non-verbal, desired, undesired behaviours).</p>
Ho et al. (2014)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to examine “studies reporting on</p>	<p>Participant characteristics</p> <p>Number of participating children: 402 (199/372 completed</p>

	<p>randomised controlled trials of the use of cognitive-behavioural approaches to intervention for children with autism spectrum disorder.”</p> <p>Number of included studies: 10</p> <p>Search limit (years): Not specified – 2012</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>intervention, 173/372 control)</p> <p>Age: 4.5 – 16 years, M = 10.5 years</p> <p>Sex: Not specified</p> <p>Description: Asperger’s syndrome, high functioning autistic disorder/autism spectrum disorder, pervasive developmental disorder not otherwise specified, portion of sample without sub-type diagnoses specified</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Cognitive behavioural intervention - Cool Kids; Building Confidence Family Cognitive Behaviour Therapy (FCBT); Social Skills Training for Children and Adolescents with Asperger Syndrome and Social-Communications Problems; Thinking about you, thinking about me; Coping Cat CBT program; Facing your fears; Group Cognitive Behaviour Therapy.</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (social skills).</p>
Kent et al. (2020)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to examine “the efficacy of play-based interventions to address the play skills of children with [autism spectrum disorder]... [and] to summarize key characteristics of a range of play-based interventions for children with [autism spectrum disorder] and assess the quality of published [randomised controlled trials].”</p> <p>Number of included studies: 19 narrative synthesis; 11 meta-analysis</p> <p>Search limit (years): Not specified – 2017</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Included moderate quality/moderate risk of bias</p>	<p>Participant characteristics</p> <p>Number of participating children: 1149</p> <p>Age: 2 – 12 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Play-based interventions- [Generic] play intervention; Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER); Lego therapy; Social stories; behavioural approaches; peer training; teacher training; Social Emotional NeuroScience Endocrinology (SENSE) Theater principles; video modelling.</p> <p>Comparison: Wait list control, another intervention</p> <p>Outcomes: Play.</p>

	<p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	
Khan et al. (2019)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: “to review the effectiveness of randomized controlled trials (RCTs) of Web-based interventions delivered to children and young people with neurodevelopmental disorders.”</p> <p>Number of included studies: 10 narrative review; 5 meta-analysis</p> <p>Search limit (years): 2000 – 2018</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Included moderate quality/moderate risk of bias</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 523 in analysis (545 in review, of which 289 were diagnosed with ASD)</p> <p>Age: 2 – 17 years, M range= 3.32 – 12.16 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: Tic disorders or chronic tic disorders, attention deficit hyperactivity disorder, specific learning disorder, dyscalculia</p> <p>Intervention(s): Web-based interventions- apps; serious games; videoconferencing; virtual environment with playable games; Web-based cognitive behavioural therapy intervention.</p> <p>Comparison: Wait list control, treatment as usual, another intervention</p> <p>Outcomes: General outcomes (condition-specific outcomes or reducing comorbid psychological symptoms); Caregiver satisfaction/dissatisfaction.</p>
Knight et al. (2013)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to determine the degree to which technology-based interventions can be considered an evidence-based practice to teach academic skills to individuals with Autism Spectrum Disorder (ASD).”</p> <p>Number of included studies: 29</p> <p>Search limit (years): 1993 – 2012</p> <p>Study designs: Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs</p> <p>Quality of studies: Included low quality/high risk of bias</p>	<p>Participant characteristics</p> <p>Number of participating children: 191 (142 with ASD)</p> <p>Age: 3 – 18 years, M = 8.4 years</p> <p>Sex: 78/100 males, 22/100 females</p> <p>Description: Autism spectrum disorder, autism, pervasive developmental disorder not otherwise specified, Rett syndrome</p> <p>Increased likelihood of ASD: Not specified</p> <p>Other conditions: Not specified</p> <p>Intervention(s): Computer assisted instruction; simultaneous prompting; differential reinforcement; error correction and feedback procedure; delayed prompting procedure; stimulus prompting.</p> <p>Comparison: Not specified</p> <p>Outcomes: Academic.</p>

	<p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	
Lang et al. (2012)	<p>Type: Narrative synthesis only</p> <p>Objectives: "to systematically identify, analyse, and summarize research involving the use of [sensory integration therapy] in the education and treatment of individuals with [autism spectrum disorder]."</p> <p>Number of included studies: 25</p> <p>Search limit (years): Not specified – 2011</p> <p>Study designs: Not specified</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participating children: 217</p> <p>Age: 2 – 12 years, M = 5.9 years</p> <p>Sex: 176/207 males, 31/207 females</p> <p>Description: Autism spectrum disorder, pervasive developmental disorder not otherwise specified, Asperger's syndrome</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Sensory-integration therapy- weighted vests; swinging or rocking stimulation; brushing with a bristle or a feather; joint compression or stretching; alternative seating; jumping or bouncing; blanket or "body sock"; playing with a water and sand sensory table; chewing on a rubber tube; and playing with specially textured toys.</p> <p>Comparison: Not specified</p> <p>Outcomes: General outcomes (intervention outcomes).</p>
Logan et al. (2017)	<p>Type: Narrative synthesis only</p> <p>Objectives: "to examine the effectiveness of [augmentative and alternative communication] interventions in supporting children [with autism spectrum disorder] to produce a broader range of communicative functions and determine the extent to which these interventions have been evaluated beyond immediate effectiveness to address maintenance, generalization, and social validity."</p> <p>Number of included studies: 30</p> <p>Search limit (years): 1994 – 2015</p>	<p>Participant characteristics</p> <p>Number of participating children: 367</p> <p>Age: 1.5 – 17 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Aided AAC systems- dedicated speech generating devices (SGDs); iPad®/iPod® Touch configured as SGDs; picture exchange communication system (PECS); low-tech aids (e.g., boards or books) incorporating pictures and photos.</p> <p>Comparison: Not specified</p>

	<p>Study designs: Randomised controlled trials, single-case experimental designs</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Outcomes: Social-communication (communication functions); Caregiver satisfaction (social validity).</p>
Makrygianni & Reed (2010)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: “to provide a comprehensive synthesis of the research literature on the outcomes and effectiveness of the behavioural [early intervention programs] for children with [autism spectrum disorder].”</p> <p>Number of included studies: 14</p> <p>Search limit (years): Not specified – 2007</p> <p>Study designs: Not specified</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participating children: 484</p> <p>Age: M = ~38 months</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Behavioural early intervention programs.</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (socialisation); Communication (communication, language); Cognition (IQ); Adaptive behaviour.</p>
Mazon et al. (2019)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to update the previous [reviews of technology-based interventions] with a focus on clinical-quality studies; to examine reliability, consistency, durability and generalisation of measurements; and to compare the methodology of two cores of studies according to two dimensions: Therapeutic Effectiveness (TE) and Technology Usability (TU).”</p> <p>Number of included studies: 31</p>	<p>Participant characteristics</p> <p>Number of participating children: 796 (576 with ASD)</p> <p>Age: 3 – 18 years</p> <p>Sex: 424/515 males, 91/515 females.</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: Down Syndrome, Speech and Language impairment (also included typically developing children)</p> <p>Intervention(s): Technology based interventions including (but not limited to) computer and robot-based interventions.</p>

	<p>Search limit (years): 2000 – 2016</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Comparison: Not specified</p> <p>Outcomes: General outcomes (statistical significance).</p>
McCoy et al. (2016)	<p>Type: Narrative synthesis only</p> <p>Objectives: to provide “a focused review of the efficacy and evidence base of [video modelling], role play, and [computer-based intervention] for teaching social skills to children and adolescents with [high functioning autism].”</p> <p>Number of included studies: 29</p> <p>Search limit (years): Database inception - 2015</p> <p>Study designs: Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 235</p> <p>Age: 3 – 17 years, M = 9 years</p> <p>Sex: 145/175 males, 28/173 females</p> <p>Description: high functioning autism with an IQ>85 or Asperger’s syndrome</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Role play; video modelling; computer-based instruction.</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (social skills).</p>
Miguel-Cruz et al. (2017)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to examine the extent and type of robots used for the rehabilitation and education of children and young people with [cerebral palsy] and [autism spectrum disorder] and the associated outcomes.”</p> <p>Number of included studies: 34</p> <p>Search limit (years): 1990 - 2016</p> <p>Study designs: Randomised controlled trials, non-</p>	<p>Participant characteristics</p> <p>Number of participating children: 338 (255 with ASD)</p> <p>Age: 0 – 18 years (inclusion criteria), M = 15.13 years (ASD only), 9.93 years (cerebral palsy and ASD)</p> <p>Sex: 149/192 males, 43/192 females</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: Cerebral palsy</p>

	<p>randomised without control, single-case experimental designs, other</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified - Funded</p> <p>Conflict of interest: Specified - No conflicts</p>	<p>Intervention(s): Robots</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (interaction); RRB (repetitive and maladaptive behaviour).</p>
Moon et al. (2020)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: "to assess the evidence for effects of therapeutic intervention with mobile device applications (apps) for individuals with autism spectrum disorder (ASD)."</p> <p>Number of included studies: 7</p> <p>Search limit (years): 2009 – 2019</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 328</p> <p>Age: 39 – 120 months</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder (inclusion criteria)</p> <p>Increased likelihood of ASD: Not eligible (inclusion criteria)</p> <p>Other conditions: None</p> <p>Intervention(s): Mobile device applications - including (but not limited to) FindMe game app, Therapy Outcomes By You (TOBY), Camp Discovery.</p> <p>Comparison: Wait list control, treatment as usual, other comparison group</p> <p>Outcomes: Social-communication; Communication (gestures, symbolic); Expressive language (expressive language, words produced); Receptive language; Cognition (visual reception); Motor (fine motor).</p>
Murza et al. (2016)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: "to provide a quantitative assessment of the effectiveness of joint attention interventions aimed at improving joint attention abilities in children with [autism spectrum disorder]."</p> <p>Number of included studies: 16 narrative synthesis, 12 meta-analysis</p> <p>Search limit (years): Database inception – 2015</p> <p>Study designs: Randomised controlled trials (inclusion criteria)</p>	<p>Participant characteristics</p> <p>Number of participating children: 694 (410 intervention; 284 control)</p> <p>Age: 11 – 152 months, M = 55 months</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not eligible (inclusion criteria)</p> <p>Other conditions: None</p> <p>Intervention(s): Joint attention interventions - Assessment, Evaluation and Programming System (AEPS) for Infants and Children; Caregiver Education</p>

	<p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Model (CEM); Caregiver Mediated Model (CMM); Hanen More Than Words (HMTW); Joint Attention Mediated Learning (JAML); Joint Attention Symbolic Play Engagement and Regulation (JASPER); Milton and Ethel Harris Research Initiative (MEHRI); Preschool Autism Communication Trial (PACT); parent training modules; and workshop training.</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (joint attention).</p>
National Autism Center (2015)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to provide critical information about which interventions have been shown to be effective for individuals with autism spectrum disorder (ASD).”</p> <p>Number of included studies: 389</p> <p>Search limit (years): Not specified</p> <p>Study designs: Not specified</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Not specified</p>	<p>Participant Characteristics</p> <p>Number of participating individuals: Not specified</p> <p>Age: No age limit (inclusion criteria)</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder, autistic disorder, Asperger’s syndrome, pervasive developmental disorder not otherwise specified (inclusion criteria)</p> <p>Increased likelihood of ASD: Not eligible (inclusion criteria)</p> <p>Other conditions: None</p> <p>Intervention(s): Behavioural interventions; Cognitive Behavioural Intervention Package; Comprehensive Behavioural Treatment for Young Children; Pivotal Response Training; Augmentative and Alternative Communication Devices; Developmental Relationship-based Treatment; Functional Communication Training; Music Therapy; Picture Exchange Communication System; Social Communication Intervention; Technology-based Intervention; Theory of Mind Training; Animal-assisted Therapy; Auditory Integration Training; DIR/Floor Time; Facilitated Communication; Movement-based Intervention; Sensory Intervention Package.</p> <p>Comparison: Not specified</p> <p>Outcomes: Overall autism characteristics (general symptoms); social-communication (interpersonal); restricted and repetitive interests and behaviours (restricted, repetitive, non-functional patterns of behaviour,</p>

		interests, or activity); sensory (sensory or emotional regulation); Communication; Cognition (higher cognitive functions); Motor; Social-emotional/challenging behaviour (self-regulation, problem behaviour); Play; Adaptive behaviour (personal responsibility); School/learning readiness (learning readiness, placement); Academic.
Naveed et al. (2019)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to "a) assess the effectiveness of non-specialist delivered or mediated interventions in autism spectrum disorder (ASD); b) systematically evaluate relevant implementation processes involved in these non-specialists delivered interventions for autism spectrum disorder, and c) and to rate the quality of evidence across different outcomes using the World Health Organization's recommended Grading of Recommendations Assessment, Development and Evaluation (GRADE) criteria."</p> <p>Number of included studies: 33</p> <p>Search limit (years): Database inception - 2018</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant Characteristics</p> <p>Number of participating children: Not specified</p> <p>Age: 16 months – 17 years</p> <p>Sex: Not specified</p> <p>Description: autism spectrum disorder, Asperger's syndrome, childhood disintegrative disorder (inclusion criteria)</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Cognitive behavioural strategies ; Social emotional Neuroscience Endocrinology (SENSE) theatre; Preschool Autism Communication Trial (PACT); Parent mediated intervention for Autism Spectrum Disorders in South Asia (PASS); Project Impact; Peer interventions; Qigong Sensory Treatment (QST); Joint Attention, Symbolic Play, Engagement, and Regulation programme (JASPER); Play project; LEAP project i.e. Learning Experiences and Alternative Program for Preschoolers and Their Parents; Hanen's more than words (HMTW) intervention program; Peer network intervention procedure; family centered music therapy; The Managing Repetitive Behaviours Programme; psychoeducation program; autism preschool program; Video-feedback Intervention to promote Positive Parenting adapted for Autism; Social ABCs; Parent mediated intervention for Autism Spectrum Disorders in South Asia (PASS) plus; enhancing interactions tutorial; Social Tools And Rules for Teens socialization (START); COMPASS for Hope; Program for the Education and Enrichment of Relational Skills (PEERS) curriculum; Therapeutic Out-come By You (TOBY) application.</p>

		<p>Comparison: Not specified</p> <p>Outcomes: Overall autism characteristics (autism symptom severity); social-communication (social skills, joint engagement, joint attention); restricted and repetitive interests and behaviours (repetitive behaviours); communication; expressive language; receptive language; cognition (visual reception); motor (motor skills); social-emotional/challenging behaviour (self-regulation); adaptive behaviour; caregiver social emotional wellbeing (parent distress, parental self-efficacy, parent-child relationship); child satisfaction (child distress).</p>
Nevill et al. (2018)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to review “randomised clinical trials of parent-mediated interventions for children with autism spectrum disorder between the ages of 1 and 6 years and [conduct] a meta-analysis on their efficacy.”</p> <p>Number of included studies: 19</p> <p>Search limit (years): 2000 – 2015</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Not specified</p>	<p>Participant Characteristics</p> <p>Number of participating children: 1205 (608 intervention, 597 control)</p> <p>Age: 15 – 72 months, M = 42 months</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Child’s Talk Project; Hanen’s More than Words (HMTW); DIR/Floortime; Parent Focus Training; Joint Attention Symbolic Play Engagement and Regulation (JASPER); Pivotal Response Training (PRT); Video Intervention to promote Positive Parenting for children with Autism (VIPP-AUTI); Home-based program; Building Blocks; Focused Playtime Intervention; Play and Language for Autistic Youngsters (PLAY) Project; Preschoolers with Autism; Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH); Social Communication, Emotion Regulation, and Transactional Supports (SCERTS); Parent-mediated Communication-focused Treatment (PACT).</p> <p>Comparison: Treatment as usual, another intervention</p> <p>Outcomes: Overall autism characteristics (autism symptom severity); social-communication (socialisation); communication (language); cognition.</p>

<p>Ona et al. (2020)</p>	<p>Type: Meta-analysis with narrative synthesis Objectives: "to compile evidence examining the effectiveness of [pivotal response treatment] (PRT) on social communication, social interaction, and repetitive behaviour for children with autism spectrum disorder." Number of included studies: 5 Search limit (years): Database inception - 2017 Study designs: Randomised controlled trials Quality of studies: Included low quality/high risk of bias Sources of funding: Not specified Conflict of interest: Specified – No conflicts</p>	<p>Participant Characteristics Number of participating children: 181 (91 intervention, 90 control) Age: 2.4 - 9.2 years, M = 5.3 years Sex: Not specified Description: Autism spectrum disorder Increased likelihood of ASD: Not included Other conditions: None Intervention(s): Pivotal Response Treatment (PRT). Comparison: Wait list control, treatment as usual, another intervention Outcomes: Social-communication (social interaction); RRB; Communication; Expressive language.</p>
<p>Oono et al. (2013)</p>	<p>Type: Meta-analysis with narrative synthesis Objectives: "To assess the effectiveness of parent-mediated early interventions in terms of the benefits for both children with autism spectrum disorder (ASD) and their parents and to explore some potential moderators of treatment effect." Number of included studies: 17 narrative synthesis; 10 meta-analysis. Search limit (years): 2002 – 2012 Study designs: Randomised controlled trials Quality of studies: Not specified Sources of funding: Specified – Funded Conflict of interest: Specified – No conflicts</p>	<p>Participant Characteristics Number of participating children: 919 Age: 17 months – 6 years Sex: 645/816 males, 171/816 females Description: Autism, autism spectrum disorder Increased likelihood of ASD: Not included Other conditions: None Intervention(s): Parent mediated interventions – Developmental Individual-Difference Relationship-Based (DIR) techniques; massage intervention; management of challenging behaviour; early intensive behavioural intervention; Pivotal Response Treatment (PRT). Comparison: Waitlist control, treatment as usual, another intervention, other comparison group Outcomes: Overall autism characteristics (severity of autism characteristics); social-communication (shared or joint attention, child initiations); communication (communication, joint language); expressive language (expression); receptive language (comprehension); cognitive (developmental/intellectual gains); social-emotional/challenging behaviour</p>

		(maladaptive behaviour); adaptive behaviour; caregiver communication and interaction (parental synchrony); caregiver social emotional wellbeing (parents' level of stress, parental confidence), caregiver satisfaction.
Parsons, Cordier, Vaz et al. (2017)	<p>Type: Narrative synthesis only</p> <p>Objectives: "to (1) systematically review the existing evidence presented by studies on parent-mediated intervention training, delivered remotely for parents having children with autism spectrum disorder and living outside of urban areas; (2) provide an overview of current parent training interventions used with this population; (3) and provide an overview of the method of delivery of the parent training interventions used with this population."</p> <p>Number of included studies: 7</p> <p>Search limit (years): 2014 – 2016</p> <p>Study designs: Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs</p> <p>Quality of studies: Included moderate quality/moderate risk of bias</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant Characteristics</p> <p>Number of participating children: Not specified</p> <p>Age: 0 - < 18 years (inclusion criteria)</p> <p>Sex: 42/52 males, 10/52 females</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Web-based training in behavioural interventions; Online and Applied System for Intervention Skills (OASIS) training intervention Research-to-practice; Improving Parents as Communication Teachers (ImPACT) on the Web; Implementation discrete-trial instructions using video training materials; Parent Early Start Denver Model (P-EDSM) training; Functional communication training.</p> <p>Comparison: Another intervention, the individual's own baseline, no comparison group</p> <p>Outcomes: Social-communication (social behaviour and communication skills); communication (vocabulary production and comprehension); caregiver satisfaction; caregiver communication and interaction (parental knowledge acquisition); caregiver social emotional wellbeing (parental self-efficacy).</p>
Parsons, Cordier, Munro et al. (2017)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: "to conduct a systematic review and meta-analysis of pragmatic language interventions for children with autism spectrum disorder (ASD)."</p> <p>Number of included studies: 21 narrative synthesis; 15 meta-analysis</p>	<p>Participant Characteristics</p> <p>Number of participating children: 925</p> <p>Age: 21 months – 14 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p>

	<p>Search limit (years): Database inception - 2016</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Intervention(s): Pragmatic language interventions - The Junior detective Program; Milton and Ethel Harris Research Initiative Treatment (MEHRIT); Building Blocks Program; Social Emotional NeuroScience Endocrinology (SENSE) theatre; Social Skills Group Intervention- High Functioning Autism; FindMe App; Therapeutic Horse Riding; FaceSay; Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER);</p> <p>Improvisational music therapy; SummerMAX; Mind Reading; Skillstreaming; Emotion Recognition Training; Seaver-NETT.</p> <p>Comparison: Wait list control, treatment as usual, another intervention</p> <p>Outcomes: Social-communication (pragmatic language).</p>
Peters-Scheffer et al. (2011)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: "to investigate the effectiveness of early intensive behavioural intervention (EIBI) based on applied behaviour analysis in young children with Autism Spectrum Disorders (ASD)."</p> <p>Number of included studies: 11</p> <p>Search limit (years): 1980 – 2009</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Not specified</p>	<p>Participant Characteristics</p> <p>Number of participating children: 344</p> <p>Age: 34 – 66 months</p> <p>Sex: 213/246 males, 33/246 females</p> <p>Description: Autism Spectrum Disorder, including autistic disorder, pervasive developmental disorder not otherwise specified, or not specified</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Early Intensive Behavioural Intervention (EIBI).</p> <p>Comparison: Treatment as usual, another intervention</p> <p>Outcomes: Social-communication (socialisation); Communication (overall); Expressive language; Receptive language; Cognition (full scale IQ, non-verbal IQ); Adaptive behaviour (adaptive behaviour, daily living).</p>
Postorino et al. (2017)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to summarise "the essential elements of parent training (PT) for disruptive behaviour in children with autism spectrum disorder (ASD) and [evaluate] the available evidence for parent</p>	<p>Participant Characteristics</p> <p>Number of participating children: 653 (343 intervention, 310 control)</p> <p>Age: 2 – 14 years</p> <p>Sex: 504/594 males, 90/594 females</p>

	<p>training using both descriptive and meta-analytic procedures.”</p> <p>Number of included studies: 8</p> <p>Search limit (years): 1980 – 2016</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Specified – Conflict</p>	<p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Parent training for disruptive behaviour.</p> <p>Comparison: Wait list control, treatment as usual, another intervention, other comparison group</p> <p>Outcomes: Social-emotional/challenging behaviour (disruptive behaviour).</p>
Reichow et al. (2018)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: “to systematically review the evidence for the effectiveness of early intensive behavioural intervention (EIBI) in increasing functional behaviours and skills, decreasing autism severity, and improving intelligence and communication skills for young children with autism spectrum disorder (ASD).”</p> <p>Number of included studies: 5</p> <p>Search limit (years): Database inception - 2017</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – Conflict</p>	<p>Participant Characteristics</p> <p>Number of participating children: 219 (116 intervention, 103 control)</p> <p>Age: 0 - <6 years (inclusion criteria), M range = 30.2 – 42.5 months</p> <p>Sex: 153/177 males, 24/177 females</p> <p>Description: Autism spectrum disorder, autistic disorder, pervasive developmental disorder not otherwise specified</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Early intensive behavioural intervention (EIBI).</p> <p>Comparison: Treatment as usual, another intervention</p> <p>Outcomes: Overall autism characteristics (autism symptoms); Social-communication (social competence); Communication; Expressive language; Receptive language; Cognition (intelligence quotient); Social-emotional/challenging behaviour (problem behaviour); Adaptive behaviour (adaptive behaviour, daily living skills); School/learning readiness (academic placement), caregiver social and emotional wellbeing (parental stress).</p>
Sandbank et al. (2020a)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to review “group design studies of non-</p>	<p>Participant Characteristics</p> <p>Number of participating children: 6240</p>

pharmacological early interventions designed for young children with autism spectrum disorder (ASD)."

Number of included studies: 130

Search limit (years): Not specified

Study designs: Randomised controlled trials, non-randomised with control

Quality of studies: Not specified

Sources of funding: Specified – Funded

Conflict of interest: Specified – Conflict

Age: 0 – 8 years, M = 54.21 months

Sex: Not specified

Description: Autism spectrum disorder (inclusion criteria)

Increased likelihood of ASD: Not included

Other conditions: None

Intervention(s): Animal-assisted therapy- Canine Assistance; Presence of a Therapeutic Service Dog; Therapeutic Horseback Riding

Behavioural- Behavioral Parent Training; Discrete Trial Training with Motor Vocal Imitation Assessment; Early Intensive Behavioral Treatment; Functional Behavior Skills Training; Home-based behavioral treatment; Home-based Early Intensive Behavioral; Intervention (EIBI); Intensive Applied Behaviour Analysis (ABA); Intensive Early Intervention; Low Intensity Behavioral Treatment; Managing Repetitive Behaviors; Picture Exchange Communication System (PECS); Peer-Mediated Intervention; Rapid Motor Imitation Antecedent; Regular Intensive Learning for Young Children with Autism; Schedules, Tools, and Activities for Transitions (STAT); Social Skills Group; Stepping Stones Triple P Positive Parenting Program; Strategies for Teaching Based on Autism Research (STAR)

Developmental- Adapted Hanen More Than Words; Developmental, Individual-Difference, Relationship-Based (DIR)-Floortime; Hanen More Than Words; Joint Attention Mediated Learning (JAML); MEHRIT (Milton and Ethel Harris Research Initiative Treatment); Parent-Mediated Communication Focused Treatment; Parent-mediated intervention for autism spectrum disorder in South Asia (PASS); Play and Language For Autistic Youngsters (PLAY)/ DIR Floortime; Scottish Early Intervention Program; Social Communication Intervention for Children with Autism and Pervasive Developmental Disorder; Video-feedback Intervention to Promote Positive Parenting adapted to autism (VIPP-AUTI)

Naturalistic developmental behavioural intervention (NDBI)- Advancing Social-Communication and Play (ASAP); Caregiver-based intervention program in community day-care centers; Denver Model; Early Social Interaction Project

(SCERTS); Early Start Denver Mode (ESDM); Home-based Building Blocks Program; home-based intervention program; ImPACT Online; Interpersonal Synchrony; Joint Attention Intervention Joint Attention Symbolic Play Engagement Regulation (JASPER); Joint Engagement Intervention; Joint Engagement Intervention with Creative Movement Therapy; Parent-Early Start Denver Model (P-ESDM); Parent-training intervention; Pivotal Response Treatment (PRT); Reciprocal Imitation Training; Social ABCs

Cognitive behaviour therapy (CBT)

Sensory based- Developmental Speech and Language Training through Music; Family-Centered Music Therapy; Improvisational Music Therapy; Music Therapy; Qigong (QST) Massage Treatment; Qigong Massage Treatment; Rhythm Intervention Sensorimotor Enrichment; Sensory Enrichment; Thai Traditional Massage; Tomatis Sound Therapy; Vestibular Stimulation via a Platform Swing

Technology based- ABRACADABRA; Emotiplay Serious Game; FaceSay; FindMe iPad App; Gaming Open Library for Intervention in Autism at Home (GOLIAH); Gaze-contingent attention training; Social Skills Training using a robotic behavioral intervention system; The Transporters animated series; Therapy Outcomes By You (TOBY) App; Transporters DVD; Transporters Program for Children with Autism

Treatment and Education of Autistic and related Communications Handicapped Children (TEACCH)

Other- "Autism 123"; Balance Training Intervention; Circle of Friends; Cognitive Method; Collaborative Model for Promoting Competence and Success (COMPASS); Comprehensive Inclusion Program; Group Psychoeducational Program for Mothers; Home-based intervention; Hyperbaric Oxygen Therapy; Individual Parent Sleep Education; Interactive Book Reading; LEAP (Learning Experiences and Alternative Program for Preschoolers); NeuroModulation Technique (NMT); Outdoor Adventure Program; Parent Education and Counselling (PEAC); Parent-Child Interaction Therapy (PCIT) or Child-directed interaction therapy (CDIT); Positive Family

		<p>Intervention (Positive Behavior Support +parent optimism training); Primary Care Stepping Stones Triple P; Professionally supported intervention; Psychoeducation Intervention; Psychomotor Intervention Program; Reading Mastery; Sleep Education Pamphlet; Sung computer-based intervention; Thought-bubble Training for Theory of Mind; Water Exercise Swimming Program</p> <p>Comparison: Not specified</p> <p>Outcomes: Overall autism characteristics (diagnostic characteristics); Social-communication; Communication (language); Cognition (cognitive); Motor; Social-emotional/challenging behaviour; Adaptive behaviour.</p>
Sandbank et al. (2020b)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to synthesise “effects of interventions on language outcomes of young children (ages 0–8 years) with autism and [evaluate] the extent to which summary effects [vary] by intervention, participant, and outcome characteristics.”</p> <p>Number of included studies: 60</p> <p>Search limit (years): Not Specified – 2017</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant Characteristics</p> <p>Number of participating children: 2908</p> <p>Age: 0 – 8 years (inclusion criteria), M = 48 months</p> <p>Sex: Not specified</p> <p>Description: Autism (inclusion criteria)</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Behavioural; developmental; naturalistic developmental behavioural intervention (NDBI); Treatment and Education of Autistic and related Communications Handicapped Children (TEACCH); sensory-based; animal-assisted; technology-based.</p> <p>Comparison: Not specified</p> <p>Outcomes: Overall effect (summary across all outcomes and language measures); Communication (composite language); Expressive language; Receptive language.</p>
Schaaf et al. (2018)	<p>Type: Narrative synthesis only</p> <p>Objectives: addresses the question “What is the efficacy of occupational therapy using Ayres Sensory Integration® (ASI) to support functioning and participation as defined by the International</p>	<p>Participant Characteristics</p> <p>Number of participating children: 101</p> <p>Age: M range = 4.4 – 8.8 years</p> <p>Sex: 85/101 males, 16/101 females</p> <p>Description: Autism spectrum disorder</p>

	<p>Classification of Functioning, Disability and Health for persons with challenges in processing and integrating sensory information that interfere with everyday life participation?"</p> <p>Number of included studies: 5</p> <p>Search limit (years): 2007 – 2015</p> <p>Study designs: Randomised controlled trials, non-randomised with control, single-case experimental designs</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Ayres Sensory Integration® (ASI).</p> <p>Comparison: Treatment as usual, another intervention, the individual's own baseline</p> <p>Outcomes: Overall autism characteristics (autistic behaviours), social-communication (caregiver assistance with social skills), Sensory (sensory-motor), communication (language skills), play, adaptive behaviour (functioning, reduction in caregiver assistance with self-care activities), community participation (participation).</p>
Schoen et al. (2019)	<p>Type: Narrative synthesis only</p> <p>Objectives: to "evaluate the effectiveness research from 2006 to 2017 on Ayres Sensory Integration (ASI) intervention for children with autism."</p> <p>Number of included studies: 3</p> <p>Search limit (years): 2006 - 2017</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant Characteristics</p> <p>Number of participating children: 89</p> <p>Age: Up to 12 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Ayres Sensory Integration® (ASI).</p> <p>Comparison: Treatment as usual, another intervention</p> <p>Outcomes: General outcomes.</p>
Srinivasan et al. (2018)	<p>Type: Narrative synthesis only</p> <p>Objectives: "to examine the effects of equine therapy on specific domains including social, communication, behavioural, and sensorimotor skills as well as broader</p>	<p>Participant Characteristics</p> <p>Number of participating children: 428 (294 intervention, 134 control; 426 ASD)</p> <p>Age: 3 – 16 years</p> <p>Sex: 328/404 males, 76/404 females</p> <p>Description: Autism spectrum disorder, Asperger syndrome</p>

	<p>functional outcomes including overall adaptive functioning and quality of life.”</p> <p>Number of included studies: 15</p> <p>Search limit (years): Database inception – not specified</p> <p>Study designs: Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs, other</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Increased likelihood of ASD: Not included</p> <p>Other conditions: Attention deficit hyperactivity disorder</p> <p>Intervention(s): Equine therapy - therapeutic horseback riding; simulated horseback riding; hippotherapy.</p> <p>Comparison: Wait list control, another intervention, the individual’s own baseline, no comparison group</p> <p>Outcomes: Social-communication; Sensory; Cognition (cognitive); Motor; Social-emotional/challenging behaviour (behavioural skills); Quality of life; Community participation (functional participation).</p>
Steinbrenner et al. (2020)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to describe a set of practices that have clear evidence of positive effects with autistic children and youth.”</p> <p>Number of included studies: 972</p> <p>Search limit (years): 2012 - 2017</p> <p>Study designs: Randomised controlled trials, non-randomised with control, single-case experimental designs.</p> <p>Quality of studies: Included high quality/low risk of bias only</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Not specified</p>	<p>Participant Characteristics</p> <p>Number of participating individuals: Not specified</p> <p>Age: 0 – 22 years (inclusion criteria)</p> <p>Sex: 5934/7031 males, 1097/7031 females</p> <p>Description: Autism spectrum disorder, Asperger/high functioning autism, autism, pervasive developmental disorder/pervasive developmental disorder not otherwise specified</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Antecedent-based interventions - augmentative and alternative communication (AAC); behavioural momentum intervention; Cognitive Behavioural/Instructional Strategies; Differential Reinforcement of Alternative, Incompatible, or Other Behaviour; Direct Instruction; Discrete Trial Training (DTT); Exercise and Movement; Extinction; Functional Behavioural Assessment; Functional Communication Training (FCT); Modeling; Music-Mediated Intervention; Naturalistic Intervention; Parent-implemented intervention; peer-based instruction and intervention; prompting; reinforcement; response interruption/redirection; self-management; sensory integration; social narratives; social skills training; task analysis; technology-</p>

		<p>aided instruction and intervention; time delay; video modelling; visual supports.</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (social, joint attention); Communication; Cognition (cognitive); Motor; Social-emotional/challenging behaviour (challenging/interfering behaviour); Play; Adaptive behaviour (adaptive/self-help); School/learning readiness; Academic.</p>
Sutherland et al. (2018)	<p>Type: Narrative synthesis only</p> <p>Objectives: "to examine the nature and outcomes of studies examining telehealth assessment and/or intervention in autism spectrum disorder (ASD)."</p> <p>Number of included studies: 14</p> <p>Search limit (years): Database inception - 2016</p> <p>Study designs: Randomised controlled trials, single-case experimental designs, other</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant Characteristics</p> <p>Number of participating individuals: 284</p> <p>Age: 19 months – upper age not specified</p> <p>Sex: Not specified</p> <p>Description: Autism, autism spectrum disorder, pervasive developmental disorder not otherwise specified</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Program Improving Parents as Communication Teachers (imPACT); internet-based Parent Implemented Communication Strategies (iPICS); general communication intervention; imitation training; Telehealth diagnostic services; 'Telehealth Facing Your Fears' Intervention'; functional behaviour assessment and functional communication training; school age intervention using web-based education; language intervention.</p> <p>Comparison: Wait list control, treatment as usual, another intervention, the individual's own baseline, no comparison group</p> <p>Outcomes: Communication; social emotional/challenging behaviour (behaviour); caregiver satisfaction (satisfaction and acceptability); caregiver communication and interaction (fidelity).</p>
Tachibana et al. (2018)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: "to investigate the effectiveness of individual and group interventions for children with autism spectrum disorder (ASD) and to compare the</p>	<p>Participant Characteristics</p> <p>Number of participating children: 1220</p> <p>Age: 1 – 6 years</p> <p>Sex: 669/792 males, 123/792 females</p>

effectiveness of these two types if possible.”

Number of included studies: 30 studies analysis II, IV; 14 studies Analysis I and III

Search limit (years): Not Specified – 2014

Study designs: Randomised controlled trials

Quality of studies: Included moderate quality/moderate risk of bias

Sources of funding: Specified – Funded

Conflict of interest: Specified – No conflict

Description: Autism, autism spectrum disorder

Increased likelihood of ASD: Not included

Other conditions: None

Intervention(s): Social communication intervention - Hanen's More Than Words; Early Start Denver Model (ESDM); Parent training; Joint Attention Symbolic Play Engagement and Regulation (JASPER); Preschool Autism Communication Trial (PACT); Treatment and Education of Autistic and related Communications Handicapped Children (TEACCH)-based group social skills; Reciprocal Imitation Training; Caregiver-based intervention program in community day-care centers; Preschool-based joint attention intervention; Caregiver Mediated Joint Engagement Intervention; Improvisational music therapy; intervention targeting development of socially synchronous engagement; Developmental, Individual-Difference, Relationship-Based(DIR)/Floortime intervention; Functional Behavior Skills Training (FBST); Building Blocks; Parent delivery of the Early Start Denver Model (P-ESDM); Joint Attention Mediated Learning (JAML) intervention; Focused Playtime Intervention (FPI); Education and Skills Training Program for Parents; Parent education and behaviour management (PEBM) Skills training intervention or control for the non-specific aspects of the PEBM parent education and counselling intervention; Home TEACCHing Program.

Comparison: Wait list control, treatment as usual, another intervention

Outcomes: Overall autism characteristics (autism general symptoms); social-communication (qualitative impairment in social interaction, reciprocity of social interaction towards others, responding to joint attention, initiating joint attention; imitation); restricted and repetitive interests and behaviours (restricted repetitive and stereotyped patterns, behaviours, interests and activities); communication (qualitative impairment in communication); expressive language; receptive language; cognition (developmental quotient); adaptive behaviour; caregiver social emotional wellbeing (parenting stress).

Tarver et al. (2019)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to assess the “evidence for the efficacy of behavioural parent interventions for disruptive and hyperactive child behaviour in autism spectrum disorders, as well as parenting efficacy and stress.”</p> <p>Number of included studies: 11</p> <p>Search limit (years): Database inception - 2017</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Not specified</p>	<p>Participant Characteristics</p> <p>Number of participating children: 764 (396 intervention, 368 control)</p> <p>Age: 2 – 14 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder, Asperger’s</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Behavioural parent interventions – Research Units in Behavioural Intervention (RUBI) Parent Training Manual; Child directed interaction therapy (CDIT); Compass for help (C-HOPE); Parent management training; parent-child interaction therapy (PCIT); Primary care stepping stones Triple P (PCSSTP); Stepping stones triple P (SSTP).</p> <p>Comparison: Wait list control, treatment as usual, another intervention, other comparison group</p> <p>Outcomes: Social-emotional/challenging behaviour (parent-reported disruptive behaviour, parent-reported hyperactivity); caregiver social emotional wellbeing (parenting stress, parenting efficacy).</p>
Tiede & Walton (2019)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to conduct “a meta-analysis of outcomes of group-design studies testing interventions using naturalistic developmental behavioural intervention strategies [for children with autism spectrum disorder].”</p> <p>Unique included studies: 27</p> <p>Search limit (years): Not Specified – 2018</p> <p>Study designs: Randomised controlled trials, non-randomised with control (inclusion criteria)</p> <p>Quality of studies: Included low quality/high risk of bias</p>	<p>Participant characteristics</p> <p>Number of participating children: Not specified</p> <p>Age: Mean age < 6 (inclusion criteria)</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder (inclusion criteria)</p> <p>Increased likelihood of ASD: Eligible (inclusion criteria)</p> <p>Other conditions: None</p> <p>Intervention(s): Naturalistic Developmental Behavioural Interventions - Early Start Denver Model (ESDM); Early Social Interaction Project (ESI); intervention emphasizing joint attention and imitation skill-building (JA/Imitation); Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER); Learning Experiences Alternative Program (LEAP); Pivotal Response</p>

	<p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Not specified</p>	<p>Treatment (PRT); Reciprocal Imitation Training (RIT); Focus parent training program; parent training.</p> <p>Comparison: Not specified</p> <p>Outcomes: Overall autism characteristics (symptoms of ASD); Social-communication (joint attention, social engagement); Expressive language; Receptive language; Cognition (cognitive development); Play; Adaptive behaviour.</p>
Treurnicht Naylor et al. (2011)	<p>Type: Narrative synthesis only</p> <p>Objectives: "to systematically review the effectiveness of music on pediatric health-related outcomes."</p> <p>Number of included studies: 17</p> <p>Search limit (years): 1984 - 2009</p> <p>Study designs: Randomised controlled trials</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participating individuals: 575 (20 with ASD)</p> <p>Age: 0.38 – 19 years</p> <p>Sex: Not specified</p> <p>Description: Autism, autistic disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: Developmental delay, learning disabilities, attention deficit hyperactivity disorder, intellectual, social, and emotional deficits including attention deficit disorder/attention deficit hyperactivity disorder, other comorbid disorders (not specified), newly arrived immigrant and refugee adolescents, children from divorced and/or separated families, children experiencing bereavement, chronic depression, psychopathology (affective, behaviour, or substance abuse), acute or chronic illness, cystic fibrosis, migraine</p> <p>Intervention(s): Music therapy.</p> <p>Comparison: Wait list control, treatment as usual, another intervention, other comparison group</p> <p>Outcomes: Social-communication (cognitive functioning and social communication); Adaptive behaviour.</p>
Trzmiel et al. (2019)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: "to assess the effectiveness of Equine-</p>	<p>Participant Characteristics</p> <p>Number of participating children: 390</p> <p>Age: 3 – 16 years, M range = 5.14 – 10.2 years</p> <p>Sex: 308/380 males, 72/380 females</p>

	<p>Assisted Activities and Therapies (EAAT) in autism spectrum disorder (ASD) patients.”</p> <p>Number of included studies: 15 narrative synthesis; 3 meta-analysis</p> <p>Search limit (years): 2000 – 2017</p> <p>Study designs: Not specified</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Equine-assisted therapy - hippotherapy, therapeutic riding.</p> <p>Comparison: Not specified</p> <p>Outcomes: Social-communication (social); Communication; Adaptive behaviour; General outcomes (socialization, engagement, maladaptive behaviours, reaction time in problem-solving situations).</p>
Tupou et al. (2019)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to identify studies involving the provision of early intervention to children with autism spectrum disorder (ASD) who were attending inclusive preschool settings. We also sought to appraise the quality of the identified studies and evaluate their effects on child outcomes. The strategies used in training teaching staff to implement these interventions with fidelity were a particular focus of the review as well.”</p> <p>Number of included studies: 16</p> <p>Search limit (years): 2000 – 2017</p> <p>Study designs: Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 809 (517 intervention, 292 control)</p> <p>Age: 12 – 72 months (inclusion criteria), M = 46 months</p> <p>Sex: Not specified</p> <p>Description: Autism/autism spectrum disorder, pervasive developmental disorder not otherwise specified, Asperger’s syndrome</p> <p>Increased likelihood of ASD: Included</p> <p>Other conditions: None</p> <p>Intervention(s): Comprehensive treatment programmes - Developmentally Appropriate Treatment for Autism (DATA); Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH); Early Intensive Behavioural Intervention (EIBI); Learning Experiences and Alternative Program for Preschoolers (LEAP); Comprehensive Autism Program (CAP); EIBI intervention described as being based on Lovaas’ UCLA model. Skills focused interventions targeting - communication, play skills, peer interaction, and reading skills.</p> <p>Comparison: Not specified</p> <p>Outcomes: Overall autism characteristics (autism severity and/or symptoms); social-communication (social skills); communication</p>

		(communication and/or language); cognition (cognition or educational strengths);); social-emotional/challenging behaviour (adaptive/maladaptive behaviour); adaptive behaviour (functional skills); general outcomes (child outcomes).
Verschuur et al. (2014)	<p>Type: Narrative review only</p> <p>Objectives: "to analyse the research on [Pivotal Responses Treatment] (PRT) in order to (a) document the range of skills that have been targeted for improvement with PRT, (b) assess the success of PRT for improving the skills of children with autism spectrum disorder (i.e., pivotal skills and untargeted skills), (c) assess the success of PRT for improving the skills of caregivers and staff, (d) evaluate the certainty of evidence arising from these studies, (e) identify limitations of the existing evidence base, and (f) suggest directions for future research."</p> <p>Number of included studies: 43</p> <p>Search limit (years): Database inception - 2013</p> <p>Study designs: Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs, other</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 420</p> <p>Age: 1 – 12 years, 7 months, M = 4 years, 7 months</p> <p>Sex: 298/363 males, 65/363 females</p> <p>Description: Autism spectrum disorder, autism, pervasive developmental disorder not otherwise specified, Asperger's syndrome</p> <p>Increased likelihood of ASD: Included</p> <p>Other conditions: None</p> <p>Intervention(s): Pivotal Response Treatment (PRT); Natural Language Paradigm; facilitated social play training; and socio-dramatic play training.</p> <p>Comparison: Wait list control, another intervention, the individual's own baseline, no comparison group</p> <p>Outcomes: General outcomes (child behaviours); Caregiver social emotional wellbeing (caregiver behaviours).</p>
Virués-Ortega (2010)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to "ascertain the collective effectiveness of applied behavior analytic (ABA) intervention for autism, estimate ABA intervention effectiveness in terms of as many outcome variables as possible in</p>	<p>Participant characteristics</p> <p>Number of participating children: 521 (323 intervention, 198 control)</p> <p>Age: M range = 22.6 – 66.3 months</p> <p>Sex: Not specified</p>

	<p>order to provide a comprehensive assessment of its effects, and analyse the effect of study characteristics including intervention duration and intensity, study design, intervention model and intervention delivery format.”</p> <p>Number of included studies: 22</p> <p>Search limit (years): 1985 - 2009</p> <p>Study designs: Randomised controlled trials, non-randomised with control, non-randomised without control</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Not specified</p>	<p>Description: Autism, pervasive developmental disorder not otherwise specified</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Applied Behavior Analytic (ABA) intervention - UCLA model, general ABA.</p> <p>Comparison: Another intervention, other comparison group, no comparison group</p> <p>Outcomes: Social-communication (Socialisation); Communication (communication, general language skills); Expressive language; Receptive language; Cognition (IQ, non-verbal IQ); Motor skills; Adaptive behaviours (overall).</p>
Waddington et al. (2016)	<p>Type: Narrative synthesis only</p> <p>Objectives: to evaluate “the Early Start Denver Model (ESDM) as an early intervention program for... children with autism spectrum disorder.”</p> <p>Number of included studies: 12</p> <p>Search limit (years): Database inception - 2015</p> <p>Study designs: Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs, other</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 336 (209 intervention, 127 control)</p> <p>Age: 9 – 63 months</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder, pervasive developmental disorder not otherwise specified</p> <p>Increased likelihood of ASD: Included</p> <p>Other conditions: None</p> <p>Intervention(s): Early Start Denver Model (ESDM).</p> <p>Comparison: Treatment as usual, another intervention, the individual’s own baseline, no comparison group</p> <p>Outcomes: Overall autism characteristics (autism severity and core diagnostic outcomes); Social-communication (social interaction and communication); General outcomes (child behavioural functioning and development); Caregiver communication and interaction (fidelity to</p>

		intervention); Caregiver social emotional wellbeing (parental stress and sense of competence); Caregiver satisfaction (social validity).
Watkins et al. (2019)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: "to examine the characteristics of interventions for students with autism spectrum disorder (ASD) in inclusive settings, offer quantitative analysis of intervention effects, examine potential moderating variables that influence outcomes, analyse the social validity of these interventions, and provide recommendations for practice and future research."</p> <p>Number of included studies: 28</p> <p>Search limit (years): 1997 – 2017</p> <p>Study designs: Randomised controlled trials, single-case experimental designs</p> <p>Quality of studies: Included moderate quality/moderate risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participating children: 293</p> <p>Age: 3 – 21 years</p> <p>Sex: 243/293 males, 50/293 females.</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Interventions in inclusive settings - visual cues; social scripts; Social Stories; video modelling; communication books; peer-mediated intervention (PMI), self-monitoring; peer networks; individualised interventions based on the results of a functional behaviour assessment (FBA); social skills groups; initiations training; high probability request sequences; music therapy; and behavioural strategies were implemented in one study each.</p> <p>Comparison: Wait list control, another intervention, the individual's own baseline</p> <p>Outcomes: General outcomes; Social-communication; restricted and repetitive interests and behaviours; social-emotional/challenging behaviour (classroom behaviour, challenging behaviour and repetitive behaviour); play</p>
Weitlauf et al. (2017)	<p>Type: Narrative synthesis only</p> <p>Objectives: "To evaluate the effectiveness and safety of interventions targeting sensory challenges in children with autism spectrum disorder (ASD)."</p> <p>Number of included studies: 24</p> <p>Search limit (years): 2010 – 2016</p> <p>Study designs: Randomised controlled trials, non-randomised with control, other</p>	<p>Participant characteristics</p> <p>Number of participating children: 1010</p> <p>Age: 2 – 16 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder, autism, pervasive developmental disorder not otherwise specified</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Sensory integration-based; environmental enrichment-</p>

	<p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>based; auditory integration-based; music therapy; massage-based; other/additional such as tactile-based tasks, and weighted blankets.</p> <p>Comparison: Wait list control, treatment as usual, another intervention, other comparison group</p> <p>Outcomes: Sensory (sensory-related outcomes), Communication (language), expressive language, cognition (nonverbal cognitive skills), motor.</p>
Weston et al. (2016)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: “to undertake a meta-analytic and systematic appraisal of the literature investigating the effectiveness of cognitive behavioural therapy (CBT) when used with individuals who have autistic spectrum disorders (ASDs) for either a) affective disorders, or b) the symptoms of ASDs.”</p> <p>Number of included studies: 48</p> <p>Search limit (years): Not specified – 2016</p> <p>Study designs: Randomised controlled trials, non-randomised with control</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Specified – Funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 2099 (1081 intervention, 1018 control)</p> <p>Age: 4 – 65 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Cognitive behavioural therapy.</p> <p>Comparison: Wait list control, treatment as usual, another intervention, other comparison group</p> <p>Outcomes: Overall autism characteristics (symptoms related to ASD)</p>
Wiese et al. (2016)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to examine the effectiveness of equine-based therapy on behavioural and social interactions in the treatment of children with autism spectrum disorder (ASD).”</p> <p>Number of included studies: 8</p> <p>Search limit (years): Not specified – 2015</p> <p>Study designs: Randomised controlled trials, non-</p>	<p>Participant characteristics</p> <p>Number of participating children: 186</p> <p>Age: 4 – 16 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder, autism, Asperger’s syndrome</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Equine-assisted therapy - Therapeutic horse-riding (THR);</p>

	<p>randomised with control, non-randomised without control, single-case experimental designs, other</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Hippotherapy; and Equine-assisted activities.</p> <p>Comparison: Wait list control, another intervention, the individual's own baseline, other comparison group, no comparison</p> <p>Outcomes: General outcomes (behaviour and social interaction).</p>
<p>Zagona & Mastergeorge (2018)</p>	<p>Type: Narrative synthesis only</p> <p>Objectives: to "describe the quality of current [peer-mediated instruction and intervention] empirical research published within the last 10 years, depict the growth and expansion of this practice as determined by published studies, examine implications for practice in inclusive settings, and explore future directions for research given the increasing number of individuals with autism spectrum disorder (ASD) included in general education classrooms."</p> <p>Number of included studies: 17</p> <p>Search limit (years): 2004 - 2014</p> <p>Study designs: Randomised controlled trials, single-case experimental designs</p> <p>Quality of studies: Included low quality/high risk of bias</p> <p>Sources of funding: Specified – Not funded</p> <p>Conflict of interest: Specified – No conflicts</p>	<p>Participant characteristics</p> <p>Number of participating children: 110</p> <p>Age: 3 – 15 years</p> <p>Sex: Not specified</p> <p>Description: Autism spectrum disorder</p> <p>Increased likelihood of ASD: Not included</p> <p>Other conditions: None</p> <p>Intervention(s): Peer-mediated instruction and intervention.</p> <p>Comparison: Another intervention, the individual's own baseline</p> <p>Outcomes: Social-communication.</p>

S11: Summary of findings from practice/category-focused systematic reviews

Table 1: Summary of findings from systematic reviews of behavioural interventions

Characteristics of interventions included in the systematic review		Findings from the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (Included studies)
Systematic reviews at the category level					
Makrygianni & Reed (2010)	<p>Label: Behavioural early intervention programs.</p> <p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers, peers/siblings.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Behavioural early intervention programs.</p>	<p>Social-communication (socialisation): Positive pooled effect.</p> <p>Communication: Positive pooled effect.</p> <p>Communication (language): Positive pooled effect.</p> <p>Cognition (IQ): Positive pooled effect.</p> <p>Adaptive behaviour: Positive pooled effect.</p> <p>Child age: Child age not related to intervention effect on cognition, adaptive behaviour, or language.</p> <p>Child characteristics: Pre-intervention communication not related to intervention effect on communication, cognition, or adaptive behaviour. Pre-intervention cognition not related to intervention effect on communication, cognition, or adaptive behaviour. Greater pre-intervention adaptive behaviour skills related to greater intervention effects on communication and adaptive behaviour, but not on cognition.</p>	Not specified	6/11	Included low quality/high risk of bias

		<p>Amount of intervention: Higher intensity (hours per week) related to greater intervention effect on cognition and adaptive behaviour, but not language. Intervention duration (months) not related to intervention effect on cognition, adaptive behaviour, or language.</p> <p>Adverse effects: Not reported.</p>			
<p>National Autism Center (2015)</p>	<p>Label: Behavioural interventions.</p> <p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p> <p>Intervention practices: Behavioural interventions.</p>	<p>Social-communication (interpersonal): Summarised positive effect.</p> <p>RRB (restricted, repetitive, non-functional patterns of behaviour, interests, or activity): Summarised positive effect.</p> <p>Sensory (sensory or emotional regulation): Summarised positive effect.</p> <p>Communication: Summarised positive effect.</p> <p>Cognition (higher cognitive functions): Summarised positive effect.</p> <p>Motor: Summarised positive effect.</p> <p>Social-emotional/challenging behaviour (self-regulation, problem behaviour): Summarised positive effect.</p> <p>Play: Summarised positive effect.</p> <p>Adaptive behaviour (personal responsibility): Summarised positive effect.</p> <p>School/learning readiness (learning readiness): Summarised positive effect.</p>	Not specified	4/10	Included low quality/high risk of bias

		Academic: Summarised positive effect. Adverse effects: Not reported.			
Sandbank et al. (2020a)	Label: Behavioural interventions. Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified. Intervention practices: Behavioral Parent Training; Discrete Trial Training with Motor Vocal Imitation Assessment; Early Intensive Behavioral Treatment; Functional Behavior Skills Training Home-based behavioral treatment; Home-based Early Intensive Behavioral Intervention (EIBI); Intensive ABA; Intensive Early Intervention; Low Intensity Behavioral Treatment; Managing Repetitive Behaviors; Picture Exchange Communication System (PECS); Peer-Mediated Intervention; Rapid Motor Imitation Antecedent; Regular Intensive Learning for Young	Overall autism characteristics (diagnostic characteristics): Positive pooled effect. Social-communication: Positive pooled effect. Communication (language): Positive pooled effect. Cognition (cognitive): Positive pooled effect. Motor: Positive pooled effect. Social-emotional/challenging behaviour: Positive pooled effect. Adaptive behaviour: Positive pooled effect. Adverse effects: Not reported.	RCTs, non-randomised with control	10/11	Not specified

	Children with Autism; Schedules, Tools, and Activities for Transitions (STAT); Social Skills Group; Stepping Stones Triple P Positive Parenting Program; Strategies for Teaching Based on Autism Research (STAR).				
Systematic reviews at the practice level					
Discrete trial training (DTT)					
Steinbrenner et al. (2020)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	Social-communication (social): Summarised positive effect. Social-communication (joint attention): Summarised positive effect. Communication: Summarised positive effect. Cognition (cognitive): Summarised positive effect. Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect. Play: Summarised positive effect. Adaptive behaviour (adaptive/self-help): Summarised positive effect. School/Learning Readiness: Summarised positive effect. Academic: Summarised positive effect.	RCTs, non-randomised with control, single-case experimental designs	7/10	High quality/low risk of bias only

		Adverse effects: Not reported.			
Early Intensive Behavioural Intervention (EIBI)					
Virués-Ortega (2010)	Setting: Clinic, home, educational. Format: Individual. Agent: Parents/caregivers, Clinicians/researchers. Mode: Face-to-face.	Social-communication (Socialisation): Positive pooled effect. Communication: Positive pooled effect. Communication (general language skills): Positive pooled effect. Expressive language: Positive pooled effect. Receptive language: Positive pooled effect. Cognition (IQ): Positive pooled effect. Cognition (non-verbal IQ): Positive pooled effect. Cognition (IQ, clinic-based programs): Positive pooled effect. Cognition (IQ, parent-managed programs): Positive pooled effect. Motor: Positive pooled effect. Adaptive behaviours (overall): Positive pooled effect. Adaptive behaviours (clinic-based programs): Positive pooled effect. Adaptive behaviours (parent managed programs): Positive pooled effect.	RCTs, non-randomised with control, non-randomised without control	8/11	Included low quality/high risk of bias

		<p>Amount of intervention: Greater total hours related to greater intervention effect on language and adaptive behaviour, but not cognition.</p> <p>Adverse effects: Not reported.</p>			
Peters-Scheffer et al. (2011)	<p>Setting: Clinic, home, educational.</p> <p>Format: Individual.</p> <p>Agent: Clinicians/researchers.</p> <p>Mode: Face-to-face.</p>	<p>Social-communication (socialisation): Positive pooled effect.</p> <p>Communication (overall): Positive pooled effect.</p> <p>Expressive language: Positive pooled effect.</p> <p>Receptive language: Positive pooled effect.</p> <p>Cognition (full scale IQ): Positive pooled effect.</p> <p>Cognition (non-verbal IQ): Positive pooled effect.</p> <p>Adaptive behaviour: Positive pooled effect.</p> <p>Adaptive behaviour (daily living): Positive pooled effect.</p> <p>Adverse effects: Not reported.</p>	RCTs, non-randomised with control	8/11	Not specified
National Autism Center (2015)	<p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p>	<p>Overall autism characteristics (general symptoms): Summarised positive effect.</p> <p>Social-communication (interpersonal): Summarised positive effect.</p> <p>Communication: Summarised positive effect.</p>	Not specified	4/10	Included low quality/high risk of bias

		<p>Cognition (higher cognitive functions): Summarised positive effect.</p> <p>Motor: Summarised positive effect.</p> <p>Social-emotional/challenging behaviour (problem behaviour): Summarised positive effect.</p> <p>Adaptive behaviour (personal responsibility): Summarised positive effect.</p> <p>School/learning readiness (learning readiness): Summarised positive effect.</p> <p>Academic: Summarised positive effect.</p> <p>Adverse effects: Not reported.</p>			
Reichow et al. (2018)	<p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Not specified.</p> <p>Mode: Face-to-face.</p>	<p>Overall autism characteristics (autism symptoms): Null pooled effect.</p> <p>Social-communication (social competence): Positive pooled effect.</p> <p>Communication: Positive pooled effect.</p> <p>Expressive language: Positive pooled effect.</p> <p>Receptive language: Positive pooled effect.</p> <p>Cognition (intelligence quotient): Positive pooled effect.</p> <p>Social-emotional/challenging behaviour (problem behaviour): Null pooled effect.</p> <p>Adaptive behaviour: Positive pooled effect.</p>	RCTs, non-randomised with control	11/11	Not specified

		<p>Adaptive behaviour (daily living skills): Positive pooled effect.</p> <p>School/learning readiness (academic placement): Summarised positive effect.</p> <p>Caregiver social and emotional wellbeing (parental stress): Summarised null effect.</p> <p>Adverse effects: Considered, and none identified.</p>			
Functional communication training					
National Autism Center (2015)	<p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p>	<p>General outcomes: Summarised inconsistent effect.</p> <p>Adverse effects: Not reported.</p>	Not specified	4/10	Included low quality/high risk of bias
Steinbrenner et al. (2020)	<p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p>	<p>Social-communication (social): Summarised positive effect.</p> <p>Communication: Summarised positive effect.</p> <p>Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect.</p> <p>Play: Summarised positive effect.</p> <p>Adaptive behaviour (adaptive/self-help): Summarised positive effect.</p> <p>School/learning readiness: Summarised positive effect.</p>	RCTs, non-randomised with control, single-case experimental designs.	7/10	High quality/low risk of bias only

		Adverse effects: Not reported.			
Language Training (production)					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	Communication: Summarised positive effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Language Training (production and understanding)					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Picture Exchange Communication System (PECS)					
Flippin et al. (2010)	Setting: Home, educational, centres. Format: Individual. Agent: Not specified. Mode: Face-to-face.	Social-communication (communicative behaviours): Positive pooled effect. Expressive language (speech or vocalisation): Null pooled effect. Adverse effects: Not reported	RCTs, non-randomised with control, single-case experimental designs	7/11	Included low quality/high risk of bias
National Autism	Setting: Not specified.	General outcomes: Summarised inconsistent effect.	Not specified	4/10	Included low

Center (2015)	Format: Not specified. Agent: Not specified. Mode: Not specified.	Adverse effects: Not reported.			quality/high risk of bias
----------------------	--	---------------------------------------	--	--	---------------------------

Footnote: "Label" refers to the term used by the authors of the systematic review to describe the category of interventions being examined; "Intervention Practices" refers to the intervention practices described by the authors as being included in the systematic review; participants in the intervention group of a systematic review generally only received one intervention practice, though this was not always specified; "pre-intervention" refers to child characteristics measured prior to the delivery of intervention; Only outcomes for which evidence was available are included; "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review; "risk of bias (included studies)" refers to the risk of bias, as assessed by the authors of the systematic review and appraised by current authors during data extraction, the rating indicates the lower bound of quality/risk of bias for studies included in the review.

Table 2. Summary of findings from systematic reviews of developmental interventions

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Systematic reviews at the category level					
Binns & Oram Cardy (2019)	<p>Label: Developmental social pragmatic interventions.</p> <p>Setting: Clinic, home.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, educators, clinicians/researchers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Child Talk; Hanen More than Words; Developmental Individual-Difference Relationship-Based (DIR); Milton and Ethel Harris Research Initiative Treatment (MEHRIT)-DIR based; Pediatric Autism and Communication Therapy (PACT); Joint attention mediated learning; Play and Language for Autistic Youngsters (PLAY) project - DIR based; Social communication, emotion regulation, transactional support (SCERTS).</p>	<p>Social-communication (social interaction and social-communication): Summarised positive effect.</p> <p>Communication (language capacities): Summarised inconsistent effect.</p> <p>Caregiver communication and interaction (parental responsiveness and directiveness): Summarised positive effect.</p> <p>Child characteristics: The level of pre-intervention overall autism characteristics inconsistently related to intervention effects on social-communication.</p> <p>Adverse effects: Not reported.</p>	RCTs only	9/10	Included low quality/high risk of bias

Sandbank et al. (2020a)	<p>Label: Developmental interventions.</p> <p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p> <p>Intervention practices: Adapted Hanen More Than Words; DIR-Floortime; Hanen More Than Words; Joint Attention Mediated Learning (JAML); MEHRIT (Milton and Ethel Harris Research Initiative Treatment); Parent-Mediated Communication Focused Treatment; Parent-mediated intervention for autism spectrum disorder in South Asia (PASS); Play and Language For Autistic Youngsters (PLAY)/DIR Floortime; Scottish Early Intervention Program; Social Communication Intervention for Children with Autism and Pervasive Developmental Disorder; Video-feedback Intervention to Promote Positive Parenting adapted to autism (VIPP-AUTI)</p>	<p>Social-communication: Positive pooled effect.</p> <p>Communication (language): Null pooled effect.</p> <p>Adverse effects: Not reported.</p>	<p>RCTs, non-randomised with control</p>	<p>10/11</p>	<p>Not specified</p>
Systematic reviews at the practice level					
Developmental relationship-based treatment					
National Autism	<p>Setting: Not specified.</p> <p>Format: Not specified.</p>	<p>General outcomes: Summarised inconsistent effect.</p>	<p>Not specified</p>	<p>4/10</p>	<p>Included low</p>

Center (2015)	Agent: Not specified. Mode: Not specified.	Adverse effects: Not reported.			quality/high risk of bias
DIR/Floortime					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised null effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Boshoff et al. (2020)	Setting: Clinic, home, natural contexts for the child. Format: Individual. Agent: Parents/caregivers, clinicians/researchers. Mode: Face-to-face.	Social-communication (social and emotional development): Summarised positive effect. Communication (language): Summarised null effect. Motor skills (motor and fine motor): Summarised null effect. Adverse effects: Not reported.	RCTs, non-randomised without control group, single-case experimental designs, other	9/10	Not specified
Naturalistic teaching strategies					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	Social-communication (interpersonal): Summarised positive effect. Communication: Summarised positive effect. School/learning readiness: Summarised positive effect.	Not specified	4/10	Included low quality/high risk of bias

		Adverse effects: Not reported.			
Steinbrenner et al. (2020)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	Social-communication (social): Summarised positive effect. Social-communication (joint attention): Summarised positive effect. Communication: Summarised positive effect. Cognition (cognitive): Summarised positive effect. Motor: Summarised positive effect. Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect. Play: Summarised positive effect. Adaptive behaviour (adaptive/self-help): Summarised positive effect. School/learning readiness: Summarised positive effect. Academic: Summarised positive effect. Adverse effects: Not reported.	RCTs, non-randomised with control, single-case experimental designs	7/10	High quality/low risk of bias only

Footnote: "Label" refers to the term used by the authors of the systematic review to describe the category of interventions being examined; "Intervention Practices" refers to the intervention practices described by the authors as being included in the systematic review; participants in the intervention group of a systematic review generally only received one intervention practice, though this was not always specified; "pre-intervention" refers to child characteristics measured prior to the delivery of intervention; Only outcomes for which evidence was available are included; "Outcomes ()" the first term refers to the outcome categories

defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review; "risk of bias (included studies)" refers to the risk of bias, as assessed by the authors of the systematic review and appraised by current authors during data extraction, the rating indicates the lower bound of quality/risk of bias for studies included in the review.

Table 3. Summary of findings from systematic reviews of naturalistic developmental behavioural interventions

Characteristics of interventions included in the systematic review		Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Systematic reviews at the category level					
Tiede & Walton (2019)	<p>Label: Naturalistic developmental behavioural interventions.</p> <p>Setting: Clinic, home, educational, community.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers, educators, clinicians/researchers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Early Start Denver Model (ESDM); Early Social Interaction Project (ESI); intervention emphasizing joint attention and imitation skill-building (JA/Imitation); Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER); Learning Experiences Alternative Program (LEAP); Pivotal Response Treatment (PRT); Reciprocal Imitation Training (RIT); Focus parent training program; parent training.</p>	<p>Overall autism characteristics (symptoms of ASD): Positive pooled effect.</p> <p>Social-communication (joint attention): Null pooled effect.</p> <p>Social-communication (social engagement): Positive pooled effect.</p> <p>Expressive language: Positive pooled effect.</p> <p>Receptive language: Positive pooled effect</p> <p>Cognition (cognitive development): Positive pooled effect.</p> <p>Cognition (non-verbal IQ): Positive pooled effect</p> <p>Play: Positive pooled effect.</p> <p>Adaptive behaviour: Null pooled effect.</p> <p>Amount of intervention: Greater total hours related to greater intervention effect on joint attention. Intervention amount (total</p>	RCTs, non-randomised with control (inclusion criteria)	10/11	Included low quality/high risk of bias

		<p>hours) not related to intervention effect on adaptive behaviour expressive or receptive language, cognitive development, overall autism characteristics, social engagement, or play.</p> <p>Adverse effects: Not reported.</p>			
Sandbank et al. (2020a)	<p>Label: Naturalistic developmental behavioural interventions.</p> <p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p> <p>Intervention practices: Advancing Social-Communication and Play (ASAP); Caregiver-based intervention program in community day-care centers; Denver Model; Early Social Interaction Project (SCERTS); Early Start Denver Model (ESDM); Home-based Building Blocks Program; home-based intervention program; ImPACT Online; Interpersonal Synchrony; Joint Attention Intervention; Joint Attention Symbolic Play Engagement Regulation (JASPER); Joint Engagement Intervention; Joint Engagement Intervention with Creative Movement Therapy; Parent-Early Start Denver Model (P-ESDM); Parent-training intervention; Pivotal Response</p>	<p>Overall autism characteristics (diagnostic characteristics): Null pooled effect.</p> <p>Social-communication: Positive pooled effect.</p> <p>RRB: Null pooled effect.</p> <p>Communication (language): Positive pooled effect</p> <p>Cognition (cognitive): Positive pooled effect.</p> <p>Social-emotional challenging behaviours: Null pooled effect</p> <p>Play: Positive pooled effect</p> <p>Adaptive behaviour: Null pooled effect</p> <p>Adverse effects: Not reported.</p>	RCTs, non-randomised with control	10/11	Not specified

	Treatment (PRT); Reciprocal Imitation Training; Social ABCs				
Systematic reviews at the practice level					
Early Start Denver Model					
Waddington et al. (2016)	<p>Setting: Clinic, home, educational, university, hospital.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, clinicians/researchers.</p> <p>Mode: Face-to-face, telepractice.</p>	<p>Overall autism characteristics (autism severity and core diagnostic outcomes): Summarised null effect</p> <p>Social-communication (social interaction and communication): Summarised positive effect</p> <p>General outcomes (child behavioural functioning and development): Summarised positive effect</p> <p>Caregiver communication and interaction (fidelity to intervention): Summarised positive effect</p> <p>Caregiver social emotional wellbeing (parental stress and sense of competence): Summarised positive effect</p> <p>Caregiver satisfaction (social validity): Summarised positive effect</p> <p>Child characteristics: Greater pre-intervention imitation was inconsistently related to intervention effects. Functional use of objects, and goal understanding related to</p>	RCTs, non-randomised with control, non-randomised without control, single-case experimental designs, other	8/10	Included low quality/high risk of bias

		<p>greater intervention effects. Pre-intervention cognitive ability and social attention not related to intervention effects.</p> <p>Child age: Child age inconsistently related to intervention effects.</p> <p>Amount of intervention: Total hours of intervention inconsistently related to intervention effects.</p> <p>Adverse effects: Not reported.</p>			
Fuller, Oliver et al. (2020)	<p>Setting: Not specified.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, clinicians/researchers.</p> <p>Mode: Face-to-face.</p>	<p>Overall autism characteristics (autism symptoms): Null pooled effect</p> <p>Social-communication: Null pooled effect</p> <p>RRB (repetitive behaviours): Null pooled effect</p> <p>Communication (language): Positive pooled effect</p> <p>Cognition: Positive pooled effect</p> <p>Adaptive behaviour (adaptive functioning): Null pooled effect</p> <p>Amount of Intervention: Duration of intervention (total weeks) not related to intervention effects on child outcomes. Intensity of intervention (hours per week) not</p>	RCTs, non-randomised with control	10/11	Not specified

		<p>related to intervention effects on child outcomes.</p> <p>Total hours of intervention not related to intervention effects on child outcomes.</p> <p>Adverse effects: Not reported.</p>			
Pivotal Response Treatment					
Verschuur et al. (2014)	<p>Setting: Clinic, home, educational.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, peers/siblings, educators, clinicians/researchers.</p> <p>Mode: Face-to-face, self-directed learning.</p>	<p>General outcomes (child behaviours): Summarised inconsistent effect.</p> <p>Caregiver social emotional wellbeing (caregiver behaviours): Summarised inconsistent effect.</p> <p>Adverse effects: Not reported.</p>	RCTs, non-randomised with control, non-randomised without control, single-case experimental designs, other	6/10	Included low quality/high risk of bias
National Autism Center (2015)	<p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p>	<p>Communication: Summarised positive effect.</p> <p>Play: Summarised positive effect.</p> <p>School/learning readiness: Summarised positive effect.</p>	Not specified	4/10	Included low quality/high risk of bias

		Adverse effects: Not reported.			
Ona et al. (2020)	Setting: Clinic, home. Format: Individual, group. Agent: Parents/caregivers, clinicians/researchers. Mode: Face-to-face.	Social-communication (social interaction): Summarised inconsistent effect. RRB: Summarised positive effect. Communication: Null pooled effect. Expressive language: Positive pooled effect. Adverse effects: Not reported.	RCTs only	8/11	Included low quality/high risk of bias

Footnote: "Label" refers to the term used by the authors of the systematic review to describe the category of interventions being examined; "Intervention Practices" refers to the intervention practices described by the authors as being included in the systematic review; participants in the intervention group of a systematic review generally only received one intervention practice, though this was not always specified; "pre-intervention" refers to child characteristics measured prior to the delivery of intervention; Only outcomes for which evidence was available are included; "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review; "risk of bias (included studies)" refers to the risk of bias, as assessed by the authors of the systematic review and appraised by current authors during data extraction, the rating indicates the lower bound of quality/risk of bias for studies included in the review.

Table 4. Summary of findings from systematic reviews of sensory-based interventions

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Systematic reviews at the category level					
Lang et al. (2012)	<p>Label: Sensory integration therapies</p> <p>Setting: Clinic, home, educational, specifically-designed room.</p> <p>Format: Individual.</p> <p>Agent: Educators, clinicians/researchers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Weighted vests; swinging or rocking stimulation; brushing with a bristle or a feather; joint compression or stretching; alternative seating; jumping or bouncing; blanket or "body sock"; playing with a water and sand sensory table; chewing on a rubber tube; and playing with specially textured toys.</p>	<p>General outcomes (intervention outcomes): Summarised null effect.</p> <p>Adverse effects: Considered and identified: "Of those 14 studies [that reported no benefit], 4 suggested that SIT may have contributed to increases in stereotypy and problem behavior" (p. 1015 of original article).</p>	Not specified	4/10	Included low quality/high risk of bias
National Autism Center (2015)	<p>Label: Sensory intervention package.</p> <p>Setting: Not specified.</p> <p>Format: Not specified.</p>	<p>General outcomes: Summarised null effect.</p> <p>Adverse effects: Not reported.</p>	Not specified	4/10	Included low quality/high risk of bias

	Agent: Not specified. Mode: Not specified. Intervention practices: Sensory intervention package.				
Sandbank et al. (2020a)	Label: Sensory-based interventions. Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified. Intervention practices: Developmental Speech and Language Training through Music; Family-Centered Music Therapy; Improvisational Music Therapy; Music Therapy; Qigong (QST) Massage Treatment; Qigong Massage Treatment; Rhythm Intervention Sensorimotor Enrichment; Sensory Enrichment; Thai Traditional Massage; Tomatis Sound Therapy; Vestibular Stimulation via a Platform Swing	Communication (language): Null pooled effect. Adverse effects: Not reported.	RCTs, non-randomised with control	10/11	Not specified

Systematic reviews at the practice level

Auditory Integration-Based Approaches

National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised null effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Weitlauf et al. (2017)	Setting: Not specified. Format: Individual. Agent: Not specified. Mode: Face-to-face.	Communication (language): Summarised null effect. Adverse effects: Not reported.	RCTs, non-randomised with control, other	9/10	Included moderate quality/moderate risk of bias
Steinbrenner et al. (2020)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised null effect. Adverse effects: Not reported.	RCTs, non-randomised with control, single-case experimental designs	7/10	High quality/low risk of bias only

Ayres Sensory Integration (ASI)

Schaaf et al. (2018)	Setting: Educational. Format: Individual, group. Agent: Caregivers/parents, educators, clinicians/researchers.	Overall autism characteristics (autistic behaviours): Summarised inconsistent effect	RCTs, non-randomised with control, single-case experimental designs	7/10	Not specified
-----------------------------	---	---	---	------	---------------

	Mode: Face-to-face.	Social-communication (caregiver assistance with social skills): Summarised null effect Sensory (sensory-motor): Summarised null effect Communication (language skills): Summarised null effect Play: Summarised null effect Adaptive behaviour (functioning, reduction in caregiver assistance with self-care activities): Summarised inconsistent effect Community participation (participation): Summarised positive effect Adverse effects: Not reported.			
Weitlauf et al. (2017)	Setting: Not specified. Format: Individual. Agent: Not specified. Mode: Face-to-face.	Sensory (sensory-related outcomes): Summarised positive effect. Motor: Summarised positive effect. Adverse effects: Not reported.	RCTs, non-randomised with control, other	9/10	Included low quality/high risk of bias
Schoen et al. (2019)	Setting: Clinic, summer camp. Format: Individual, group.	General outcomes: Summarised inconsistent effect.	RCTs, non-randomised with control	8/10	Not specified

	Agent: Educators, clinicians/researchers. Mode: Face-to-face.	Adverse effects: Not reported.			
Steinbrenner et al. (2020)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	Social-communication (social): Summarised positive effect. Communication: Summarised positive effect. Cognition (cognitive): Summarised positive effect. Motor: Summarised positive effect. Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect. Adaptive behaviour (adaptive/self-help): Summarised positive effect. Academic: Summarised positive effect. Adverse effects: Not reported.	RCTs, non-randomised with control, single-case experimental designs	7/10	High quality/low risk of bias only
Environmental enrichment					
Weitlauf et al. (2017)	Setting: Not specified. Format: Individual. Agent: Not specified. Mode: Face-to-face.	Expressive language: Summarised null effect. Cognition (nonverbal cognitive skills): Summarised positive effect.	RCTs, non-randomised with control, other	9/10	Included low quality/high risk of bias

		Adverse effects: Not reported.			
--	--	---------------------------------------	--	--	--

Music therapy					
Treurnicht Naylor et al. (2011)	Setting: Clinic, educational. Format: Individual. Agent: Clinician/researcher. Mode: Face-to-face.	Social-communication (cognitive functioning and social communication): Summarised positive effect. Adaptive behaviour: Summarised null effect. Adverse effects: Not reported.	RCTs only	7/10	Included low quality/high risk of bias
Geretsegger et al. (2014)	Setting: Clinic, home, educational, hospital. Format: Individual, group with family. Agent: Clinicians/researchers. Mode: Face-to-face.	Social-communication (social adaptation – overall): Positive pooled effect. Communication (non-verbal, overall): Positive pooled effect. Communication (verbal, overall): Positive pooled effect. Quality of life (joy): Positive pooled effect. Caregiver social emotional wellbeing (quality of family relationships): Positive pooled effect. Adverse effects: Considered, and none identified.	RCTs, non-randomised with control (inclusion criteria)	11/11	Not specified

National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Steinbrenner et al. (2020)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	Social-communication (social): Summarised positive effect. Communication: Summarised positive effect. Motor: Summarised positive effect. Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect. Play: Summarised positive effect. Adaptive behaviour (adaptive/self-help): Summarised positive effect. School/learning readiness: Summarised positive effect. Adverse effects: Not reported.	RCTs, non-randomised with control, single-case experimental designs	7/10	High quality/low risk of bias only
Sensory diet					
Steinbrenner et al. (2020)	Setting: Not specified. Format: Not specified. Agent: Not specified.	General outcomes: Summarised null effect. Adverse effects: Not reported.	RCTs, non-randomised with control, single-	7/10	High quality/low risk of bias only

	Mode: Not specified.		case experimental designs		
--	-----------------------------	--	---------------------------	--	--

Footnote: "Label" refers to the term used by the authors of the systematic review to describe the category of interventions being examined; "Intervention Practices" refers to the intervention practices described by the authors as being included in the systematic review; participants in the intervention group of a systematic review generally only received one intervention practice, though this was not always specified; Only outcomes for which evidence was available are included; "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review; "risk of bias (included studies)" refers to the risk of bias, as assessed by the authors of the systematic review and appraised by current authors during data extraction, the rating indicates the lower bound of quality/risk of bias for studies included in the review.

Table 5: Summary of findings from systematic reviews of Treatment and Education of Autistic and related Communications Handicapped Children (TEACCH)

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Systematic reviews at the category level					
Sandbank et al. (2020a)	Label: TEACCH Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified. Intervention practices: TEACCH.	Social-communication: Null pooled effect. Adverse effects: Not reported.	RCTs, non-randomised with control	10/11	Not specified
Systematic reviews at the practice level					
Structured teaching					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias

Footnote: "Label" refers to the term used by the authors of the systematic review to describe the category of interventions being examined; "Intervention Practices" refers to the intervention practices described by the authors as being included in the systematic review; participants in the intervention group of a systematic review

generally only received one intervention practice, though this was not always specified; Only outcomes for which evidence was available are included; "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review; "risk of bias (included studies)" refers to the risk of bias, as assessed by the authors of the systematic review and appraised by current authors during data extraction, the rating indicates the lower bound of quality/risk of bias for studies included in the review.

Table 6. Summary of findings from systematic reviews of technology-based interventions

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Systematic reviews at the category level					
National Autism Center (2015)	<p>Label: Technology-based intervention.</p> <p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p> <p>Intervention practices: Technology-based interventions.</p>	<p>General outcomes: Summarised inconsistent effect.</p> <p>Adverse effects: Not reported.</p>	Not specified	4/10	Included low quality/high risk of bias
Mazon et al. (2019)	<p>Label: Technology-based intervention.</p> <p>Setting: Clinic, home, educational, therapeutic centre, overtime clinic</p> <p>Format: Individual.</p> <p>Agent: Not specified.</p> <p>Mode: Face-to-face, computer assisted, robot.</p> <p>Intervention practices: Technology based interventions</p>	<p>General outcomes (statistical significance): Summarised inconsistent effect.</p> <p>Adverse effects: Considered and identified: "6 participants were excluded due to refusal or distress" (p. 243-244 of the original article).</p>	RCTs, non-randomised with control	6/10	Not specified

	including (but not limited to) computer and robot-based interventions.				
Khan et al. (2019)	<p>Label: Web-Based Interventions.</p> <p>Setting: Clinic, home, educational, hospital.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers, clinicians/researchers.</p> <p>Mode: Face-to-face, apps, serious games, online.</p> <p>Intervention practices: Apps; serious games; videoconferencing; virtual environment with playable games; Web-based cognitive behavioural therapy intervention.</p>	<p>Caregiver satisfaction/dissatisfaction: Summarised inconsistent effect.</p> <p>Adverse effects: Considered, and none identified.</p>	RCTs only	9/11	Included moderate quality/moderate risk of bias
Sandbank et al. (2020a)	<p>Label: Technology-based interventions.</p> <p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p> <p>Intervention practices: ABRACADABRA; Emotiplay Serious Game; FaceSay; FindMe</p>	<p>Social-communication: Null pooled effect.</p> <p>Social-emotional/challenging behaviour: Null pooled effect.</p> <p>Adverse effects: Not reported.</p>	RCTs, non-randomised with control	10/11	Not specified

	<p>iPad App; Gaming Open Library for Intervention in Autism at Home (GOLIAH); Gaze-contingent attention training; Social Skills Training using a robotic behavioral intervention system; The Transporters animated series; Therapy Outcomes By You (TOBY) App; Transporters DVD; Transporters Program for Children with Autism</p>				
<p>Steinbrenner et al. (2020)</p>	<p>Label: Technology aided instruction and intervention.</p> <p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p> <p>Intervention practices: Technology-aided instruction</p>	<p>Social-communication (social): Summarised positive effect.</p> <p>Social-communication (joint attention): Summarised positive effect.</p> <p>Communication: Summarised positive effect.</p> <p>Cognition (cognitive): Summarised positive effect.</p> <p>Motor: Summarised positive effect.</p> <p>Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect.</p> <p>Play: Summarised positive effect.</p> <p>Adaptive behaviour (adaptive/self-help): Summarised positive effect.</p> <p>School/learning readiness: Summarised positive effect.</p>	<p>RCTs, non-randomised with control, single-case experimental designs.</p>	<p>7/10</p>	<p>High quality/low risk of bias only</p>

		Academic: Summarised positive effect. Adverse effects: Not reported.			
Systematic reviews at the practice level					
Apps					
Moon et al. (2019)	Setting: Clinic, home, educational. Format: Individual. Agent: Not specified. Mode: Face-to-face.	Social-communication: Null pooled effect. Communication (gestures): Null pooled effect. Communication (symbolic): Null pooled effect. Expressive language: Null pooled effect. Expressive language (words produced): Null pooled effect. Receptive language: Null pooled effect. Cognition (visual reception): Positive pooled effect. Motor (fine motor): Positive pooled effect. Adverse effects: Not reported.	RCTs only	10/11	Included low quality/high risk of bias
Griffith et al. (2020)	Setting: Home, educational. Format: Individual. Agent: Not specified. Mode: Face-to-face, apps.	Social-communication: Summarised null effect. Adverse effects: Not reported.	RCTs, non-randomised with control	8/10	Included low quality/high risk of bias

Augmentative and Alternative Communication (AAC)					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Logan et al. (2017)	Setting: Clinic, home, educational, therapy centre Format: Individual. Agent: Parents/caregivers, peers/siblings, educators, clinicians/researchers. Mode: Face-to-face.	Social-communication (communication functions): Summarised inconsistent effect. Caregiver satisfaction (social validity): Summarised inconsistent effect. Adverse effects: Not reported.	RCTs, single-case experimental designs	8/10	Included low quality/high risk of bias
Steinbrenner et al. (2020)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	Social-communication (social): Summarised positive effect. Social-communication (joint attention): Summarised positive effect. Communication: Summarised positive effect. Motor: Summarised positive effect. Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect. Play: Summarised positive effect.	RCTs, non-randomised with control, single-case experimental designs	7/10	High quality/low risk of bias only

		Academic: Summarised positive effect. Adverse effects: Not reported.			
Computer-based instruction					
Knight et al. (2013)	Setting: Clinic, home, educational. Format: Individual. Agent: Parents/caregivers, educators. Mode: Face-to-face, computer assisted. Intervention practices: Simultaneous prompting; differential reinforcement; error correction and feedback procedure; delayed prompting procedure; stimulus prompting.	Academic: Summarised inconsistent effect. Adverse effects: Not reported.	RCTs, non-randomised with control, non-randomised without control, single-case experimental designs	7/10	Included low quality/high risk of bias
McCoy et al. (2016)	Setting: Clinic, home, educational, parent's office Format: Individual. Agent: Peers/siblings Mode: Face-to-face, virtual environment.	Social-communication (social skills): Summarised positive effect. Adverse effects: Not reported.	RCTs, non-randomised with control, non-randomised without control, single-case experimental designs	6/10	Included low quality/high risk of bias

Facilitated communication					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised null effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Robots					
Miguel-Cruz et al. (2017)	Setting: Not specified. Format: Individual. Agent: Not specified. Mode: Face-to-face, robot.	Social-communication (interaction): Summarised inconsistent effect. RRB (repetitive and maladaptive behaviours): Summarised negative effect. Adverse effects: Considered and identified. Summarised evidence of "negative" effects (p. 434 of the original article).	RCTs, non-randomised without control, single-case experimental designs, other	5/10	Included low quality/high risk of bias
Sign instruction					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias

Footnote: "Label" refers to the term used by the authors of the systematic review to describe the category of interventions being examined; "Intervention Practices" refers to the intervention practices described by the authors as being included in the systematic review; participants in the intervention group of a systematic review

generally only received one intervention practice, though this was not always specified; Only outcomes for which evidence was available are included; "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review; "risk of bias (included studies)" refers to the risk of bias, as assessed by the authors of the systematic review and appraised by current authors during data extraction, the rating indicates the lower bound of quality/risk of bias for studies included in the review.

Table 7. Summary of findings from systematic reviews of animal-assisted interventions

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Systematic reviews at the category level					
National Autism Center (2015)	Label: Animal-assisted therapy. Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified. Intervention practices: Animal-assisted therapy.	General outcomes: Summarised null effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Steinbrenner et al. (2020)	Label: Animal-assisted. Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified. Intervention practices: Animal-assisted	General outcomes: Summarised null effect Adverse effects: Not reported.	RCTs, non-randomised with control, single-case experimental designs	7/10	High quality/low risk of bias only
Systematic reviews at the practice level					

Canine-assisted intervention					
Hill et al. (2019)	<p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Clinicians/researchers, animal handlers.</p> <p>Mode: Face-to-face delivery, canine</p>	<p>Social-communication (verbal behaviours): Summarised inconsistent effects.</p> <p>Social-communication (non-verbal behaviours): Summarised inconsistent effects.</p> <p>Social-communication (desired behaviours): Summarised inconsistent effects.</p> <p>Social-communication (undesired behaviours): Summarised inconsistent effects.</p> <p>Child adverse effects: Considered and identified. Table 5 of the systematic review includes the following statements under "undesirable behaviours"¹ (p. 21):</p> <ul style="list-style-type: none"> • "↑ tantrums, anxiety, and aggression" (Mey 2017) • "↑ Some anxiety expressed towards dog (student C)" (Stevenson et al., 2015) • "↑ Self-stimulating behaviours (hand flapping) (frequency/-duration)" (Matin 2002) 	Non-randomised with control, non-randomised without control, single-case experimental designs, other	8/10	Not specified
Hardy & Weston (2020)	<p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Not specified.</p>	<p>Social-communication (social behaviour): Summarised positive effect.</p>	Not specified	6/10	Not specified

	Mode: Face-to-face, canine.	Adverse effects: Not reported.			
Equine assisted therapy					
Wiese et al. (2016)	Setting: Not specified. Format: Individual. Agent: Not specified. Mode: Face-to-face, equine.	General outcomes (behaviour and social interaction): Summarised inconsistent effect. Adverse effects: Considered, and none identified.	RCTs, non-randomised with control, non-randomised without control, single-case experimental designs, other	9/10	Not specified
Srinivasan et al. (2018)	Setting: Not specified. Format: Individual, group. Agent: Parents/caregivers, riding instructors, assistants (trained personnel or parents), support staff. Mode: Face-to-face, equine.	Social-communication: Summarised inconsistent effect. Sensory: Summarised positive effect. Cognition (cognitive): Summarised null effect. Motor: Summarised inconsistent effect. Social-emotional/challenging behaviour (behavioural skills): Summarised inconsistent effect. Quality of life: Summarised inconsistent effect. Community participation (functional participation): Summarised inconsistent effect. Adverse effects: Not reported.	RCTs, non-randomised with control, non-randomised without control, single-case experimental designs, other	7/10	Not specified

Trzmiel et al. (2019)	Setting: Not specified. Format: Individual. Agent: Not specified. Mode: Face-to-face, equine.	Social-communication (social): Null pooled effect. Communication: Null pooled effect. Adaptive behaviour: Null pooled effect. General outcomes (socialization, engagement, maladaptive behaviours, reaction time in problem-solving situations): Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	7/11	Included low quality/high risk of bias
------------------------------	--	--	---------------	------	--

¹ The authors of the current review note that classification of these behaviours as 'undesirable' is based on the subjective judgement of the original authors and do not present a view in documenting these findings.

Footnote: "Label" refers to the term used by the authors of the systematic review to describe the category of interventions being examined; "Intervention Practices" refers to the intervention practices described by the authors as being included in the systematic review; participants in the intervention group of a systematic review generally only received one intervention practice, though this was not always specified; Only outcomes for which evidence was available are included; "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review; "risk of bias (included studies)" refers to the risk of bias, as assessed by the authors of the systematic review and appraised by current authors during data extraction, the rating indicates the lower bound of quality/risk of bias for studies included in the review.

Table 8. Summary of findings from systematic reviews of cognitive behaviour therapy

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Ho et al. (2014)	<p>Label: Cognitive behavioural approaches.</p> <p>Setting: Clinic.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, peers/siblings, clinicians/researchers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Cool Kids; Building Confidence Family Cognitive Behaviour Therapy (FCBT); Social Skills Training for Children and Adolescents with Asperger Syndrome and Social-Communications Problems; Thinking about you, thinking about me; Coping Cat CBT program; Facing your fears; Group Cognitive Behaviour Therapy.</p>	<p>Social-communication (social skills): Positive pooled effect.</p> <p>Adverse effects: Not reported.</p>	RCT only	7/11	Not specified
National Autism	<p>Label: Cognitive behavioural intervention package.</p>	<p>Social-communication (interpersonal): Summarised positive effect.</p>	Not specified	4/10	Included low

Center (2015)	<p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p> <p>Intervention practices: Cognitive behavioural intervention package</p>	<p>Sensory (sensory or emotional regulation): Summarised positive effect.</p> <p>Social-emotional/challenging behaviour (problem behaviour): Summarised positive effect.</p> <p>Adaptive behaviour (personal responsibility): Summarised positive effect.</p> <p>School/learning readiness (placement): Summarised positive effect.</p> <p>Adverse effects: Not reported.</p>			quality/high risk of bias
Weston et al. (2016).	<p>Label: Cognitive behavioural therapy.</p> <p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Not specified.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Cognitive behavioural therapy.</p>	<p>Overall autism characteristics (symptoms related to ASD, self-reported): Null pooled effect.</p> <p>Overall autism characteristics (symptoms related to ASD, clinician-reported): Positive pooled effect.</p> <p>Adverse effects: Not reported.</p>	Randomised controlled trials, non-randomised with control	9/11	Not specified
Steinbrenner et al. (2020)	<p>Label: Cognitive behavioural/instructional strategies.</p> <p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p>	<p>Social-communication (social): Summarised positive effect.</p> <p>Communication: Summarised positive effect.</p> <p>Cognition (cognitive): Summarised positive effect.</p>	Randomised controlled trials, non-randomised with control, single-case experimental designs.	7/10	High quality/low risk of bias only

	Mode: Not specified. Intervention practices: Cognitive behavioural/ instructional strategies.	Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect. Adaptive behaviour (adaptive/self-help): Summarised positive effect. School/learning readiness: Summarised positive effect. Academic: Summarised positive effect. Adverse effects: Not reported.			
Exposure package					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias

Footnote: "Label" refers to the term used by the authors of the systematic review to describe the category of interventions being examined; "Intervention Practices" refers to the intervention practices described by the authors as being included in the systematic review; participants in the intervention group of a systematic review generally only received one intervention practice, though this was not always specified; Only outcomes for which evidence was available are included; "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review; "risk of bias (included studies)" refers to the risk of bias, as assessed by the authors of the systematic review and appraised by current authors during data extraction, the rating indicates the lower bound of quality/risk of bias for studies included in the review.

Table 9. Summary of findings from systematic reviews of 'other' interventions

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Imitation based training					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Multi-component package					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Reductive package					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Social behavioural learning strategy					

National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised null effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Social cognition intervention					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised null effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Social communication intervention					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Social skills training					
Steinbrenner et al. (2020)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	Social-communication (social): Summarised positive effect. Communication: Summarised positive effect. Cognition (cognitive): Summarised positive effect.	Randomised controlled trials, non-randomised with control, single-case experimental designs.	7/10	High quality/low risk of bias only

		Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect. Play: Summarised positive effect. Adaptive behaviour (adaptive/self-help): Summarised positive effect. School/learning readiness: Summarised positive effect. Adverse effects: Not reported.			
Social thinking intervention					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised null effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias
Theory of Mind training					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	General outcomes: Summarised inconsistent effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias

Footnote: "Label" refers to the term used by the authors of the systematic review to describe the category of interventions being examined; "Intervention Practices" refers to the intervention practices described by the authors as being included in the systematic review; participants in the intervention group of a systematic review generally only received one intervention practice, though this was not always specified; Only outcomes for which evidence was available are included; "Outcomes ()"

the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review; "risk of bias (included studies)" refers to the risk of bias, as assessed by the authors of the systematic review and appraised by current authors during data extraction, the rating indicates the lower bound of quality/risk of bias for studies included in the review.

S12: Summary of findings from outcome-focused systematic reviews

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Social-communication					
Murza et al. (2016)	<p>Setting: Clinic, home, educational.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, educators, clinicians/researchers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Joint attention interventions - Assessment, Evaluation and Programming System (AEPS) for Infants and Children; Caregiver Education Model (CEM); Caregiver Mediated Model (CMM); Hanen More Than Words (HMTW); Joint Attention Mediated Learning (JAML); Joint Attention Symbolic Play Engagement and Regulation (JASPER); Milton and Ethel Harris Research Initiative (MEHRI); Preschool Autism Communication Trial (PACT); parent training modules; and workshop training.</p>	<p>Social-communication (joint attention): Positive pooled effect.</p> <p>Agent: Intervention agent (parent, non-parent) not related to intervention effects on communication.</p> <p>Adverse effects: Not reported.</p>	RCT only	9/11	Included low quality/high risk of bias

<p>Parsons, Cordier, Munro et al. (2017)</p>	<p>Setting: Clinic, home, educational.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, peers/siblings, educators, clinicians/researchers, certified therapeutic riding instructor.</p> <p>Mode: Face-to-face, computer assisted.</p> <p>Intervention practices: Pragmatic language interventions - The Junior detective Program; Milton and Ethel Harris Research Initiative Treatment (MEHRIT); Building Blocks Program; Social Emotional NeuroScience Endocrinology (SENSE) theatre; Social Skills Group Intervention- High Functioning Autism; FindMe App; Therapeutic Horse Riding; FaceSay; Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER); Improvisational music therapy; SummerMAX; Mind Reading; Skillstreaming; Emotion Recognition Training; Seaver-NETT.</p>	<p>Social-communication (pragmatic language): Positive pooled effect.</p> <p>Child age: Age not related to intervention effects on social-communication.</p> <p>Setting: Intervention setting not related to intervention effects on social-communication.</p> <p>Format: Intervention format (individual, group) not related to intervention effects on social-communication.</p> <p>Agent: Positive intervention effect for interventions with active parent involvement, but not for interventions with parent education alone.</p> <p>Adverse effects: Not reported.</p>	<p>RCT only</p>	<p>9/11</p>	<p>Included low quality/high risk of bias</p>
---	---	--	-----------------	-------------	---

Fuller & Kaiser (2020)	<p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers, educators, clinicians/researchers.</p> <p>Mode: Not specified.</p> <p>Intervention practices: Early interventions – not specified.</p>	<p>Social-communication: Positive pooled effect.</p> <p>Child age: Age related to intervention effects on social-communication. Intervention effects increased from 2 to 4 years of age, but then diminished as children got older. Greatest intervention effects at around 4 years of age.</p> <p>Amount of intervention: Total hours not related to intervention effects on social-communication. Intervention duration (weeks) not related to intervention effects on social-communication.</p> <p>Agent: Intervention agent (clinicians, parents, school staff) not related to intervention effects on communication.</p> <p>Adverse effects: Not reported.</p>	<p>RCT, non-randomised without control (inclusion criteria)</p>	<p>9/11</p>	<p>Not specified</p>
Bejarano-Martín et al. (2020)	<p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregiver, peers/siblings, educators, clinicians/researchers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Focused intervention practices - Discrete trial training (DTT); Pivotal Response Training (PRT), Contingent imitation; discrete trial training (DTT) plus social interaction,</p>	<p>Social-communication: Positive pooled effect.</p> <p>Social-communication (imitation): Positive pooled effect.</p> <p>Social-communication (joint attention): Positive pooled effect.</p> <p>Social-communication (play): Positive pooled effect.</p>	<p>RCTs, non-randomised with control, single-case experimental designs (inclusion criteria)</p>	<p>9/11</p>	<p>High quality/low risk of bias only</p>

	mediated learning with active engagement; picture exchange communication system (PECS); video modelling; prompting and reinforcement; physical and verbal cues; token economy and prompting; photographic schedules.	<p>Child age: Age inconsistently related to intervention effects on social-communication.</p> <p>Child characteristics: Child communication skills prior to intervention not related to intervention effects on social-communication. Child cognitive ability prior to intervention not related to intervention effects on social-communication.</p> <p>Amount of intervention: Total hours inconsistently related to intervention effects on social-communication.</p> <p>Agent: Interventions involving caregivers or teachers had a similar positive effect to those involving clinicians alone.</p> <p>Adverse effects: Not reported.</p>			
Communication					
Sandbank et al. (2020b)	<p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers, educators, clinicians/researchers.</p> <p>Mode: Not specified.</p>	<p>Communication (composite language): Positive pooled effect.</p> <p>Expressive language: Positive pooled effect.</p> <p>Receptive language: Positive pooled effect.</p> <p>General outcomes (summary across all outcomes and language measures): Positive pooled effect.</p>	RCTs, non-randomised with control	10/11	Not specified

		<p>Child age: Age not related to intervention effects on communication.</p> <p>Child characteristics: Level of overall autism characteristics prior to intervention not related to intervention effects on communication. Greater language skills prior to intervention related to greater intervention effects on communication.</p> <p>Amount of intervention: Total hours not related to intervention effects on communication.</p> <p>Agent: Intervention agent (clinician, caregiver, educator, technology, combination, other) not related to intervention effects on communication.</p> <p>Adverse effects: Not reported.</p>			
Expressive language					
Hampton & Kaiser (2016)	<p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers, clinicians/researchers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Early interventions- Early Intensive Behavioural Intervention (EIBI); Early Intervention Preschool (EIP); Early Start Denver Model (ESDM); Joint Attention Mediated Learning (JAML); Joint Attention;</p>	<p>Expressive language (spoken language): Positive pooled effect.</p> <p>Child age: Age not related to intervention effects on expressive language (spoken language).</p> <p>Amount of intervention: Total hours not related to intervention effects on expressive language (spoken language).</p> <p>Agent: Interventions involving clinicians and parents related to greater intervention effect on</p>	Randomised controlled trials, non-randomised with control	10/11	Included low quality/high risk of bias

	<p>Structured Play Engagement; and Regulation (JAML); Learning Experiences and Alternative Program (LEAP); Milton and Ethel Harris Research Initiative Treatment (MEHRIT); More Than Words (MTW); Pediatric Autism and Communication Therapy (PACT); Play and Language for Autistic Youngsters; PRT, Pivotal Response Training (Play and Language for Autistic Youngsters); Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH); Scottish Early Intervention Preschool; Parent training model (PSwA); Focused playtime (FPI); Speech remediation; Teach Town basics; Early Social Interaction (ESI); Parent training, Behaviour analytic.</p>	<p>expressive language (spoken language) than clinicians or parents alone.</p> <p>Adverse effects: Not reported.</p>			
Gross motor					
Case & Yun (2019)	<p>Setting: Experimental, practice/service.</p> <p>Format: Individual.</p> <p>Agent: Not specified.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Fundamental motor skills including fundamental motor skills instruction, adapted physical education instruction, physical activities and fitness exercises, young athletes</p>	<p>Motor (gross motor): Positive pooled effect [practices: fundamental motor skills, equestrian assisted therapy, physical activity].</p> <p>Motor (gross motor): Null pooled effect [practice: technology].</p> <p>Child age: Age not related to intervention effects on motor skills.</p>	Not specified	7/11	Not specified

	motor program, multisport camp training, adaptive soccer program, physical education program with fundamental motor skill instruction, intensive fundamental motor skill instruction, Sports, Play, and Active Recreation for Kids (SPARK); equestrian assisted training; technology interventions including sports active video game participation, video-based makoto arena training, robot imitation and movement activities, simulated developmental horse riding; physical activity interventions including physical activity/table tennis, rhythm training and movement-based games, aquatic exercise training.	<p>Amount of intervention: Greater total hours related to greater intervention effects on motor skills.</p> <p>Adverse effects: Not reported.</p>			
Play					
Kent et al. (2020)	<p>Setting: Clinic, home, educational, community (theatre group).</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, peers/siblings, educators, clinicians/researchers, unfamiliar adults.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Play-based interventions- [Generic] play intervention; Joint Attention, Symbolic Play, Engagement, and Regulation</p>	<p>Play: Positive pooled effect.</p> <p>Format: The intervention format (individual, group) did not relate to intervention effects on play.</p> <p>Setting: Intervention setting not related to the intervention effect on play skills.</p> <p>Adverse effects: Not reported.</p>	RCT only	10/11	Included moderate quality/moderate risk of bias

	(JASPER); Lego therapy; Social stories; behavioural approaches; peer training; teacher training; Social Emotional NeuroScience Endocrinology (SENSE) Theater principles; video modelling.				
--	---	--	--	--	--

Footnote: "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review.

S13: Summary of findings from intervention delivery-focused systematic reviews

Table 1. Summary of systematic reviews focussing on the intervention setting.

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Inclusive school setting					
Tupou et al. (2019)	<p>Setting: Educational.</p> <p>Format: Individual, group.</p> <p>Agent: Educators.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Comprehensive treatment programmes - Developmentally Appropriate Treatment for Autism (DATA); Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH); Early Intensive Behavioural Intervention (EIBI); Learning Experiences and Alternative Program for Preschoolers (LEAP); Comprehensive Autism Program (CAP); EIBI intervention described as being based on Lovaas' UCLA model; Skills focused interventions targeting -</p>	<p>Overall autism characteristics (autism severity and/or symptoms): Summarised positive effect.</p> <p>Social-communication (social skills): Summarised positive effect.</p> <p>Communication (communication and/or language): Summarised positive effect.</p> <p>Cognition (cognition or educational strengths): Summarised inconsistent effect.</p> <p>Social-emotional/challenging behaviour (adaptive/maladaptive behaviour): Summarised positive effect.</p> <p>Adaptive behaviour (functional skills): Summarised positive effect.</p> <p>General outcomes (child outcomes): Summarised inconsistent effect.</p> <p>Adverse effects: Not reported.</p>	Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs	9/10	Included low quality/high risk of bias

	communication, play skills, peer interaction, and reading skills.				
Watkins et al. (2019)	<p>Setting: Educational.</p> <p>Format: Individual, group.</p> <p>Agent: Peers/siblings, educators, clinicians/researchers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Interventions in inclusive settings - visual cues; social scripts; Social Stories; video modelling; communication books; peer-mediated intervention (PMI), self-monitoring; peer networks; individualised interventions based on the results of a functional behaviour assessment (FBA); social skills groups; initiations training; high probability request sequences; music therapy; and behavioural strategies were implemented in one study each.</p>	<p>General outcomes: Positive pooled effect.</p> <p>Social-communication: Positive pooled effect.</p> <p>RRB: Positive pooled effect.</p> <p>Social-emotional/challenging behaviour (classroom behaviour, challenging behaviour and repetitive behaviour): Positive pooled effect.</p> <p>Social-emotional/challenging behaviour (classroom behaviour): Positive pooled effect.</p> <p>Play: Positive pooled effect.</p> <p>Intervention agent: Interventions delivered by teachers had a greater intervention effect than interventions delivered by researchers or peers.</p> <p>Adverse effects: Not reported.</p>	Randomised controlled trials, single-case experimental designs	10/11	Included moderate quality/moderate risk of bias

Footnote: "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review.

Table 2. Summary of systematic reviews focussing on the intervention format.

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Individual/ group					
Tachibana et al. (2018)	<p>Setting: Clinic, home, educational.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, educators, clinicians/researchers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Social communication intervention - Hanen's More Than Words; Early Start Denver Model (ESDM); Parent training; Joint Attention Symbolic Play Engagement and Regulation (JASPER); Preschool Autism Communication Trial (PACT); Treatment and Education of Autistic and related Communications Handicapped Children (TEACCH)-based group social skills; Reciprocal Imitation Training; Caregiver-based intervention program in community day-care centers; Preschool-based joint attention</p>	<p>Overall autism characteristics (autism general symptoms – individual intervention): Null pooled effect.</p> <p>Social-communication (qualitative impairment in social interaction – individual intervention): Null pooled effect.</p> <p>Social-communication (reciprocity of social interaction towards others – individual intervention): Positive pooled effect.</p> <p>Social-communication (reciprocity of social interaction towards others – group intervention): Positive pooled effect.</p> <p>Social-communication (initiating joint attention– individual intervention): Null pooled effect.</p> <p>Social-communication (initiating joint attention – group intervention): Null pooled effect.</p> <p>Social-communication (imitation): Null pooled effect.</p> <p>Social-communication (responding to joint attention – individual intervention): Null pooled effect.</p>	RCT only	11/11	Included moderate quality/moderate risk of bias

	<p>intervention; Caregiver Mediated Joint Engagement Intervention; Improvisational music therapy; intervention targeting development of socially synchronous engagement; Developmental, Individual-Difference, Relationship-Based(DIR)/Floortime intervention; Functional Behavior Skills Training (FBST); Building Blocks; Parent delivery of the Early Start Denver Model (P-ESDM); Joint Attention Mediated Learning (JAML) intervention; Focused Playtime Intervention (FPI); Education and Skills Training Program for Parents; Parent education and behaviour management (PEBM) Skills training intervention or control for the on specific aspects of the PEBM parent education and counselling intervention; Home TEACCHing Program.</p>	<p>RRB (restricted repetitive and stereotyped patterns behaviours, interests and activities): Null pooled effect.</p> <p>Communication (qualitative impairment in communication – individual intervention): Null pooled effect.</p> <p>Expressive language (individual interventions): Null pooled effect.</p> <p>Expressive language (group intervention): Null pooled effect.</p> <p>Receptive language (individual intervention): Null pooled effect.</p> <p>Receptive language (group intervention): Null pooled effect.</p> <p>Cognition (developmental quotient – individual intervention): Positive pooled effect.</p> <p>Adaptive behaviour (individual intervention): Null pooled effect.</p> <p>Adaptive behaviour (group intervention): Null pooled effect.</p> <p>Caregiver communication and interaction (parental synchrony): Positive pooled effect.</p> <p>Caregiver social emotional wellbeing (parenting stress – individual intervention): Null pooled effect.</p> <p>Caregiver social emotional wellbeing (parenting stress – group intervention): Null pooled effect.</p>			
--	--	--	--	--	--

		<p>Intervention format: Intervention format (individual, group) did not relate to intervention effects on overall autism characteristics, social-communication, expressive language, receptive language, cognition, or adaptive behaviour.</p> <p>Adverse effects: Not reported.</p>			
--	--	--	--	--	--

Footnote: "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review.

Table 3. Summary of systematic reviews focussing on the intervention agent.

	Characteristics of interventions included in the systematic review	Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Non-specialist implemented/mediated					
Naveed et al. (2019)	<p>Setting: Clinic, home, educational, community.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers, siblings/peers, educators.</p> <p>Mode: Face-to-face, telepractice.</p> <p>Intervention practices: Cognitive behavioural strategies; Social Emotional NeuroScience</p> <p>Endocrinology (SENSE) theatre; Preschool Autism Communication Trial (PACT); Parent mediated intervention for Autism Spectrum Disorders in South Asia (PASS); Project Impact; Peer interventions; Qigong Sensory Treatment (QST); Qigong massage; Joint Attention, Symbolic Play, Engagement, and Regulation programme (JASPER); Play project; LEAP project i.e. Learning Experiences and Alternative Program for</p>	<p>Overall autism characteristics (autism symptom severity): Positive pooled effect.</p> <p>Social-communication (social skills): Positive pooled effect.</p> <p>Social-communication (joint engagement): Positive pooled effect.</p> <p>Social-communication (joint attention): Null pooled effect.</p> <p>RRB (repetitive behaviours): Positive pooled effect.</p> <p>Communication: Positive pooled effect.</p> <p>Expressive language: Positive pooled effect.</p> <p>Receptive language: Null pooled effect.</p> <p>Cognition (visual reception): Positive pooled effect.</p> <p>Motor (motor skills): Positive pooled effect.</p> <p>Social-emotional/challenging behaviour (self-regulation): Positive pooled effect.</p>	RCT only	9/11	Included low quality/high risk of bias

	<p>Preschoolers and Their Parents; Hanen's more than words (HMTW) intervention program; Peer network intervention procedure; family centered music therapy; The Managing Repetitive Behaviours Programme; psychoeducation program; autism preschool program; Video-feedback Intervention to promote Positive Parenting adapted for Autism; Social ABCs; Parent-mediated intervention for Autism Spectrum Disorders in South Asia (PASS) plus; enhancing interactions tutorial; Social Tools And Rules for Teens socialization (START); COMPASS for Hope; Program for the Education and Enrichment of Relational Skills (PEERS) curriculum; Therapeutic Outcome By You (TOBY) application.</p>	<p>Adaptive behaviour: Null pooled effect.</p> <p>Caregiver social emotional wellbeing (parental distress): Positive pooled effect.</p> <p>Caregiver social emotional wellbeing (parental self-efficacy): Positive pooled effect.</p> <p>Caregiver social emotional wellbeing (parent-child relationship): Positive pooled effect.</p> <p>Child satisfaction (child distress): Positive pooled effect.</p> <p>Child age: Age not related to intervention effects.</p> <p>Amount of intervention: Number of intervention sessions not related to intervention effects. Intervention duration (weeks) not related to intervention effects.</p> <p>Intervention agent: Intervention agent (parent, peer, teacher, school staff, child care worker) not related to intervention effects on autism core characteristics (including joint attention). Parent-implemented interventions related to greater effect on child joint engagement than peer/educator-implemented interventions.</p> <p>Adverse effects: Not reported.</p>			
Parent-implemented/mediated					

<p>Oono et al. (2013)</p>	<p>Setting: Clinic, home, out of home locations.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers.</p> <p>Mode: Face-to-face, self-training with a manual and videotapes.</p> <p>Intervention practices:</p> <p>Developmental Individual-Difference Relationship-Based (DIR) techniques; massage intervention; management of challenging behaviour; early intensive behavioural intervention; Pivotal Response Treatment (PRT).</p>	<p>Overall autism characteristics (severity of autism characteristics): Positive pooled effect.</p> <p>Social-communication (shared or joint attention): Positive pooled effect.</p> <p>Social-communication (child initiations): Null pooled effect.</p> <p>Social-communication (summarised): Summarised inconsistent effect.</p> <p>Communication: Null pooled effect.</p> <p>Communication (joint language): Null pooled effect.</p> <p>Expressive language (expression - direct or independent assessment): Null pooled effect.</p> <p>Receptive language (comprehension - direct or independent assessment): Null pooled effect.</p> <p>Cognitive (developmental/intellectual gains): Summarised positive effect.</p> <p>Social-emotional/challenging behaviour (maladaptive behaviour): Summarised null effect.</p> <p>Adaptive behaviour: Null pooled effect.</p> <p>Caregiver communication and interaction (parental synchrony): Positive pooled effect.</p> <p>Caregiver social emotional wellbeing (parents' level of stress): Null pooled effect.</p>	<p>RCT only</p>	<p>11/11</p>	<p>Not specified</p>
----------------------------------	--	---	-----------------	--------------	----------------------

		<p>Caregiver social-emotional wellbeing (parental confidence): Summarised positive effect.</p> <p>Caregiver satisfaction: Summarised positive effect.</p> <p>Adverse effects: Not reported.</p>			
Nevill et al. (2018)	<p>Setting: Clinic, home, community.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Child's Talk Project; Hanen's More than Words (HMTW); DIR/Floortime; Parent Focus Training; Joint Attention Symbolic Play Engagement and Regulation (JASPER); Pivotal Response Training (PRT); Video Intervention to promote Positive Parenting for children with Autism (VIPP-AUTI); Home-based program; Building Blocks; Focused Playtime Intervention; Play and Language for Autistic Youngsters (PLAY) Project; Preschoolers with Autism; Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH); Social Communication, Emotion Regulation, and Transactional Supports (SCERTS); Parent-mediated</p>	<p>Overall autism characteristics (autism symptom severity): Positive pooled effect.</p> <p>Social-communication (socialisation): Positive pooled effect.</p> <p>Communication (language): Positive pooled effect.</p> <p>Cognition: Positive pooled effect.</p> <p>Amount of intervention: Intervention amount (total hours) not related to intervention effect on autism core characteristics, socialisation, communication, or cognition.</p> <p>Adverse effects: Not reported.</p>	RCT only	7/11	Not specified

	Communication-focused Treatment (PACT).				
Tarver et al. (2019)	<p>Setting: Not specified.</p> <p>Format: Individual, group, workshops.</p> <p>Agent: Parents/caregivers.</p> <p>Mode: Face-to-face.</p> <p>Intervention practices: Behavioural parent interventions – Research Units in Behavioural Intervention (RUBI) Parent Training Manual; Child directed interaction therapy (CDIT); Compass for help (C-HOPE); Parent management training; parent-child interaction therapy (PCIT); Primary care stepping stones Triple P (PCSSTP); Stepping stones triple P (SSTP).</p>	<p>Social-emotional/challenging behaviour (parent-reported disruptive behaviour): Positive pooled effect.</p> <p>Social-emotional/challenging behaviour (parent-reported hyperactivity): Positive pooled effect.</p> <p>Caregiver social emotional wellbeing (parenting stress): Positive pooled effect.</p> <p>Caregiver social emotional wellbeing (parenting efficacy): Null pooled effect.</p> <p>Adverse effects: Not reported.</p>	RCT only	8/11	Included low quality/high risk of bias
Steinbrenner et al. (2020)	<p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p> <p>Intervention practices: Not specified</p>	<p>Social-communication (social and joint attention): Summarised positive effect.</p> <p>Communication: Summarised positive effect.</p> <p>Cognition (cognitive): Summarised positive effect.</p> <p>Motor: Summarised positive effect.</p> <p>Social-emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect.</p>	Randomised controlled trials, non-randomised with control, single-case experimental designs.	7/10	Included high quality/low risk of bias only

		<p>Play: Summarised positive effect.</p> <p>Adaptive behaviour (adaptive/self-help): Summarised positive effect.</p> <p>School/learning readiness: Summarised positive effect.</p> <p>Academic: Summarised positive effect.</p> <p>Adverse effects: Not reported.</p>			
Parent training					
National Autism Center (2015)	<p>Setting: Not specified.</p> <p>Format: Not specified.</p> <p>Agent: Not specified.</p> <p>Mode: Not specified.</p> <p>Intervention practices: Not specified</p>	<p>Overall autism characteristics (general symptoms): Summarised positive effect.</p> <p>Social-communication (interpersonal): Summarised positive effect.</p> <p>RRB (restricted, repetitive, nonfunctional patterns of behavior, interests, or activity): Summarised positive effect.</p> <p>Social emotional/challenging behaviour (problem behaviour): Summarised positive effect.</p> <p>Play: Summarised positive effect.</p> <p>Adverse effects: Not reported.</p>	Not specified	4/10	Included low quality/high risk of bias
Postorino et al. (2017)	<p>Setting: Clinic.</p> <p>Format: Individual, group.</p>	<p>Social-emotional/challenging behaviour (disruptive behaviour): Positive pooled effect.</p>	Randomised controlled trials, non-	7/11	Included low

	Agent: Parents/caregivers. Mode: Face-to-face, telepractice. Intervention practices: Parent training for disruptive behaviour	Adverse effects: Not reported.	randomised with control		quality/high risk of bias
Peer implemented/mediated					
Chang & Locke (2016)	Setting: Educational, afternoon camp. Format: Individual, group. Agent: Peers/siblings. Mode: Face-to-face. Intervention practices: Peer-mediated interventions	Social-communication (social initiations, social responses, social communications): Summarised positive effect. Adverse effects: Not reported.	Randomised controlled trials, non-randomised without control	7/10	Included low quality/high risk of bias
Zagona & Mastergeorge (2018)	Setting: Clinic, educational, research centre. Format: Individual, group. Agent: Peers/siblings. Mode: Face-to-face. Intervention practices: Peer-mediated instruction and intervention	Social-communication: Summarised positive effect. Adverse effects: Not reported.	Randomised controlled trials, single-case experimental designs	6/10	Included low quality/high risk of bias
Steinbrenner et al. (2020)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified.	Social-communication (social and joint attention): Summarised positive effect. Communication: Summarised positive effect. Cognition (cognitive): Summarised positive effect.	Randomised controlled trials, non-randomised with control, single-case	7/10	Included high quality/low risk of bias only

	Intervention practices: Not specified	Play: Summarised positive effect. Social emotional/challenging behaviour (challenging/interfering behaviour): Summarised positive effect. School/learning readiness: Summarised positive effect. Academic: Summarised positive effect. Adverse effects: Not reported.	experimental designs.		
Peer-training					
National Autism Center (2015)	Setting: Not specified. Format: Not specified. Agent: Not specified. Mode: Not specified. Intervention practices: Not specified.	Social-communication (interpersonal): Summarised positive effect. RRB (restricted, repetitive, nonfunctional patterns of behaviour, interests, or activity): Summarised positive effect. Communication: Summarised positive effect. School/learning readiness: Summarised positive effect. Adverse effects: Not reported.	Not specified	4/10	Included low quality/high risk of bias

Footnote: "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review.

Table 4. Summary of systematic reviews focussing on the intervention mode.

Characteristics of interventions included in the systematic review		Findings form the systematic review	Study designs	Risk of bias (systematic review)	Risk of bias (included studies)
Telepractice					
Parsons, Cordier, Vaz et al. (2017)	<p>Setting: Home.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers.</p> <p>Mode: Telepractice, videoconferencing, DVD, online modules.</p> <p>Intervention practices: Web-based training in behavioural interventions; Online and Applied System for Intervention Skills (OASIS) training intervention Research-to-practice; Improving Parents as Communication Teachers (ImPACT) on the Web; Implementation discrete-trial instructions using video training materials; Parent Early Start Denver Model (P-EDSM) training; Functional communication training.</p>	<p>Social-communication (social behaviour and communication skills): Summarised inconsistent effect.</p> <p>Communication (vocabulary production and comprehension): Summarised positive effect.</p> <p>Caregiver satisfaction: Summarised positive effect.</p> <p>Caregiver communication and interaction (parental knowledge acquisition): Summarised positive effect.</p> <p>Caregiver social emotional wellbeing (parental self-efficacy): Summarised positive effect.</p> <p>Adverse effects: Not reported.</p>	Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs.	7/10	Included moderate quality/moderate risk of bias

<p>Ferguson et al. (2019)</p>	<p>Setting: Clinic, home.</p> <p>Format: Individual, group.</p> <p>Agent: Parents/caregivers, peers/siblings, educators, clinicians/researchers, other associated professionals working in the field.</p> <p>Mode: Telehealth, written instructions, videoconferencing, websites, DVDs.</p> <p>Intervention practices: Telehealth interventions with behavioural principles-functional analysis (FA); functional communication training (FCT); naturalistic and incidental teaching; behaviour support strategies (e.g., positive behaviour support); preference assessments; Early Start Denver Model (ESDM); Improving Parents as Communication Teachers (imPACT).</p>	<p>General outcomes (efficacy outcomes): Summarised positive effect.</p> <p>Adverse effects: Not reported.</p>	<p>Randomised controlled trials, non-randomised with control, non-randomised without control, single-case experimental designs, other.</p>	<p>9/10</p>	<p>Included low quality/high risk of bias</p>
<p>Sutherland et al. (2019)</p>	<p>Setting: Clinic.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers, educators.</p> <p>Mode: Telepractice, online training.</p> <p>Intervention practices: Program Improving Parents as Communication Teachers (imPACT); internet-based Parent Implemented Communication Strategies (iPICS); general communication</p>	<p>Communication: Summarised inconsistent effect.</p> <p>Social emotional/challenging behaviour (behaviour): Summarised positive effect.</p> <p>Caregiver satisfaction (satisfaction and acceptability): Summarised positive effect.</p> <p>Caregiver communication and interaction (fidelity): Summarised positive effect.</p>	<p>Randomised controlled trials, single-case experimental designs, other.</p>	<p>7/10</p>	<p>Not specified</p>

	intervention; imitation training; Telehealth diagnostic services; 'Telehealth Facing Your Fears' Intervention'; functional behaviour assessment and functional communication training; school age intervention using web-based education; language intervention.	Adverse effects: Not reported.			
Akemoglu et al. (2020)	<p>Setting: Not specified.</p> <p>Format: Individual.</p> <p>Agent: Parents/caregivers.</p> <p>Mode: Telepractice, online training, DVDs, handouts.</p> <p>Intervention practices: Parent-implemented telehealth interventions – Communication intervention; Early Start Denver Model (ESDM); Parents Early Start Denver Model (P-ESDM); Reciprocal Imitation Training (RIT); Decide, Arrange, Now, Count, and Enjoy (DANCE); Improving Parents as Communication Teachers (imPACT); Internet-based Parent-implemented Communication Strategies (i-PiCS); Prepare, Offer, Wait, and Respond (POWR).</p>	<p>Social-communication: Summarised inconsistent effect.</p> <p>Caregiver communication and interaction (parents' use of strategies): Summarised positive effect.</p> <p>Adverse effects: Not reported.</p>	Randomised controlled trials, single-case experimental designs.	8/10	Not specified

Footnote: "Outcomes ()" the first term refers to the outcome categories defined for this umbrella review, the term in parenthesis refers to the author's term(s) for the outcome, where there is no term in brackets, the systematic review author's outcome classification matched that of the current umbrella review.

S14: Location (by continent) of included studies

Author (year)	Continent(s)
Akemoglu et al. (2020)	Europe, North America
Bejarano-Martín et al. (2020)	Not specified
Binns & Oram Cardy (2019)	Not specified
Boshoff et al. (2020)	Asia, Europe, North America
Case & Yun (2019)	Not specified
Chang & Locke (2016)	Not specified
Ferguson et al. (2019)	Not specified
Flippin et al. (2010)	Not specified
Fuller & Kaiser (2020)	Not specified
Fuller, Oliver et al. (2020)	Asia, Australia, Europe, North America
Geretsegger et al. (2014)	Australia, South America/Caribbean, North America
Griffith et al. (2020)	Asia, Australia, Europe, North America
Hampton & Kaiser (2016)	Australia, Europe, North America
Hardy & Weston (2020)	Not specified
Hill et al. (2019)	Not specified
Ho et al. (2014)	Not specified
Kent et al. (2020)	Not specified
Khan et al. (2019)	Australia, Europe, South America/Caribbean, North America
Knight et al. (2013)	Not specified
Lang et al. (2012)	Not specified
Logan et al. (2017)	Not specified
Makrygianni & Reed (2010)	Not specified

Mazon et al. (2019)	Not specified
McCoy et al. (2016)	Not specified
Miguel-Cruz et al. (2017)	Not specified
Moon et al. (2020)	Australia, Europe, North America
Murza et al. (2016)	Not specified
National Autism Center (2015)	Not specified
Naveed et al. (2019)	Asia, Australia, Europe, North America
Nevill et al. (2018)	Asia, Australia, Europe, North America
Ona et al. (2020)	Not specified
Oono et al. (2013)	Asia, Australia, Europe, North America
Parsons, Cordier, Vaz et al. (2017)	Australia, North America
Parsons, Cordier, Munro et al. (2017)	Asia, Australia, Europe, North America
Peters-Scheffer et al. (2011)	Not specified
Postorino et al. (2017)	Australia, North America
Reichow et al. (2018)	Europe, North America
Sandbank et al. (2020a)	Not specified
Sandbank et al. (2020b)	Not specified
Schaaf et al. (2018)	Not specified
Schoen et al. (2019)	Asia, North America
Srinivasan et al. (2018)	Asia, Europe, North America
Steinbrenner et al. (2020)	Not specified
Sutherland et al. (2018)	North America
Tachibana et al. (2018)	Asia, Australia, Europe, North America

Tarver et al. (2019)	Australia, North America
Tiede & Walton (2019)	Not specified
Treurnicht Naylor et al. (2011)	Asia, Australia, Pacific, Europe, North America
Trzmiel et al. (2019)	Not specified
Tupou et al. (2019)	Not specified
Verschuur et al. (2014)	Not specified
Virués-Ortega (2010)	Asia, Australia, Europe, South America/Caribbean, North America
Waddington et al. (2016)	Australia, North America
Watkins et al. (2019)	Not specified
Weitlauf et al. (2017)	Asia, Australia, Europe, South America/Caribbean, North America
Weston et al. (2016)	Asia, Australia, Europe, North America
Wiese et al. (2016)	Europe, North America
Zagona & Mastergeorge (2018)	Not specified

S15: Quality appraisal ratings: item-level and total quality appraisal ratings for each included systematic review

	1. Review question stated	2. Inclusion criteria appropriate	3. Search strategy appropriate	4. Sources and resources adequate	5. Quality appraisal appropriate	6. Independent critical appraisal	7. Minimised errors in data extraction	8. Methods to combine studies appropriate	9. Publication bias assessed (meta-analyses)	10. Policy and/or practice recommendations	11. Directives for new research appropriate	Total*
Akemoglu et al. (2020)	✓	✓	✓	×	✓	✓	✓	×	N/A	✓	✓	8/10
Bejarano-Martín et al. (2020)	✓	✓	✓	×	✓	✓	✓	×	✓	✓	✓	9/11
Binns & Oram Cardy (2019)	✓	✓	✓	×	✓	✓	✓	✓	N/A	✓	✓	9/10
Boshoff et al. (2020)	✓	✓	✓	×	✓	✓	✓	✓	N/A	✓	✓	9/10
Case & Yun (2019)	✓	✓	✓	×	×	✓	×	×	✓	✓	✓	7/11
Chang & Locke (2016)	✓	✓	✓	×	✓	✓	×	×	N/A	✓	✓	7/10
Ferguson et al. (2019)	✓	✓	✓	×	✓	✓	✓	✓	N/A	✓	✓	9/10
Flippin et al. (2010)	✓	✓	✓	×	✓	✓	×	×	×	✓	✓	7/11

Fuller & Kaiser (2020)	✓	✓	✓	✓	✓	×	✓	×	✓	✓	✓	9/11
Fuller, Oliver et al. (2020)	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	10/11
Geretsegger et al. (2014)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11/11
Griffith et al. (2020)	✓	✓	✓	×	✓	✓	×	✓	N/A	✓	✓	8/10
Hampton & Kaiser (2016)	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	10/11
Hardy & Weston (2020)	✓	×	✓	×	✓	✓	×	×	N/A	✓	✓	6/10
Hill et al. (2019)	✓	✓	✓	×	✓	✓	×	✓	N/A	✓	✓	8/10
Ho et al. (2014)	✓	×	✓	×	✓	×	✓	×	✓	✓	✓	7/11
Kent et al. (2020)	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	10/11
Khan et al. (2019)	✓	✓	✓	✓	✓	✓	×	✓	×	✓	✓	9/11
Knight et al. (2013)	✓	✓	✓	×	✓	✓	×	×	N/A	✓	✓	7/10
Lang et al. (2012)	✓	×	✓	×	✓	×	×	×	N/A	✓	×	4/10

Logan et al. (2017)	✓	✓	✓	×	✓	✓	✓	×	N/A	✓	✓	8/10
Makrygianni & Reed (2010)	×	✓	×	×	✓	✓	✓	×	×	✓	✓	6/11
Mazon et al. (2019)	✓	✓	✓	×	✓	×	×	×	N/A	✓	✓	6/10
McCoy et al. (2016)	✓	✓	✓	×	✓	×	×	×	N/A	✓	✓	6/10
Miguel-Cruz et al. (2017)	✓	✓	×	×	×	×	✓	×	N/A	✓	✓	5/10
Moon et al. (2020)	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	10/11
Murza et al. (2016)	✓	✓	✓	✓	✓	✓	✓	×	×	✓	✓	9/11
National Autism Center (2015)	✓	×	×	×	✓	×	×	×	N/A	✓	✓	4/10
Naveed et al. (2019)	✓	✓	✓	×	✓	✓	✓	×	✓	✓	✓	9/11
Nevill et al. (2018)	✓	✓	✓	×	✓	×	×	✓	×	✓	✓	7/11

Ona et al.(2020)	✓	✓	✓	✓	✓	×	×	✓	×	✓	✓	8/11
Oono et al.(2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11/11
Parsons, Cordier, Vaz et al. (2017)	✓	✓	✓	×	✓	✓	×	×	N/A	✓	✓	7/10
Parsons, Cordier, Munro et al. (2017)	✓	✓	✓	✓	✓	×	×	✓	✓	✓	✓	9/11
Peters-Scheffer et al.(2011)	✓	✓	×	×	✓	✓	×	✓	✓	✓	✓	8/11
Postorino et al.(2017)	✓	✓	✓	×	✓	×	✓	×	✓	✓	×	7/11
Reichow et al.(2018)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11/11
Sandbank et al.(2020a)	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	10/11
Sandbank et al.(2020b)	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	10/11
Schaaf et al.(2018)	✓	✓	✓	×	✓	×	×	✓	N/A	✓	✓	7/10

Schoen et al. (2019)	✓	✓	✓	×	✓	✓	✓	×	N/A	✓	✓	8/10
Srinivasan et al. (2018)	✓	×	✓	×	×	✓	✓	✓	N/A	✓	✓	7/10
Steinbrenner et al. (2020)	✓	✓	✓	×	✓	✓	×	×	N/A	✓	✓	7/10
Sutherland et al. (2018)	✓	✓	✓	×	✓	×	×	✓	N/A	✓	✓	7/10
Tachibana et al. (2018)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11/11
Tarver et al. (2019)	✓	✓	✓	×	✓	✓	×	✓	×	✓	✓	8/11
Tiede & Walton (2019)	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	10/11
Treurnicht Naylor et al. (2011)	✓	✓	✓	×	✓	×	×	✓	N/A	✓	✓	7/10
Trzmiele et al. (2019)	✓	✓	×	✓	✓	✓	×	×	✓	×	✓	7/11
Tupou et al. (2019)	✓	✓	✓	×	✓	✓	✓	✓	N/A	✓	✓	9/10

Verschuur et al. (2014)	✓	×	✓	×	✓	×	×	✓	N/A	✓	✓	6/10
Virués-Ortega (2010)	✓	✓	✓	×	✓	✓	×	×	✓	✓	✓	8/11
Waddington et al. (2016)	✓	✓	✓	×	✓	✓	✓	×	N/A	✓	✓	8/10
Watkins et al. (2019)	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	10/11
Weitlauf et al. (2017)	✓	✓	✓	✓	✓	✓	×	✓	N/A	✓	✓	9/10
Weston et al. (2016)	✓	✓	✓	✓	✓	✓	×	✓	✓	×	✓	9/11
Wiese et al. (2016)	✓	✓	✓	✓	✓	✓	×	✓	N/A	✓	✓	9/10
Zagona & Mastergeorge (2018)	✓	×	✓	×	✓	✓	×	×	N/A	✓	✓	6/10

S16: Appraisal tool(s) used within each included systematic review to assess study quality/risk of bias

Systematic Review	Appraisal tool(s)
Akemoglu et al. (2020)	Horner et al. (2005) single-case research; Gersten et al. (2005) group-design
Bejarano-Martín et al. (2020)	EBP Update Workgroup Reviewer Training criteria (Wong et al., 2015) of the National Professional Development Centre on Autism Spectrum Disorders
Binns & Oram Cardy (2019)	Critical Appraisal Skills Programme tool (CASP, 2018); Dollaghan's (2007) scale
Boshoff et al. (2020)	McMaster Critical Review Form for Quantitative Studies (Law et al., 1998)
Case & Yun, (2019)	Quality assessment tool for pre–post studies with no control group (National Heart, Lung, and Blood Institute, 2014)
Chang & Locke (2016)	Evaluative method for evaluating and determining evidence-based practices in autism (Reichow et al., 2008)
Ferguson et al. (2019)	Evaluative method for evaluating and determining evidence-based practices in autism (Reichow et al., 2008)
Flippin et al. (2010)	Horner et al. (2005) and Wolf (1978) single-subject designs; Gersten et al. (2005) group designs
Fuller & Kaiser (2020)	Cochrane Collaboration (Higgins et al., 2011)
Fuller, Oliver et al. (2020)	Study quality indicators (random assignment, use of assessors who were blind or naïve of the group assignment). Measurement–quality variables were coded based on Sandbank et al. (2020a).
Geretsegger et al. (2014)	Cochrane risk of bias tool (Higgins, 2011)
Griffith et al. (2020)	Adapted Cochrane risk of bias tool
Hampton & Kaiser (2016)	Cochrane Collaboration (Higgins et al., 2011)

Hardy & Weston (2020)	Adapted from Jarde et al. (2013)
Hill et al. (2019)	Single-case experimental design scale (Tate et al. 2008); Downs and Black (1998) checklist
Ho et al. (2014)	Gersten et al. (2005)
Kent et al. (2020)	The QualSyst critical appraisal tool (Kmet et al., 2004)
Khan et al. (2019)	Joanna Briggs Institute Critical Appraisal Checklist for RCTs
Knight et al. (2013)	Horner et al. (2005) single-case; Gersten et al. (2005) group designs
Lang et al. (2012)	Certainty of evidence (Schlosser, 2009; Simeonsson & Bailey, 1991; Smith, 1981).
Logan et al. (2017)	Strength of evidence (e.g., Millar et al., 2006); Methodological rigor (Odom et al., 2003)
Makrygianni & Reed (2010)	Evaluative method for evaluating and determining evidence-based practices in autism (Reichow et al., 2008)
Mazon et al. (2019)	SIGN ratings for levels of evidence (SIGN, 2008); Jadad Score for methodological quality (Jadad et al., 1996)
McCoy et al. (2016)	Evaluative method for evaluating and determining evidence-based practices (Reichow, 2011)
Miguel-Cruz et al. (2017)	Physiotherapy Evidence Database (PEDro) scale for RCTs; available standards and recommendations for critical reviews as a proxy of assessment of the risk of bias in non-RCTs
Moon et al. (2020)	Cochrane risk of bias (RoB)-2 tool
Murza et al. (2016)	Cochrane Collaboration's Tool for Assessing Risk of Bias (Higgins et al., 2011).
National Autism Center (2015)	Scientific Merit Rating Scale (SMRS)
Naveed et al. (2019)	Cochrane Collaboration tool for randomized controlled trials (Higgins et al., 2011)

Nevill et al. (2018)	Grading of Recommendations Assessment, Development and Evaluation (Guyatt et al., 2011)
Ona et al. (2020)	Modified version of the guidelines from the Cochrane Consumers and Communication Review Group (Ryan et al., 2007)
Oono et al. (2013)	Cochrane Collaboration tool for assessing risk of bias (Higgins 2011)
Parsons, Cordier, Vaz et al. (2017)	Standard quality assessment (Kmet et al. 2004)
Parsons, Cordier, Munro et al. (2017)	Standard quality assessment (Kmet et al. 2004)
Peters-Scheffer et al. (2011)	Downs and Black (1998) Checklist
Postorino et al. (2017)	Cochrane risk of bias assessment tool (Higgins 2013)
Reichow et al. (2018)	Cochrane Collaboration's tool for assessing risk of bias (Higgins, 2017)
Sandbank et al. (2020a)	Cochrane Collaboration's tool for assessing risk of bias (Higgins, 2011), plus additional indicators proposed by Yoder et al. (2013)
Sandbank et al. (2020b)	As per Sandbank 2020a
Schaaf et al. (2018)	Cochrane Collaboration tool for assessing risk of bias (Higgins 2011)
Schoen et al. (2019)	CEC Standards for Evidence-Based Practices in Special Education (Cook et al., 2015)
Srinivasan et al. (2018)	Levels of evidence described by Sackett and colleagues (1997); Physiotherapy Evidence Database (PEDro) scale
Steinbrenner et al. (2020)	Gersten et al. (2005) group design; Horner et al. (2005) single-case; review guidelines established by the WWC
Sutherland et al. (2018)	Scientific Merit Rating Scale (SMRS; National Autism Center, 2015)

Tachibana et al. (2018)	Cochrane Collaboration's Tool for Assessing Risk of Bias (Higgins et al., 2011).
Tarver et al. (2019)	Cochrane risk of bias tool (Higgins et al., 2011)
Tiede & Walton (2019)	Evaluative Method for Determining Evidence-Based Practice in Autism (Reichow et al., 2008)
Treurnicht Naylor et al. (2011)	Physiotherapy Evidence Database (PEDro) scale
Trzmiel et al. (2019)	Quality Assessment Tool for Quantitative Studies (QATQS; National Collaborating Centre for Methods and Tools, 2008)
Tupou et al. (2019)	Modified version of Goldstein et al.'s (2014) framework
Verschuur et al. (2014)	Certainty of evidence rated using the classification system described by Lang et al. (2012), Palmen et al. (2012), Ramdoss et al. (2011) and Ramdoss et al. (2012).
Virués-Ortega (2010)	Downs and Black (1998) checklist
Waddington et al. (2016)	Evaluative Method for Determining Evidence-Based Practices in Autism (Reichow et al., 2008; Reichow, 2011)
Watkins et al. (2019)	What Works Clearinghouse (WWC, 2014)
Weitlauf et al. (2017)	Self-developed tool: ASD-specific assessment informed by the Methods Guide for Effectiveness and Comparative Effectiveness Reviews (2014)
Weston et al. (2016)	National Institute for Health and Care Excellence Quality Appraisal Checklist for Quantitative Intervention Studies (National Institute for Health and Care Excellence, 2012)
Wiese et al. (2016)	The National Health and Medical Research Council (NHMRC) hierarchy of evidence (Australian Government 2009); The McMaster Quantitative Critical Appraisal Review Form for Quantitative Studies (Law et al., 1998)
Zagona & Mastergeorge (2018)	Scientific Merit Rating Scale (SMRS; National Autism Center, 2015)

S17: Raw data and summary statements from each included systematic review for all categorised outcomes in the current umbrella review

Akemoglu et al. (2020) - Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication	"Parents' use of naturalistic teaching strategies resulted in improvements in child Social-communication skills although not all studies have found robust effects on child outcomes. Because communication levels of participants varied, researchers targeted different child communication responses (i.e., behavior) and focused on a variety of communication skills across studies."	Summarised inconsistent effect
Caregiver communication and interaction (parent's use of strategies)	"parent-implemented interventions were found to be effective at increasing parents' use of specific strategies, such as environmental arrangement (Guðmundsdóttir et al. 2017, 2019), modeling, mand model (McDufe et al. 2013; Meadan et al. 2016), time delay (Douglas et al. 2018; Meadan et al. 2016), following the child's lead (McDufe et al. 2013; Vismara et al. 2012, 2013, 2018), and prompting strategies and expansions (Douglas et al. 2018; McDufe et al. 2013; Wainer and Ingersoll 2013). Specifically, coaching parents to embed communication strategies into a variety of family routines resulted in increased responsive and modelling strategy use by parents and targeted communication rates by children (Douglas et al. 2018; McDufe et al. 2013; Meadan et al. 2016).	Summarised positive effect

Bejarano-Martín et al. (2020) – Meta-analysis

Outcome	Context		Studies included	Effect size	Heterogeneity	Categorised outcome
Social-communication	Group studies		18	$g = 0.51$, 95CI [0.37, 0.65]	$I^2 = 23.01$	Positive pooled effect
	Single case studies		25	NAP = 0.86, 90CI [0.59, 0.98]	-	Positive pooled effect
Social-communication (Imitation)	Group studies		4	$g = 0.43$, 95CI [0.10, 0.75]	$I^2 = 6.62$	Positive pooled effect
	Single case studies		7	NAP = 0.90, 90CI [0.59, 0.96]	-	Positive pooled effect
Social-communication (Joint attention)	Group studies		14	$g = 0.55$, 95CI [0.39, 0.70]	$I^2 = 19.83$	Positive pooled effect
	Single case studies		10	NAP = 0.86, 90CI [0.59, 0.99]	-	Positive pooled effect
Social-communication (Play)	Group studies		6/7 ¹	$g = 0.47$, 95CI [0.25, 0.70]	$I^2 = 73.56$	Positive pooled effect
	Single case studies		8/9 ¹	NAP = .81, 90CI [0.58, 0.96]	-	Positive pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Child age	Group/single case	Social-communication	24 group, 31 SCD	Group: "did prove to be significant, $Q(1) = 6.95$, $p = 0.008$. Effect sizes were greater when participants' preintervention ages were lower (see Appendix H for more information)." Single case: "The correlations did not show		Age inconsistently related to intervention effects on social-communication

				effects in terms of age, IQ or language (see Appendix I for more information)."	
Child characteristics	Group/single case	Social-communication	14 group, 17 SCD	<p>"nonsignificant for group and single case"</p> <p>"All the descriptive moderators (overall cognitive ability, verbal ability...) were nonsignificant"</p>	Child communication skills and cognitive ability prior to intervention not related to intervention effects on social-communication.
Intervention amount	Group/single case	Social-communication	16 group, 27 SCD	<p>Group: "were nonsignificant... Treatment dosage increased with increasing participants' age, although this relationship was not significant ($r = 0.271$, $p = 0.076$). In addition, when we eliminated the two studies where treatment dosage was much higher than the rest of the studies, the relationship between the dosage and the effect was significantly positive (see Fig. 6 in Appendix I).</p> <p>Single case: "The correlation analyses for single-case studies showed significant effects according to the treatment dosage moderator (Table 2), with the effect being greater when the treatment dosage was increased (number of sessions X hours)"</p>	Total hours inconsistently related to intervention effects on social-communication.
Intervention agent	Overall	Social-communication	9 group, 7 SCD	"Nine studies with group design included caregivers or teachers as active components in treatment programmes. The effect sizes	Interventions involving caregivers or teachers had a similar positive effect to those

				<p>for programmes where, in addition to the main therapist, the caregivers or teachers had an active role in the intervention, ranged from $g = 0.11$ to $g = 1.02$. Fig. 4 shows the individual effect size for this analysis ($g = 0.50$, $K = 9$, 95% [CI 0.32, 0.68], $Z = 5.39$, $p < 0.001$). This was a medium effect. The sample of studies was not sufficiently large and the I^2 statistic (0.00) did not meet the criteria to proceed with moderator or publication bias analyses.</p> <p>Seven studies with single-case design included caregivers or teachers in treatment programmes. The effect sizes for these programmes ranged from $NAP = 0.75$ to $NAP = 0.99$. Fig. 4 shows the individual effect size for this analysis ($NAP = 0.89$, $K = 7$, 90% [CI 0.66, 0.99], $Z = 62.83$, $p < 0.001$). This was a medium effect. The sample of studies was not sufficiently large to proceed with publication bias analyses."</p>	<p>involving clinicians alone.</p>
--	--	--	--	---	------------------------------------

¹ Both numbers reported.

Binns & Oram Cardy (2019) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication (social interaction and Social-communication)	<p>"Each of the four studies evaluating social interaction capacities or overall Social-communication reported positive results, with moderate (Solomon et al., 2014; Wetherby et al., 2014) to large effects (Aldred et al., 2004; Green et al., 2010; Pajareya & Nopmaneejumrulers, 2011). Aldred et al. (2004) included both social interaction and communication outcome measures, and reported positive results in the social interaction domain of the ADOS, but no significant change on the communication domain"</p>	Summarised positive effect
Communication (language capacities)	<p>"Six studies used standardized language tests as outcome measures (e.g. Preschool Language Scale; Zimmerman, Steiner, & Pond, 2006). Of these, three reported mixed results across different language tests (Green et al., 2010; Schertz et al., 2013; Wetherby et al., 2014) and three reported no effects (Aldred et al., 2004; Casenhiser et al., 2013; Solomon et al., 2014). Two of the studies that reported mixed results found small to moderate positive effects in children's receptive language, but not in expressive language (Schertz et al., 2013; Wetherby et al., 2014). Green et al. (2010) found no effects using assessor rated measures of language."</p>	Summarised inconsistent effect
Caregiver communication and interaction (parent responsiveness and directiveness)	<p>"Caregiver interaction outcomes. Pre–post Social-communication or language outcomes of caregivers were examined within six studies. Parent outcomes most commonly reported related to parent responsiveness and parental control.</p> <p><i>Responsiveness.</i> Parental responsiveness significantly increased for parents who had participated in DSP intervention, with two studies reporting large positive effects (Casenhiser et al., 2013; Solomon et al., 2014). By contrast, Carter et al. (2011) reported no changes in parental responsiveness with moderate effects noted, which may have related to small sample size (n=28).</p> <p><i>Parental control/directiveness.</i> Within DSP interventions, parental directiveness is not thought to support spontaneous communication or language and is therefore discouraged. Three studies reported reductions in directiveness with moderate (Solomon et al., 2014) to large effects (Aldred et al., 2004; Venker et al., 2012)."</p>	Summarised positive effect

Moderators	Outcome	Verbatim summary from systematic review	Categorised outcome
Child characteristics	Social-communication (Social-communication and language skills)	“Two studies examined how a child’s autism severity influenced treatment effects, and results were conflicting. Pajareya et al.(2012) found that the less severe the impairments or the higher the level of overall performance of the child prior to intervention, the more likely they were to have positive gains from the DSP intervention. In contrast, Schertz et al. (2018) found that more positive changes in responding to joint attention occurred for the children with more severe autism. However, treatment effects for following faces, turn taking, and initiating joint attention were not influenced by autism severity.”	The level of pre-intervention Overall autism characteristics inconsistently related to intervention effects on social-communication.

Boshoff et al. (2020) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication (social and emotional development)	“In Table 3, it can be seen that the most prominent developmental area in which positive outcomes were indicated across the studies was the socio-emotional area, with the use of various outcome measures. Positive results were found on the FEAS outcome measure in five studies, on the FEDQ used in two studies, the CARS (n=2 studies), CoC (n=1 study),CBRS (n=2 studies), FEDL (n=1 study), the Assessment of Child Socio-Communication (n=1 study), the Assessment Scale of Children with ASD (n=1 study), and the VABS-2 (n=1 study), acknowledging that studies may have used more than one of these measures.”	Summarised positive effect
Communication (language)	“...and language showed no changes in the Preschool Language Scale (n = 1 study) and the Mullen Scales (n = 1 study).”	Summarised null effect

Motor skills (motor and fine motor)	"Other developmental changes did not show improvements: the VABS-2 showed no changes in motor development (n = 1 study), the Mullen Scales showed no changes in fine motor and visual perception"	Summarised null effect
--	---	------------------------

Case & Yun (2019) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Gross motor	Overall	20 interventions from 18 studies	$\delta = 0.99$, 95CI [0.62, 1.36]	Q = 223.36 I ² = 91.49	Positive pooled effect
	Technology interventions	4	$\delta = 1.42$, 95CI [-0.78, 3.62]	-	Null pooled effect
	Fundamental motor skills	11	$\delta = 0.68$, 95CI [0.44, 0.92]	-	Positive pooled effect
	Equestrian assisted therapy	2	$\delta = 1.20$, 95CI [0.67, 1.37]	-	Positive pooled effect
	Physical activity	3	$\delta = 1.20$, 95CI [0.41, 1.98]	-	Positive pooled effect

Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review	Categorised outcome
Child age	Overall	Motor (gross motor)	20 interventions from 18 studies	"The use of evidence-based practices and the mean age of the sample were not found to be significant moderators based on the results of the heterogeneity analyses. However, the summary effect sizes for interventions with younger and older children were both considered to be large."	Age not related to intervention effects on motor skills.
Intervention amount	Overall	Motor (gross motor)	20 interventions from 18 studies	"The total intervention time and intervention setting were found to be significant moderators, with interventions with 16 or more hours and interventions within a research or experimental setting eliciting significantly larger effect sizes than the interventions that were less than 16 hr and in practical or service settings."	Greater total hours related to greater intervention effects on motor skills.
Intervention practice	Overall	Motor (gross motor)	20 interventions from 18 studies	"The use of evidence-based practices and the mean age of the sample were not found to be significant moderators based on the results of the heterogeneity analyses. However, the summary effect sizes for interventions with younger and older children were both considered to be large."	Intervention practices had similar intervention effects on motor skills.

Chang & Locke (2016) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication (social initiations, social responses, Social-communications)	<p>"All studies used a social skills measure, but the type of measure and social outcome widely varied across studies. All studies used direct observations to measure children's social skills, but only two studies used observers who were blinded to children's treatment condition (Kasari et al., 2012; Roeyers, 1996). All of the observation measures examined children's initiations of and responses to Social-communication; however, these data were collected in different social contexts and used different operational definitions. For example, Kalyva and Avramidis (2005) examined social initiations and responses separately during a one-hour circle time, while Kamps et al. (2014) combined both social initiations and responses (i.e., communicative acts) and observed children during a 10-min free play. Other studies also measured children's joint engagement, conversation, and duration of social interaction (Kasari et al., 2012; Roeyers, 1996).</p> <p>In addition to observations, two of the studies also used multi-rater (i.e., parents, teachers, and researchers) social skills measures (Corbett et al., 2014; Kasari et al., 2012). Corbett et al. (2014) had parents complete the Social Responsiveness Scale (Constantino & Gruber, 2005), which measures children's social awareness, Social-communication, and social cognition. Researchers were asked to rate children's social skills using the Developmental Neuropsychological Assessment (NEPSY; Korkman, Kirk, & Kemp, 2007), that measures social perception, and the Companionship Scale (Bauminger, 2007) that assesses children's verbal and nonverbal social behaviors using a 5-point Likert scale (Corbett et al., 2014). Kasari et al. (2012) used the Teacher Perceptions of Social Skills, which measures children's social skills and classroom behaviors (e.g., quality interactions with peers) on a 3-point Likert scale. Data also were collected directly from children. Children were asked to complete a peer nomination measure that examined their social acceptance and social network inclusion before and after treatment as well as during a 3-month follow-up (Kasari et al., 2012). Lastly, two of the studies also reported effect sizes for the social outcomes (Corbett et al., 2014; Kasari et al., 2012). The effect sizes varied depending on the social outcome and ranged from small to large effect size ($d = 0.23-0.74$). Of the different social outcomes from the two studies, social awareness had the smallest effect size and total social skills had the largest effect size.... Using Reichow et al.'s (2008) framework and definition, the evidence demonstrated by the reviewed studies indicates that PMIs have "established evidence based practice."</p>	Summarised positive effect

Ferguson et al. (2019) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Child outcomes (efficacy outcomes)	“Results of efficacy (Fig. 3) show that 61% (n=17) of studies were rated as ‘positive’ in which improvements were achieved by all participants across all dependent variables...Overall, 32% (n=9) of studies received a ‘mixed’ efficacy rating (Barkaia et al. 2017; Bearss et al. 2017; Machalicek et al. 2016; Meadan et al. 2016; Suess et al. 2014; Vismara et al. 2013, 2016; Wainer and Ingersoll 2015; Wilczynski et al. 2017). For example, 44% (n=4) of these studies found improvements in interventionist treatment fidelity across all participants but failed to increase scores of Social-communication or imitation behaviours consistently across participants (Meadan et al. 2016; Wainer and Ingersoll 2015; Vismara et al. 2013). None of the 28 studies included in this review received a ‘negative’ rating.”	Summarised positive effect

Flippin et al. (2010) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Social-communication (communicative behaviours)	Single-subject designs	8	Glass’s $\Delta = 0.51$, 95CI [0.04, 0.67]	-	Positive pooled effect
Expressive language (speech or vocalisation)	Single-subject designs	5	Glass’s $\Delta = 0.17$ 95CI [-0.01, 0.36]	-	Null pooled effect

Fuller & Kaiser (2020) – Meta-analysis

Outcome	Context		Studies included	Effect size	Heterogeneity	Categorised outcome
Social-communication	-		29	$g = 0.355$, 95CI [0.207,0.503]	$Q = 49.83$ $I^2 = 43.8\%$ $\tau^2 = 0.065$	Positive pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Child age	-	Social-communication	Not specified	<p>"The mean age of participants, in years, was a significant predictor of treatment effect size on Social-communication outcomes, such that older participants were associated with larger out-comes ($\beta = 0.84$; $p = 0.039$). The quadratic of participant age was also a significant predictor of treatment effect size, but in the opposite direction ($\beta = -0.11$; $p = 0.049$), indicating that the benefit of age diminished as children approached 8 years. Optimal outcomes were observed at age 3.81 years. Including age in the model explains some of the observed heterogeneity in the sample ($\tau^2 = 0.052$, $I^2 = 37.28\%$, Adjusted $R^2 = 24.40\%$).</p>		Age related to intervention effects on social-communication, with greatest gains made at around 4 years of age.
Intervention amount	-	Social-communication	Not specified	<p>"The total dosage of intervention (measured as the total number of hours) and the duration or intervention (measured as length in weeks) were used as two measures of intervention dosage. Total dosage and duration were not significant predictors of treatment effect sizes on Social-communication outcomes, using separate meta-regressions (total dosage: $\beta = -0.00003$, $p = 0.746$; duration: $\beta = 0.00082$, $p = 0.972$). Additionally, neither dose nor duration</p>		Total hours not related to intervention effects on social-communication.
Intervention duration	-	Social-communication	Not specified			Intervention duration (weeks) not related to

				explained any of the observed heterogeneity in the sample (dosage: $I^2 = 48.34\%$ Adjusted $R^2 = 0\%$; duration: $I^2 = 45.81\%$ Adjusted $R^2 = 0\%$)."	intervention effects on social-communication.
Intervention agent	-	Social-communication	29	"A total of 19 studies included the parent in the intervention, four studies included school staff in the intervention, and six studies were implemented directly by clinicians (researcher or therapist). The largest effect sizes were shown when the intervention was delivered by clinicians ($g = 0.587$, 95% CI [0.258–0.916], $p < 0.001$, $Q = 5.26$, $I^2 = 4.9\%$, $k = 6$), followed by parents ($g = 0.330$, 95% CI [0.203–0.447], $p < 0.001$, $Q = 39.35$, $I^2 = 54.3\%$, $k = 19$), and school staff ($g = 0.218$, 95% CI [– 0.006 to – 0.441], $p = 0.057$, $Q = 1.91$, $I^2 = 0\%$, $k = 4$). The only effect size that was not statistically significant at the 0.05 level was the effect for interventions implemented by school staff; however, this effect size was calculated from only four studies. There was no significant between-group variance ($Q = 3.32$, $p = 0.190$), indicating that the effect size of intervention did not differ significantly based on the interventionist."	Intervention agent (clinicians, parents, school staff) not related to intervention effects on communication.

Fuller, Oliver et al. (2020) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Overall autism characteristics (autism symptoms)	-	9	$g = 0.070$ (-)	$I^2 = 48.90\%$ $\tau^2 = 0.073$	Null pooled effect

Social-communication	-		8	$g = 0.209 (-)$	$I^2 = 72.53\%$ $\tau^2 = 0.176$	Null pooled effect
RRB (repetitive behaviours)	-		5	$g = -0.016 (-)$	-	Null pooled effect
Communication (language)	-		11	$g = 0.408 (-)$	$I^2 = 52.70\%$ $\tau^2 = 0.088$	Positive pooled effect
Cognition	-		9	$g = 0.412 (-)$	$I^2 = 66.30\%$ $\tau^2 = 0.145$	Positive pooled effect
Adaptative behaviour (adaptive functioning)	-		6	$g = 0.121 (-)$	$I^2 = 49.03\%$ $\tau^2 = 0.062$	Null pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Duration of intervention	-	Child outcomes	Not specified	<p>"The studies used a wide range of intervention dosages both in intensity and in length, ranging in intensity from one hour per week to 20 hours per week, and ranging in length from six weeks to 156 weeks. This resulted in total hours of intervention ranging from 12 hours to 2080 hours. However, a meta-regression showed that child outcomes were not significantly related to the length of intervention ($B = -0.01$, $p = 0.46$), to the hours per week of</p>		Duration of intervention (total weeks) not related to intervention effects on child outcomes.
Intensity of intervention	-	Child outcomes	Not specified			Intensity of intervention (hours per week) not related to intervention effects on child outcomes.

Intervention amount	-	Child outcomes	Not specified	intervention ($B = -0.02$, $p = 0.73$), or to the total number of hours ($B = 0.004$, $p = 0.66$)."	Total hours of intervention not related to intervention effects on child outcomes.
---------------------	---	----------------	---------------	---	--

Geretsegger et al. (2014) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Social-communication (social adaptation)	Overall	4	SMD = 0.41, 95CI [0.21, 0.60]	Chi ² = 15.34 I ² = 80%	Positive pooled effect
Communication (non-verbal)	Overall	Not specified	SMD = 0.47, 95CI [0.21, 0.73]	Chi ² = 1.32 I ² = 0%	Positive pooled effect
Communication (verbal)	Overall	6	SMD = 0.33, 95CI [0.16, 0.49]	Chi ² = 0.72 I ² = 0%	Positive pooled effect
Quality of life (joy)	-	1	SMD = 0.96, 95CI [0.04, 1.88]	-	Positive pooled effect
Caregiver social emotional wellbeing (quality of family relationships)	-	2	SMD = 0.82, 95CI [0.13, 1.52]	Chi ² = 0.03 I ² = 0%	Positive pooled effect

Griffith et al. (2020) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication	"None of the 3 studies reported significant improvement in the primary Social-communication skills outcome measures for the app treatment group compared with the control group. Effect sizes for gains in the app groups on Social-communication outcomes ranged from 0 to 0.40."	Summarised null effect

Hampton & Kaiser (2016) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Expressive language (spoken language)	-	26	$g = 0.26$, 95CI [0.11, 0.42]	$\tau^2 = 0.083$ $Q = 59.08$ $I^2 = 57.7\%$	Positive pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review	Categorised outcome
Child age	-	Expressive language (spoken language)	26	"The second meta-regression moderator analysis examined the impact of age of participants and included the same 26 studies and control variables. The null hypothesis could not be rejected: the effect of interventions on spoken-language for younger and older participants did not differ significantly ($\beta = 0.092$, $SE = 0.096$). This analysis accounted for none of the heterogeneity ($R^2 = 0.00\%$),	Age not related to intervention effects on spoken language.

				indicating that interventions delivered at different ages resulted in similar outcomes."	
Intervention amount	-	Expressive language (spoken language)	26	"The first meta-regression included all 26 studies. The results indicated the total intervention dose ($\beta=0.008$, $SE=0.010$; total hours of intervention computed as length of treatment x hours per week), and number of indicators of bias ($\beta=0.027$, $SE=0.027$) did not significantly predict the magnitude of spoken-language outcomes."	Total hours of intervention not related to intervention effects on expressive language (spoken language).
Intervention agent	-	Expressive language (spoken language)	26	"The random effects ANOVA model for the subgroup analysis of implementers (clinician only, parent only or parent plus clinician) summarises the outcomes within types of implementers (Fig.2). There was a significant difference among the sub-groups [$Q=59.08(25)$, $P<0.001$]. None of the heterogeneity was explained within the parent-only group, the parent plus clinician group explained 36.4%, and 77.1% was explained by the clinician-only group. The subgroup analysis indicated a significantly better effect on language outcomes for parent plus clinician delivered interventions ($g=0.42$) as compared with parent-only ($g=0.11$) or clinician-only ($g=0.08$) delivered interventions."	Interventions involving clinicians and parents related to greater intervention effect on spoken language than clinicians or parents alone.

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication (social behaviour)	"Results of the five studies indicated positive effects of CAT on the frequency and duration of social behavior of children with ASD (Becker et al. 2017; Fung and Leung 2014; Grigore and Rusu 2014; Martin and Farnum 2002; Redefer and Goodman 1989)... However, due to the methodological weaknesses of these studies, it would be unfitting to make any assertions about the degree to which CAT impacts social behavior."	Summarised positive effect

Hill et al. (2019) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication (verbal behaviours)	Table 5 in the systematic review provides evidence of a mixture of outcomes (positive, null, negative) across targeted outcomes. The authors do not provide a brief cohesive summary in text.	Summarised inconsistent effects
Social-communication (non-verbal behaviours)		Summarised inconsistent effects
Social-communication (desired behaviours)		Summarised inconsistent effects
Social-communication (undesired behaviours)		Summarised inconsistent effects

Ho et al. (2014) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
---------	---------	------------------	-------------	---------------	---------------------

Social-communication (social skills)	-	3	g = 0.98, 95CI [0.47, 1.49]	-	Positive pooled effect
---	---	---	-----------------------------	---	------------------------

Kent et al. (2020) – Meta-analysis

Outcome	Context		Studies included	Effect size	Heterogeneity	Categorised outcome
Play	Pre/post within group analysis of intervention groups		11	g = 0.439, 95CI [0.209, 0.669]	Q = 17.210 I ² = 41.9%	Positive pooled effect
	Between-group analysis		8	g = 0.335, 95CI [0.083, 0.586]	-	
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Format	Individual, group	Play	8	<p>“Following the subgroup analysis of intervention characteristics, a meta-regression analysis was performed on eight studies to further explain variability of the results (Chang et al. 2016, b; Goods et al. 2013, b; Kasari et al. 2006, b, 2012, b, 2014, b, 2015, b; Poslawsky et al. 2015, b; Quirnbach et al. 2009, b). The analysis of intervention characteristics indicated that intervention setting and group vs individual were not significant mediators of intervention effects (see Table 5). However, focus of the intervention (i.e., child, parent, peer or teacher)</p>		The intervention format (individual, group) did not relate to intervention effects on play.

				was found to be a significant mediator of play outcomes ($Q(3) = 8.52, p = 0.036$)."	
Focus of intervention	Child, parent, peer, teacher	Play	Not specified	<p>"The three interventions that focused on the child demonstrated a significant, large effect size ($z(3) = 2.954, p = 0.003$, Hedges' $g = 0.903$, 95% CI $[0.304, 1.501]$), whereas the three interventions that had a combination of child and parent focus demonstrated a significant, small effect size ($z(3) = 2.387, p = 0.017$, Hedges' $g = 0.291$, 95% CI $[0.052, 0.529]$). There was only one intervention that focused on a combination of the child and peer and only one that focused on the teacher included in analysis, both demonstrated a negligible effect size that was not significant ($z(1) = 0.094, p = 0.925$, Hedges' $g = 0.033$, 95% CI $[-0.663, 0.730]$) and ($z(1) = 0.142, p = 0.887$, Hedges' $g = 0.036$, 95% CI $[-0.455, 0.526]$) respectively... However, focus of the intervention (i.e., child, parent, peer or teacher) was found to be a significant mediator of play outcomes ($Q(3) = 8.52, p = 0.036$)."</p>	Interventions that focused on the child related to better intervention effects on play skills compared to interventions that focused on parents, peers, or teachers.
Intervention setting	Clinic, home, school	Play	Not specified	<p>"No effect size for the clinic, home, or school setting was significant (clinic $z(2) = 1.221, p = 0.222$, Hedges' $g = 0.887$, 95% CI $[-0.537, 2.311]$; home: $z(2) = 1.402, p = 0.161$, Hedges' $g = 0.286$, 95% CI $[-0.114, 0.685]$; school: $z(4) = 1.469, p = 0.142$, Hedges' $g = 0.259$, 95% CI $[-0.087, 0.605]$)... The analysis of intervention characteristics indicated that intervention setting</p>	Intervention setting not related to the intervention effect on play skills.

				and group vs individual were not significant mediators of intervention effects (see Table5)."	
--	--	--	--	---	--

Khan et al. (2019) – Meta-analysis (relevant outcomes based on narrative synthesis only)

Outcome	Verbatim summary from systematic review	Categorised outcome
Caregiver satisfaction/dissatisfaction	"In the study by Conaughton et al [22], children and parents reported moderate levels of satisfaction following treatment. In the study by Fletcher-Watson et al [24], parents gave verbal comments on the app and what they perceived to be their child's response to it. Replies were categorized as Positive, Mixed, or Negative, and there were positive responses to questions on overall experience with the app, whether the child and parent liked the app, and ease of use. In the other study to measure participant satisfaction [26], caregivers of children in the Therapy Outcomes By You (TOBY) intervention group were asked to list up to 3 features that they liked or disliked about the app. The most frequent like statement related to TOBY providing a helpful therapy-planning tool. Other common statements were that TOBY was easy to use and that the app provided a positive learning experience for their child with an attractive structure and layout. The most common dislike statement was that the offline iPad activities were too time-consuming to prepare"	Summarised inconsistent effect

Knight et al. (2013) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Academic	Results are summarised in Table 3 "Three demonstrations of effect" and indicated inconsistent effects.	Summarised inconsistent effect

Lang et al. (2012) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
General outcomes (intervention outcomes)	<p>"The results of 14 studies (56%) were classified as negative because no benefit to any participant on any dependent measure was found. Of those 14 studies, 4 suggested that SIT may have contributed to increases in stereotypy and problem behavior (Carter, 2005; Davis et al., 2011; Devlin et al., 2011; Kane et al., 2004). Across the studies reporting negative findings, eight were rated as providing a suggestive level of certainty (e.g., Watling & Dietz, 2007), one was rated at the preponderance level (Devlin et al., 2011) and five were rated as providing a conclusive level of certainty. All five studies with a conclusive level of certainty and negative findings involved wearing a weighted vest. The results of eight studies were classified as mixed because some but not all participants improved or some but not all dependent variables improved. For example, Ayres and Tickle (1980) classified six participants as "good responders" to SIT and four as "poor responders". Across the studies with mixed results, six were classified at the suggestive level of certainty and two were classified at the conclusive level of certainty (Hodgetts et al., 2011b; Van Rie & Heflin, 2009). The results of three studies were classified as positive all with a suggestive level of certainty (Fazlioglu & Baran, 2008; Linderman & Stewart, 1999; Thompson, 2011)."</p>	Summarised null effect

Logan et al. (2017) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication (communication functions)	<p><i>Single-case:</i> "In six of the SCEDs (25%), evidence was provided of at least partial improvement over time, and in 18 (75%) there was evidence of improvement in all participants over time. Notably, all targeted communication functions improved to some extent"</p> <p><i>Group designs:</i> "In each of the group studies of PECS (Table 2), improvements were found consistently for teaching object requests, but inconsistently for other functions."</p>	Summarised inconsistent effect

	<p><i>Maintenance:</i> "Assessment of intervention maintenance was included in 12 SCED studies (50%) (see Table 1). In all of these, at least partial maintenance was demonstrated (i.e., of some dependent variables or participants). In the group studies, four included assessment of intervention maintenance, but it was demonstrated in only two (see Table 2). Where maintenance did occur, it was demonstrated in performance on communication assessments (e.g., Schreibman & Stahmer, 2014), or varied according to communication behavior (e.g., demonstration of maintenance of production of comments over time versus attenuation of effects on other dependent variables; Kasari et al., 2014)."</p> <p><i>Generalisation:</i> "Of the SCED studies, 12 (50%) included assessment of generalization, with all demonstrating it to some degree (see Supplemental Appendix B for definition). Generalization was addressed in only two group studies (33%). Schreibman and Stahmer (2014) included a generalization setting in their intervention, but did not report specific information about transfer of effects. In a follow-up to Yoder and Stone (2006), Yoder and Lieberman (2010) reported generalization for a far-treatment measurement context (i.e., with the use of a different examiner, setting, activity, and materials)."</p>	
Caregiver satisfaction (social validity)	"Of the SCED studies, six (25%) included assessment of social validity for procedures, and nine (38%) for outcomes (see Table 1). All demonstrated social validity at least partially for procedures and outcomes. Social validity was not assessed or included in five of the six group studies (83%). In contrast, Schreibman and Stahmer (2014) surveyed parental satisfaction, finding that although highly satisfied with the PECS intervention, parents of children who received the intervention rated it as significantly more difficult to implement than did parents of children who received Pivotal Response Training, an intervention that did not include aided AAC."	Summarised inconsistent effect

Makrygianni & Reed (2010) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Social-communication (socialisation)	High methodological quality group, and pre/post in treatment group only	4	wES = 0.736, Mean SE = 0.141	Q = 7.800	Positive pooled effect

Communication	High methodological quality group, and pre/post in treatment group only	4	wES = 0.967, Mean SE = 0.115	Q = 2.100	Positive pooled effect
Communication (language)	High methodological quality group, and pre/post in treatment group only	4	wES = 0.990, Mean SE = 0.134	Q = 1.672	Positive pooled effect
	Low methodological quality group, and pre/post in treatment group only	4	wES = 0.897, Mean SE = 0.148	Q = 3.298	Positive pooled effect
	High methodological quality group, and pre/post compared to control group	2	wES = 0.534, Mean SE = 0.224	Q = 0.404	Positive pooled effect
	Low methodological quality group, and pre/post compared to control group	4	wES = 0.910, Mean SE = 0.177	Q = 1.996	Positive pooled effect
Cognition (IQ)	High methodological quality group, and pre/post in treatment group only	5	wES = 0.950, Mean SE = 0.132	Q = 0.535	Positive pooled effect
	Low methodological quality group, and pre/post in treatment group only	11	wES = 0.909, Mean SE = 0.079	Q = 17.73	Positive pooled effect
	High methodological quality group, and pre/post compared to control group	3	wES = 0.568, Mean SE = 0.192	Q = 5.076	Positive pooled effect
	Low methodological quality group, and pre/post compared to control group	8	wES = 0.730, Mean SE = 0.123	Q = 19.431	Positive pooled effect

Adaptive behaviour	High methodological quality group, and pre/post in treatment group only		4	wES = 0.421, Mean SE = 0.154	Q = 7.990	Positive pooled effect
	Low methodological quality group, and pre/post in treatment group only		7	wES = 0.474, Mean SE = 0.108	Q = 8.032	Positive pooled effect
	High methodological quality group, and pre/post compared to control group		2	wES = 0.971, Mean SE = 0.256	Q = 4.310	Positive pooled effect
	Low methodological quality group, and pre/post compared to control group		5	wES = 0.656, Mean SE = 0.153	Q = 11.523	Positive pooled effect
Moderators	Context	Outcome	Studies included	Verbatim summary from systematic review		Categorised outcome
Child age	-	IQ	ES ₁ = 14 ES ₂ = 8	<p>"Apart from the above trends, there were no statistical significantly correlations found with the ES₁s¹. Concerning the other ES₂² relationships, there were not any statistically significant correlation, and it would be unwise to comments further, as the number of the programs providing the relevant ES₂s was quite small"</p>		Child age not related to intervention effect on cognition, adaptive behaviour, or language.
Child characteristics	-	Cognition (intellectual abilities), communication (language), adaptive behaviour	ES ₁ & ES ₂ Cognition (intake) n varies from 5 – 14 studies across outcome	<p><i>Cognition:</i> "This factor was not correlated with any of the ES₁ and ES₂ for the studied developmental aspects. This implies that the children's intellectual abilities at intake have little impact on the effectiveness of the behavioural programs."</p>		Pre-intervention communication not related to intervention effect on communication, cognition, or adaptive behaviour. Pre-intervention cognition

			<p>Communication (intake) n varies from 2-6 studies across outcome</p> <p>Adaptive behaviour n varies from 5-9 studies across outcome</p>	<p><i>Communication (language):</i> "This factor is not correlated with any of the ESs. This means that the effectiveness of the behavioural EIPs does not depend on the language abilities of the children at intake. The behavioural EIPs are equally effective for both non-linguistic children, and children who were able to speak at the beginning of the program, and their effectiveness compared to the control programs is not affected by language abilities of the children at intake"</p> <p><i>Adaptive behaviour:</i> "This factor is correlated significantly with ES1 for language abilities ($r = 0.924$), and with ES2 for adaptive behaviour ($r = 0.859$). The first relationship means that the higher the adaptive behaviour abilities of the children at intake, the more effective the behavioural EIPs are in improving the language abilities of the children. The second correlation shows that the better the adaptive behaviour abilities of the children at intake, the more effective the behavioural EIPs are compared to eclectic programs in improving these abilities of the children."</p>	<p>not related to intervention effect on communication, cognition, or adaptive behaviour. Greater pre-intervention adaptive behaviour skills related to greater intervention effects on communication and adaptive behaviour, but not on cognition.</p>
Intervention duration	-	IQ	<p>ES₁ = 14</p> <p>ES₂ = 8</p>	<p>"No statistical significant relationship was found for any ES1 of developmental aspects. Thus, the most conservative conclusion would be that prolonging an intervention program over several years does not necessarily entail the maintenance of the same progress rate in the developmental domains, and that the effectiveness of the program varies independently from the programs' duration"</p>	<p>Intervention duration (months) not related to intervention effect on cognition, adaptive behaviour, or language.</p>

Intervention intensity	-	IQ	ES ₁ = 12 ES ₂ = 8	<p>"The present analysis shows (see Table 4) that there are statistically significant correlations between the intensity of the EIP and ES1 for children's intellectual, and adaptive behavioural, functioning. The correlation coefficients of 0.674 for intellectual abilities, and 0.855 for adaptive behavioural functioning, are characterised as moderate to high. Thus, it appears that more intensive programs, in general, have a higher impact on the gain in intellectual, and adaptive behavioural abilities of children with ASD. However, the intensity of the behavioural program does not seem to be correlated with progress on the children's language abilities. There was also a high, positive correlation between program intensity and ES2 for intellectual abilities ($r = 0.842$), and between program intensity and ES2</p> <p>for adaptive behaviour abilities ($r = 0.885$). This means that the more intensive the behavioural EIP, the more effective it is compared to the control program in improving the intellectual and adaptive behaviour abilities of children with ASD."</p>	Higher intensity (hours per week) related to greater intervention effect on cognition and adaptive behaviour, but not language.
-------------------------------	---	----	---	---	---

¹ "ES1 describes the effectiveness of the behavioural EIPs in terms of the difference between the pre-treatment and posttreatment performances."

² "ES2 The second approach to assessing the effectiveness of the behavioural EIPs, ES2, gives the magnitude of the effect comparing the behavioural group with the control group (where one existed)"

Mazon et al. (2019) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
---------	---	---------------------

General outcomes (statistical significance)	<p>"Overall, TE studies reported inconsistent results concerning the TBI effect, i.e., 7 with highly-positive, 8 with slightly-positive, and 8 with limited evidence. Fewer of the TBI effects reported in RCT studies were highly-positive (N = 3/14) than in controlled studies (N = 4/8, Table 5). Although there were fewer TU studies, all controlled trials, the TBI effects reported were mostly slightly-positive (N = 4/6). Hence, the highly-positive evidence for TBI was dependent on the study design, irrespective of its aim (TE vs. TU): the more robust the study design, the less consistent the results."</p>	Summarised inconsistent effect
--	--	--------------------------------

McCoy et al. (2016) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication (social skills)	<p>"Two of the SSRD studies used a CBI intervention to increase social skills, producing a median NAP effect size of [note NAP could only be calculated based on two studies] 1.0. A NAP effect size between 0.93 and 1 reflects a treatment of large effect. Table 4 provides a summary of the NAP effect size for each individual study...[regarding research strength and evidence-based practice evaluation]: For studies that used a CBI intervention, one (8.33 %) study was rated as "strong" and two (16.66 %) studies were rated as "adequate". The remaining nine studies (75 %) were rated as "weak". An evidence-based status Z score of 45 was calculated $[(1*30) + (2*15) + (0*4) + (0*2) = 60]$, indicating that CBI interventions could be categorized as an established evidence-based practice (Reichow 2011). Table 4 provides a summary of the strength ratings for each study included in this review."</p>	Summarised positive effect

Miguel-Cruz et al. (2017) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome

Social-communication (interaction)	<p>"Regarding the outcome interaction, the highest level of evidence is 4, which was provided by a post-test-only control group that showed that children with ASD did not show any statistically significant differences compared with typically developing children when recognizing the basic emotional expressions of the Zeno R50 robot [14], and two pretest–post-test no control group studies had a level of evidence of 4, whereby the autistic behaviour of children with ASD decreased after interacting with a NAOTMrobot[35], and that they showed more engagement in their interactive behaviour with a NAOTMrobot than with a teacher [36]. The remaining studies that assessed the outcomes related to inter-action skills in children with ASD achieved the lowest level of evidence, i.e., 5, including a case study and a single case that showed that the KEEPONVRrobot sparked the child's interest in interacting [37] and facilitated the spontaneous exchange and sharing of mental states with other children [38]. Another case study showed that children with ASD paid attention to the Gipy-1robot for almost 80% of the sessions [39]. Three case studies reported mixed results regarding the effects of using the NAOTMrobot on children's skills at imitating the robot's actions [40–42]. One case study reported that children with ASD showed a decrease in stereotyped behaviours during interaction with aNAOTMrobot [43]. A single case design reported that children showed improved social behaviour when playing with their peers after they had interacted with the KASPAR robot during play activities [44]. Thus, the level of evidence is low regarding these robots for the interaction skills outcome."</p>	Summarised inconsistent effect
RRB (repetitive and maladaptive behaviours)	<p>"The highest level of clinical evidence in the papers involving children with ASD was an RCT that got a PEDro score of 5 [15]. According to the Sackett criteria [26], this paper offers a level of evidence of 3 that an intervention with a NAOTMrobot did not have an effect on reducing repetitive and maladaptive behaviours in children with ASD. In contrast, a significant reduction in repetitive and maladaptive behaviours was observed in the group that received treatment based on interaction with a therapist. Similarly, the group that interacted with a human showed a significant reduction in negative affect and an increase in interested affect, whereas the robot group showed a reduction in positive affect."</p>	Summarised negative effect

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Social-communication	3-month follow-up	2	SMD = 0.18, 95CI [-0.20, 0.56]	I ² = 0%	Null pooled effect
	6-month follow-up	2	SMD = 0.00, 95CI [-0.55, 0.55]	I ² = 53.11%	Null pooled effect
Communication (gestures)	3-month follow-up	2	SMD = 0.32, 95CI [-0.05, 0.69]	I ² = 0%	Null pooled effect
Communication (symbolic)	3-month follow-up	2	SMD = 0.05, 95CI [-0.33, 0.43]	I ² = 0%	Null pooled effect
Expressive language	-	2	SMD = 0.25, 95CI [-0.36, 0.86]	I ² = 60.99%	Null pooled effect
Expressive language (words produced)	-	2	SMD = -0.23, 95CI [-0.68, 0.22]	I ² = 32.56%	Null pooled effect
Receptive language	-	2	SMD = 0.24, 95CI [-0.13, 0.61]	I ² = 0%	Null pooled effect
Cognition (visual reception)	-	2	SMD = 0.41, 95CI [0.03, 0.80]	I ² = 5.2%	Positive pooled effect
Motor (fine motor)	-	2	SMD = 0.44, 95CI [0.06, 0.81]	I ² = 0%	Positive pooled effect

Outcome	Context		Studies included	Effect size	Heterogeneity	Categorised outcome
Social-communication (joint attention)	Joint attention versus control group		9	$g = 0.660 (0.395, 0.925)$	Not specified	Positive pooled effect
	Joint attention versus symbolic play		2	$g = 0.527 (0.077, 0.978)$	Not specified	Positive pooled effect
	Joint attention versus control group: treatment administered by parent		5	$g = 0.678 (0.313, 1.043)$	Not specified	Positive pooled effect
	Joint attention versus control group: discrete trial training plus social interactive approach		5	$g = 0.762 (0.337, 1.187)$	Not specified	Positive pooled effect
	Joint attention versus control group: social interactive approach only		4	$g = 0.589 (0.194, 0.983)$	Not specified	Positive pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Intervention agent	-	Social-communication (joint attention)	Not specified	"All comparisons, including those conducted as follow ups, resulted in a statistically significant effect, with the largest effects evidenced for discrete trial training plus social interactive approach followed by joint attention treatments that were administered by a parent. However, the overlapping confidence intervals suggest that none of the comparisons were statistically different from each other (Schenker and		Intervention agent (parent, non-parent) not related to intervention effects on communication.

				Gentleman 2001). This implies that the interventions are similar in terms of efficacy with one type of intervention not significantly more efficacious than another. Specifically, treatment administrator, dosage, and design (control or comparison, etc.) characteristics of the studies do not appear to produce significantly different effects due to the overlapping confidence intervals.”	
--	--	--	--	--	--

National Autism Center (2015) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Behavioural interventions		
Social-communication (interpersonal)	Noted as 'skill increased'	Summarised positive effect
RRB (restricted, repetitive, non-functional patterns of behaviour, interests, or activity)	Noted as 'behaviors decreased'	Summarised positive effect
Sensory (sensory or emotional regulation)	Noted as 'behaviors decreased'	Summarised positive effect
Communication	Noted as 'skill increased'	Summarised positive effect
Cognition (higher cognitive functions)	Noted as 'skill increased'	Summarised positive effect
Motor	Noted as 'skill increased'	Summarised positive effect
Social-emotional/challenging behaviour (self-regulation, problem behaviour)	Self-regulation: Noted as 'skill increased'	Summarised positive effect

	Problem behaviour: Noted as behaviours decreased'	
Play	Noted as 'skill increased'	Summarised positive effect
Adaptive behaviour (personal responsibility)	Noted as 'skill increased'	Summarised positive effect
School/learning readiness (learning readiness)	Noted as 'skill increased'	Summarised positive effect
Academic	Noted as 'skill increased'	Summarised positive effect
Early Intensive Behavioural Interventions (EIBI)		
Overall autism characteristics (general symptoms)	Noted as 'behaviors decreased'	Summarised positive effect
Social-communication (interpersonal)	Noted as 'skill increased'	Summarised positive effect
Communication	Noted as 'skill increased'	Summarised positive effect
Cognition (higher cognitive functions)	Noted as 'skill increased'	Summarised positive effect
Motor	Noted as 'skill increased'	Summarised positive effect
Social-emotional/challenging behaviour (problem behaviour)	Noted as 'behaviors decreased'	Summarised positive effect
Adaptive behaviour (personal responsibility)	Noted as 'skill increased'	Summarised positive effect
School/learning readiness (learning readiness)	Noted as 'skill increased'	Summarised positive effect
Academic	Noted as 'skill increased'	Summarised positive effect

Functional Communication Training		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Language Training (Production)		
Communication	Noted as 'skill increased'	Summarised positive effect
Language Training (Production and Understanding)		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Picture Exchange Communication System (PECS)		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Developmental Relationship-based Treatment		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
DIR/Floortime		
General outcomes	Identified as having an 'unestablished level of evidence'	Summarised null effect
Naturalistic Teaching Strategies		
Social-communication (interpersonal)	Noted as 'skill increased'	Summarised positive effect
Communication	Noted as 'skill increased'	Summarised positive effect
School/learning readiness (learning readiness)	Noted as 'skill increased'	Summarised positive effect

Pivotal Response Treatment (PRT)		
Communication	Noted as 'skill increased'	Summarised positive effect
Play	Noted as 'skill increased'	Summarised positive effect
School/learning readiness (learning readiness)	Noted as 'skill increased'	Summarised positive effect
Sensory-intervention package		
General outcomes	Identified as having an 'unestablished level of evidence'	Summarised null effect
Auditory Integration Training		
General outcomes	Identified as having an 'unestablished level of evidence'	Summarised null effect
Music Therapy		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Structured Teaching		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Technology-based Intervention		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Augmentative and Alternative Communication (AAC)		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect

Facilitated Communication		
General outcomes	Identified as having an 'unestablished level of evidence'	Summarised null effect
Sign Instruction		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Animal-assisted Therapy		
General outcomes	Identified as having an 'unestablished level of evidence'	Summarised null effect
Cognitive Behavioural Intervention		
Social-communication (interpersonal)	Noted as 'skill increased'	Summarised positive effect
Sensory (sensory or emotional regulation)	Noted as 'behaviors decreased'	Summarised positive effect
Social-emotional/challenging behaviour (problem behaviour)	Noted as 'behaviors decreased'	Summarised positive effect
Adaptive behaviour (personal responsibility)	Noted as 'skill increased'	Summarised positive effect
School/learning readiness (placement)	Noted as 'skill increased'	Summarised positive effect
Exposure Package		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Imitation Based Training		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect

Multi-component Package		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Reductive Package		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Social Behavioural Learning Strategy		
General outcomes	Identified as having an 'unestablished level of evidence'	Summarised null effect
Social Cognition Intervention		
General outcomes	Identified as having an 'unestablished level of evidence'	Summarised null effect
Social-communication Intervention		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Social Thinking Intervention		
General outcomes	Identified as having an 'unestablished level of evidence'	Summarised null effect
Theory of Mind Training		
General outcomes	Identified as having an 'emerging level of evidence'	Summarised inconsistent effect
Parent Training		
Overall autism characteristics (general symptoms)	Noted as 'behaviors decreased'	Summarised positive effect

Social-communication (interpersonal)	Noted as 'skill increased'	Summarised positive effect
RRB (restricted, repetitive, nonfunctional patterns of behaviour, interests, or activity)	Noted as 'behaviors decreased'	Summarised positive effect
Social emotional/challenging behaviour (problem behaviour)	Noted as 'behaviors decreased'	Summarised positive effect
Play	Noted as 'skill increased'	Summarised positive effect
Peer-Training		
Social-communication (interpersonal)	Noted as 'skill increased'	Summarised positive effect
RRB (restricted, repetitive, nonfunctional patterns of behaviour, interests, or activity)	Noted as 'behaviors decreased'	Summarised positive effect
Communication	Noted as 'skill increased'	Summarised positive effect
School/learning readiness (learning readiness)	Noted as 'skill increased'	Summarised positive effect

Naveed et al. (2019) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Overall autism characteristics (autism symptom severity)	-	7 trials, 10 studies ¹	SMD = 0.44, 95CI [0.27, 0.60]	I ² = 0% Chi ² = 5.42	Positive pooled effect

Social-communication (social skills)	-	10 trials, 18 studies ¹	SMD = 0.53, 95CI [0.34, 0.73]	I ² = 48.59% Chi ² = 31.12	Positive pooled effect
Social-communication (joint engagement)	-	4 trials, 7 studies ¹	SMD = 0.63, 95CI [0.21, 1.06]	I ² = 75.88% Chi ² = 24.87	Positive pooled effect
Social-communication (joint attention)	-	7 trials, 8 studies ¹	SMD = 0.16, 95CI [-0.22, 0.54]	I ² = 76.13% Chi ² = 29.32	Null pooled effect
RRB (repetitive behaviours)	-	2 trials, 3 studies ¹	SMD = 0.33, 95CI [0.05, 0.62]	I ² = 0% Chi ² = 0.17	Positive pooled effect
Communication	-	15 trials, 13 studies ¹	SMD = 0.23, 95CI [0.03, 0.42]	I ² = 37.96% Chi ² = 17.73	Positive pooled effect
Expressive language	-	15 trials, 6 studies ¹	SMD = 0.47, 95CI [0.22, 0.72]	I ² = 53.59% Chi ² = 8.62	Positive pooled effect
Receptive language	-	15 trials, 4/5 studies ¹	SMD = 0.16, 95CI [-0.24, 0.55]	I ² = 53.34% Chi ² = 7.38	Null pooled effect
Cognition (visual reception)	-	3	SMD = 0.29, 95CI [0.01, 0.57]	I ² = 0% Chi ² = 1.22	Positive pooled effect
Motor (motor skills)	-	5 trials, 6 studies ¹	SMD = 0.25, 95CI [0.02, 0.48]	I ² = 0% Chi ² = 4.18	Positive pooled effect

Social emotional/challenging behaviour (self-regulation)	-	3		SMD = 0.54, 95CI [0.06, 1.03]	I ² = 55.91% Chi ² = 4.36	Positive pooled effect
Adaptive behaviour	-	6 trials, 7 studies ¹		SMD = 0.26, 95CI [-0.001, 0.52]	I ² = 41.44% Chi ² = 10.25	Null pooled effect
Caregiver social emotional wellbeing (parental distress)	-	7		SMD = 0.33, 95CI [0.09, 0.57]	I ² = 52.01% Chi ² = 18.75	Positive pooled effect
Caregiver social emotional wellbeing (parental self-efficacy)	-	4		SMD = 0.42, 95CI [0.23, 0.62]	I ² = 0% Chi ² = 4.64	Positive pooled effect
Caregiver social emotional wellbeing (parent-child relationship)	-	6		SMD = 0.67, 95CI [0.23, 1.10]	I ² = 76.0% Chi ² = 20.83	Positive pooled effect
Child satisfaction (child distress)	-	2		SMD= 0.55, 95CI [0.25, 0.85]	I ² = 0% Chi ² = 1.76	Positive pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Child age	-	General outcomes	Not specified	"Initially, meta-regression analysis was run inclusive for all outcomes. It did not reveal any significant effects of age, year of publication or duration of program and session or number of sessions or quality of trials on the significance of these interventions."		Age not related to intervention effects
Intervention duration	-	General outcomes	Not specified			Intervention duration (weeks) not related to intervention effects

Intervention amount	-	General outcomes	Not specified		Number of intervention sessions not related to intervention effects
Intervention agent	-	Autism core characteristics (symptom severity), social-communication (joint attention)	Not specified	"Subgroup analyses was run when specific outcomes reported in four studies. It did not reveal any significant differences among interventions delivered by different agents on outcomes of symptom severity and joint attention."	Intervention agent (parent, peer, teacher, school staff, childcare worker) not related to intervention effects on autism core characteristics (including joint attention)

¹Both numbers reported.

Nevill et al. (2018) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Overall autism characteristics (autism symptom severity)	-	6	$g = 0.22$, 95CI [0.03, 0.41]	$Q = 3.79$ $I^2 = 0\%$	Positive pooled effect
Social-communication (socialisation)	-	13	$g = 0.23$, 95CI [0.09, 0.36]	$Q = 35.90$ $I^2 = 66.57\%$	Positive pooled effect
Communication (language)	-	13	$g = 0.16$, 95CI [0.02, 0.31]	$Q = 11.50$ $I^2 = 0\%$	Positive pooled effect

Cognition	-		6	g = 0.24, 95CI [0.03, 0.46]	Q = 1.86 I² = 0%	Positive pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Intervention amount	<20h parent training vs 20 hours or higher of parent training	Autism core characteristics (symptom severity), social-communication (socialisation), communication (language), cognition	ASD severity: <20h n=2, ≥20h n=4 Social-communication (socialisation): <20h n=5, ≥20h n=8 Communication (language): <20h n=6, ≥20h n=7 Cognition: <20h n=1, ≥20h n=5	“Effect of intervention by dose of parent training. Dose of active intervention ranged from 2.3 to 104 h. Studies were coded as providing less than 20 h (k = 9) or 20 h or more (k = 10) of parent training while in the active treatment group. Results of subgroup meta-analyses based on dose are shown in Table 8. For studies with less than 20 h of parent training, socialization and communication-language was associated with small treatment effects. Analyses were not performed for cognition or ASD symptom severity because there was only one study assessing change in cognition and two studies assessing change in ASD symptom severity. Across studies with doses at or above 20 h, small effects were observed for socialization and cognition, and trivial non-significant effects were observed for ASD symptom severity and communication-language. Outcomes were not significantly different based on dose of treatment. Hedges’Q homogeneity tests were non-significant across outcomes.”		Total hours of intervention not related to intervention effect on autism core characteristics, socialisation, communication, or cognition.

Outcome	Context	Studies included	Verbatim summary from systematic review		Categorised outcome
Social-communication (social interaction)	-	-	<p>"Hardan et al. (2015) measured the effectiveness of PRT by using an objectively assessed severity scale (CGI-S) (SMD 0.46; 95% CI -0.12 to 1.04; P= 0.12) and an improvement scale (CGI-I) (SMD 1.12; 95% CI 0.50 to 1.74; P=0.0004). The authors also reported a more subjective outcome measure (SRS) that gave rise to an SMD of 0.48 (95% CI -1.10 to 1.06; P= 0.10). The reported effect estimates were highly inconsistent, preventing us from drawing firm conclusions about the effectiveness of PRT."</p>		Summarised inconsistent effect
RRB	-	-	<p>"Only Mohammadzaheri et al. (2015) assessed repetitive behavior through direct assessment, and the authors showed a statistically significant effect in favor of PRT (SMD 15.97; 95% CI 11.57 to 20.36; P<0.0001)."</p>		Summarised positive effect
			Effect size	Heterogeneity	
Communication	-	2	SMD = 1.12, 95CI [-0.49, 2.73]	I ² = 89% τ ² = 1.2	Null pooled effect
Expressive language	-	2	SMD = 0.48, 95CI [0.04, 0.93]	I ² = 0% τ ² = 0.0	Positive pooled effect

Oono et al. (2013) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Overall autism characteristics (severity of autism characteristics)	-	6	SMD = -0.30, 95CI [-0.52, -0.08]	I ² = 0%	Positive pooled effect
Social-communication (shared or joint attention)	-	3	SMD = 0.41, 95CI [0.14, 0.68]	I ² = 0%	Positive pooled effect
Social-communication (child initiations)	-	4	SMD = 0.38, 95CI [-0.07, 0.82]	I ² = 60%	Null pooled effect
Communication	Parent or teacher report	3	SMD = 5.31, 95CI [-6.77, 17.39]	I ² = 75%	Null pooled effect
Communication (joint language)	Direct or independent assessment	2	SMD = 0.45, 95CI [-0.05, 0.95]	I ² = 0%	Null pooled effect
Expressive language (expression)	Direct or independent assessment	3	SMD = 0.14, 95CI [-0.16, 0.45]	I ² = 29%	Null pooled effect
Receptive language (comprehension)	Direct or independent assessment	2	SMD = 0.29, 95CI [-0.20, 0.78]	I ² = 57%	Null pooled effect
			Verbatim summary from systematic review		
Social-communication			"Carter 2011 used a directly observed assessment measure, the Early Social Communication Scales, and found no difference after intervention. Studies using a parent-report of socialisation skills, the Vineland Adaptive Behavior Scales		Summarised inconsistent effect

			(Smith 2000; Roberts 2011; Tonge 2012) found a varied picture depending on the contrast condition, but suggesting some improvement within the more intensive treatment group. Despite the treatment focus being on physical massage, Silva 2009 also reported a significant improvement on a measure of teacher-reported social and language skills."	
Cognitive (developmental/intellectual gains)	-	-	"five studies (Smith 2000; Drew 2002; Rickards 2007; Dawson 2010; Tonge 2012) with varying theoretical basis and methods for assessing developmental/intellectual gains reported on this outcome. Dawson 2010 and Rickards 2007 suggest that small gains were made in this domain following intervention. However, Drew 2002 and Tonge 2012 (individual and group intervention, respectively) did not report any difference in this domain between intervention and control groups following intervention. Smith 2000 found greater gains for the intensive therapist-delivered intervention condition. Evidence for gains from parent-mediated intervention therefore may be suggested. However, gains in formal assessment may in part reflect child co-operation."	Summarised positive effect
Social-emotional/challenging behaviour (maladaptive behaviour)	-	-	"Four studies (Smith 2000; Tonge 2006/Tonge 2012; Rickards 2007; Roberts 2011) reported on this outcome. Due to significant and important differences between these studies in theoretical basis and outcome measures used, a meta-analysis could not be conducted. None found a significant difference in maladaptive behaviour in favour of the intervention group, even where that was the focus of intervention (Tonge 2012)."	Summarised null effect

			Effect size	Heterogeneity	
Adaptive behaviour	-	2	SMD = 1.06, 95CI [-2.95, 5.06]	I ² = 86%	Null pooled effect
Caregiver communication and interaction (parental synchrony)	-	3	SMD = 0.90, 95CI [0.56, 1.23]	I ² = 27%	Positive pooled effect
Caregiver social emotional wellbeing (parents' level of stress)	-	2	SMD = -0.17, 95CI [-0.70, 0.36]	I ² = 0%	Null pooled effect
			Verbatim summary from systematic review		
Caregiver social emotional wellbeing (parental confidence)	-	-	"in the Nefdt 2010 (Table 5) study, observers rated parent confidence in carrying out procedures with their child; parents in the intervention group appeared to be more confident compared with those in the control conditions."	Summarised positive effect	
Caregiver satisfaction	-	-	"Parents' satisfaction with therapy: only one study reported on this outcome and it was stated that "customer" satisfaction was high with mean ratings of 5.48 (out of 6) on the group experience questionnaire and 3.46 (out of 4) on the group leader experience questionnaire (Carter 2011)"	Summarised positive effect	

Parsons, Cordier, Munro et al. (2017) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
---------	---------	------------------	-------------	---------------	---------------------

Social-communication (pragmatic language)	Compared to controls	17 intervention groups from 15 studies	$g = 0.274$, 95CI [0.088 – 0.460]	$Q = 19.413$ $I^2 = 17.570\%$	Positive pooled effect
	Intervention effect (i.e., within intervention group, pre/post comparison)	17 intervention groups from 15 studies	$g = 0.500$, 95CI [0.352 – 0.647]	-	Positive pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review	Categorised outcome
Child age		Social-communication (pragmatic language)	17 intervention groups from 15 studies	"No differences were detected in outcomes as a result of participant age or method of pragmatic language measurement (i.e., parent report, observation, or lab task)....Lastly, as there was a concordance between increased age and receiving intervention in a group, participant age was examined in relation to mode. This did not produce a significant result, indicating age did not mediate the effect of mode of delivery (i.e., individual, group, or both)."	Age not related to intervention effects on social-communication.
Intervention setting	Home, school, clinic	Social-communication (pragmatic language)	17 intervention groups from 15 studies	"Interventions set in the clinic demonstrated a significant, moderate effect size ($z(12) = 5.758$, $p < 0.001$, Hedge's $g = 0.535$, 95%CI = 0.353–0.718), which was the largest effect size calculated as a function of setting. Interventions set in the school were approaching significance, with a small effect ($z(3) = 1.925$, $p = 0.054$, Hedge's $g = 0.408$, 95%CI = -0.007–0.824), Interventions set in the clinic demonstrated a significant, moderate effect size ($z(12) = 5.758$, $p < 0.001$, Hedge's $g = 0.535$, 95%CI = 0.353–0.718), which was the largest effect and interventions set in the home did not have	Intervention setting not related to intervention effects on social-communication.

				a significant effect on improving pragmatic language skills when compared to the other settings ($z(2) = 1.846$, $p = 0.065$). However, these results should be interpreted with caution as only two studies were set in the home and just one at school compared to 12 in the clinic setting group”	
Intervention format	Individual, group	Social-communication (pragmatic language)	17 intervention groups from 15 studies	“Whether interventions were administered to a group, the individual or both, effects were significant and moderate in size. Group interventions produced the largest effect of the three modalities ($z(5) = 3.811$, $p < 0.001$, Hedge’s $g = 0.553$, 95%CI = 0.269–0.838). The analysis of intervention characteristics indicated that intervention setting and mode were not significant mediators of intervention effect.”	Intervention format (individual, group) not related to intervention effects on social-communication.
Intervention agent	Child, parent, children and parent	Social-communication (pragmatic language)	17 intervention groups from 15 studies	“Approaches that integrated a caregiver into the program via education and/or coaching in intervention techniques demonstrated a significant, moderate-large effect ($z(4) = 5.265$, $p < 0.001$, Hedge’s $g = 0.760$, 95%CI = 0.477–1.043), while the intervention that focused on parent education only had no significant impact on the pragmatic language skills of children with ASD ($z(1) = 0.341$, $p = 0.733$). The majority of studies focused on administering the intervention directly to the children with ASD, and these interventions demonstrated a significant, moderate effect ($z(12) = 5.842$, $p < 0.001$, Hedge’s $g = 0.482$, 95%CI = 0.320–0.644). Again, caution is required in interpreting these results as there is only one study in the parent focused group, and 12 and 4 in the child focused and combined child and parent focused groups respectively...intervention focus (e.g. child, parent or child and parent) was found to be a	Positive intervention effect for interventions with active parent involvement, but not for interventions with parent education alone.

				significant mediator of pragmatic language outcomes ($F(2) = 4.17$, $p = 0.0381$), accounting for all of the between study variance in the model ($R^2 = 100\%$)."	
--	--	--	--	---	--

Parsons, Cordier, Vaz et al. (2017) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication (social behaviour and communication skills)	"Improvements in social behavior were measured in 2 studies using the Vineland adaptive behavior scales (2nd edition)[55] with Ingersoll and Berger [43], Ingersoll et al [44], and Pickard et al [45] reporting no significant difference prepost intervention and Vismara et al [48] reporting a significant difference in the social domains. Video-recorded interactions of the children with their parents were used in the studies conducted by Vismara et al [12,48] and Wacker et al [47]. All reported statistically significant improvements prepost intervention in joint attention and affect toward the parents with Wacker et al [47] reporting a reduction in child problem behavior."	Summarised inconsistent effect
Communication (vocabulary production and comprehension)	"Vismara et al [12,48] and the study by Ingersoll and Berger [43], Ingersoll et al [44], and Pickard et al [45] utilized the MacArthur communicative developmental inventories [54] to measure the child's abilities in vocabulary production and comprehension. In all 3 studies, statistically significant improvements were reported in the children's vocabulary production and comprehension from baseline to follow-up."	Summarised positive effect
Caregiver satisfaction	"All reported that parents were satisfied with the training they received. When comparing a therapist-assisted and self-guided website versus a self-guided website only, large effect sizes were recorded in parents' perception of the appropriateness of the intervention and child Social-communication gains (Cohen $d=0.94$ and 0.84 respectively) in the study by Ingersoll and Berger [43], Ingersoll et al [44], and Pickard et al [45]."	Summarised positive effect

Caregiver communication and interaction (parental knowledge acquisition)	"Knowledge acquisition by parents was measured by Hamad et al [49], Heitzman-Powell et al [50], and in the study by Ingersoll and Berger [43], Ingersoll et al [44], and Pickard et al [45] using quizzes covering the content in the intervention; all studies reported significant increases in knowledge post intervention. All of the studies reported statistically significant improvements in parents' skills in administering skills learnt through the interventions. These findings present evidence that parents who received the appropriate training could gain skills in the delivery of interventions, thus improving the skills in Social-communication and behavior of their children with ASD."	Summarised positive effect
Caregiver social emotional wellbeing (parental self-efficacy)	"Parents' self-efficacy was evaluated in the study by Ingersoll et al [44] and Pickard et al [45]. The authors stated that whereas there was a statistically significant ($P < .01$) improvement and a large effect size (Cohen $d = 1.34$) preintervention to postintervention for both groups, there was no difference between groups. Parents' stress levels were not measured pre-post interventions in any of the studies. Parents' stress levels were not measured pre-post interventions in any of the studies."	Summarised positive effect

Peters-Scheffer (2011) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Social-communication (socialisation)	Comparing intervention and control group	7	$z = 2.03$, 95CI [0.18 - 9.75]	$\tau^2 = 0.75$	Positive pooled effect
Communication (overall)	Comparing intervention and control group	7	$z = 3.79$, 95CI [5.03 - 15.85]	$\tau^2 = 35.98$	Positive pooled effect
Expressive language	Comparing intervention and control group	5	$z = 4.40$, 95CI [8.43 - 21.99]	$\tau^2 = 27.23$	Positive pooled effect

Receptive language	Comparing intervention and control group	5	$z = 7.19$, 95CI [10.14 - 17.75]	$\tau^2 = 0.75$	Positive pooled effect
Cognition (full scale IQ)	Comparing intervention and control group	10	$z = 4.47$, 95CI [6.73 - 17.23]	$\tau^2 = 56.3$	Positive pooled effect
Cognition (non-verbal IQ)	Comparing intervention and control group	5	$z = 2.36$, 95CI [1.88 - 20.30]	$\tau^2 = 0.70$	Positive pooled effect
Adaptive behaviour	Comparing intervention and control group	7	$z = 3.622$, 95CI [2.72 - 9.13]	$\tau^2 = 0.14$	Positive pooled effect
Adaptive behaviour (daily living)	Comparing intervention and control group	7	$z = 5.07$, 95CI [3.36 - 7.61]	$\tau^2 = 1.30$	Positive pooled effect

Postorino et al. (2017) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Social emotional/challenging behaviour (disruptive behaviour)	-	8	SMD = -0.59, 95CI [-0.88, -0.30]	$Q = 16.77$ $I^2 = 57.8\%$	Positive pooled effect

Reichow et al. (2018) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Overall autism characteristics (autism symptoms)	EIBI versus treatment as usual	2	SMD = -0.34, 95CI [-0.79, 0.11]	Q = 0.23 I ² = 0% Tau ² = 0.00	Null pooled effect
Social-communication (social competence)	EIBI versus treatment as usual	5	MD = 6.56, 95CI [1.52, 11.61]	Q = 5.25 I ² = 23.87% Tau ² = 7.94	Positive pooled effect
Communication	EIBI versus treatment as usual	5	MD = 11.22, 95CI [5.39, 17.04]	Q = 1.86 I ² = 0% Tau ² = 0.00	Positive pooled effect
Expressive language	EIBI versus treatment as usual	4	SMD = 0.51, 95CI [0.12, 0.90]	Q = 4.46 I ² = 32.77% Tau ² = 0.05	Positive pooled effect
Receptive language	EIBI versus treatment as usual	4	SMD = 0.55, 95CI [0.23, 0.87]	Q = 1.52 I ² = 0% Tau ² = 0.00	Positive pooled effect
Cognition (intelligence quotient)	EIBI versus treatment as usual	5	MD = 15.44, 95CI [9.29, 21.59]	Q = 1.16 I ² = 0%	Positive pooled effect

				Tau ² = 0.00	
Social emotional/challenging behaviour (problem behaviour)	EIBI versus treatment as usual	2	SMD = -0.58, 95CI [-1.24, 0.07]	Q = 1.71 I ² = 41.37% Tau ² = 0.09	Null pooled effect
Adaptive behaviour	EIBI versus treatment as usual	5	MD = 9.58, 95CI [5.57, 13.60]	Q = 2.43 I ² = 0% Tau ² = 0.00	Positive pooled effect
Adaptive behaviour (daily living skills)	EIBI versus treatment as usual	5	MD = 7.77, 95CI [3.75, 11.79]	Q = 1.73 I ² = 0% Tau ² = 0.00	Positive pooled effect
Verbatim summary from systematic review					
School/learning readiness (academic placement)	-	2	<p>“Two studies provided data pertaining to academic placement (that is, percentage of time spent with typical peers) (Cohen 2006; Smith 2000). Cohen 2006 reported that 17/21 children receiving EIBI (6/17 full inclusion without assistance, 11/17 with paraprofessional support) and 1/21 children receiving TAU were included in general education settings. Smith 2000 reported that 6/15 children receiving EIBI (4/6 full inclusion without assistance 2/6 partial inclusion with paraprofessional support) and 3/13 children receiving TAU were included in general education settings at post-treatment.”</p>		Summarised positive effect

Caregiver social and emotional wellbeing (parental stress)	-	1	"One study (Remington 2007) reported data on parental stress using the Questionnaire on Resources and Stress - Short Form (52- item scale; Friedrich 1983). The results from their study indicated that parents of children receiving EIBI had similar levels of stress compared to parents of children receiving TAU; that is, there was not a statistically significant difference in the levels of stress between parents of children in the treatment and comparison groups at post-treatment (see Analysis 1.10)."	Summarised null effect
---	---	---	---	------------------------

Sandbank et al. (2020a) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Behavioural Interventions					
Overall autism characteristics (diagnostic characteristics)	All studies	8	$g = 0.45$, 95CI [0.26, 0.63]	Not specified	Positive pooled effect
Social-communication	All studies	20	$g = 0.40$, 95CI [0.18, 0.61]	Not specified	Positive pooled effect
Communication (language)	All studies	14	$g = 0.24$, 95CI [0.01, 0.47]	Not specified	Positive pooled effect
Cognition (cognitive)	All studies	21	$g = 0.29$, 95CI [0.05, 0.54]	Not specified	Positive pooled effect
Motor	All studies	8	$g = 0.42$, 95CI [0.13, 0.72]	Not specified	Positive pooled effect
Social emotional/challenging behaviour	All studies	13	$g = 0.46$, 95CI [0.27, 0.66]	Not specified	Positive pooled effect
Adaptive behaviour	All studies	21	$g = 0.38$, 95CI [0.19, 0.56]	Not specified	Positive pooled effect

Developmental Interventions					
Social-communication	All studies	14	$g = 0.30$, 95CI [0.11, 0.50]	Not specified	Positive pooled effect
Communication (language)	All studies	8	$g = 0.06$, 95CI [-0.08, 0.21]	Not specified	Null pooled effect
Naturalistic developmental behavioural interventions (NDBIs)					
Overall autism characteristics (diagnostic characteristics)	All studies	6	$g = 0.05$, 95CI [-0.38, 0.48]	Not specified	Null pooled effect
Social-communication	All studies	24	$g = 0.35$, 95CI [0.18, 0.53]	Not specified	Positive pooled effect
RRB	All studies	7	$g = -0.01$, 95CI [-0.34, 0.32]	Not specified	Null pooled effect
Communication (language)	All studies	19	$g = 0.20$, 95CI [0.03, 0.38]	Not specified	Positive pooled effect
Cognition (cognitive)	All studies	9	$g = 0.26$, 95CI [0.01, 0.51]	Not specified	Positive pooled effect
Social emotional challenging behaviours	All studies	6	$g = 0.17$, 95CI [-0.28, 0.61]	Not specified	Null pooled effect
Play	All studies	6	$g = 0.33$, 95CI [0.13, 0.54]	Not specified	Positive pooled effect
Adaptive behaviour	All studies	6	$g = 0.16$, 95CI [-0.24, 0.56]	Not specified	Null pooled effect
Sensory-based Interventions					

Communication (language)	All studies	7	$g = 0.28, 95CI [-0.19, 0.76]$	Not specified	Null pooled effect
Treatment and Education of Autistic and related Communications Handicapped Children (TEACCH)					
Social-communication	All studies	6	$g = -0.11, 95CI [-0.93, 0.71]$	Not specified	Null pooled effect
Technology-based Interventions					
Social-communication	All studies	9	$g = 0.05, 95CI [-0.18, 0.27]$	Not specified	Null pooled effect
Social emotional/challenging behaviour	All studies	7	$g = 0.42, 95CI [-0.19, 1.03]$	Not specified	Null pooled effect

Sandbank et al. (2020b) – Meta-analysis

Outcome	Context		Studies included	Effect size	Heterogeneity	Categorised outcome
General outcomes	Summary across all outcomes and language measures		Not specified	RVE = 0.184, 95CI [0.075, 0.292]	$I^2 = 58.6\%$ $\tau^2 = 0.123$ $\tau = 0.351$	Positive pooled effect
Communication (composite language)	Intervention versus comparison		10	RVE = 0.284, 95CI [-0.0465, 0.614]	Not specified	Positive pooled effect
Expressive language	Intervention versus comparison		59	RVE = 0.18, 95CI [0.077, 0.283]	Not specified	Positive pooled effect
Receptive language	Intervention versus comparison		46	RVE = 0.135, 95CI [0.000, 0.269]	Not specified	Positive pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Child age	Combined across categories of intervention	Communication (language)	58	"Results from meta regression models that included participant characteristics suggested that chronological age at intervention onset did not moderate intervention effect sizes ($B = 0.03$, $p = .641$)."		Age not related to intervention effects on communication
Child characteristics: Core autism characteristics	Combined across categories of intervention	Communication (language)	27	"Autism symptomatology categorizations also did not moderate intervention effects: Significantly different effects were not observed for participant samples rated as "high symptomatology" compared		The level of overall autism characteristics prior to intervention not related to intervention

(autism symptomology)				to samples for which autism symptomatology was categorized as "moderate" ($B = 0.09$, $p = .639$)."	effects on communication.
Child characteristics: Communication (language age)	Combined across categories of intervention	Communication (language)	17	"Language age in months did significantly moderate intervention effects, such that higher mean language ages were associated with larger intervention effects ($B = 0.25$, $p = .010$). This result was significant even after correcting for multiple comparisons."	Greater language skills prior to intervention related to greater intervention effects on communication.
Intervention amount	Combined across categories of intervention	Communication (language)	60	"Results from the metaregression models that included intervention variables indicated that effect sizes were not moderated by intervention type (see Table 3) or by cumulative intervention intensity in hours."	Total hours not related to intervention effects on communication.
Intervention practice	Combined across categories of intervention	Communication (language)	60		Intervention category (behavioural, developmental, NDBI, sensory-based, TEACCH, technology-based, other) not related to intervention effects on communication.
Intervention agent	Combined across categories of intervention	Communication (effect size)	60	"However, interventionist was a significant moderator of effect sizes, when alpha was nominally set at .05. Results from the meta regression model that included the categorical variable of interventionist, with caregiver as the reference category, indicated that intervention effects were significantly larger for interventions	Intervention agent (clinician, caregiver, educator, technology, combination, other) not related to intervention effects on communication.

				<p>implemented by clinicians compared to caregivers alone ($B = 0.33$, $p = .044$) and marginally larger for those implemented by a combination of interventionists (e.g., caregivers and clinicians working together, $B = 0.26$, $p = .058$) compared to caregivers alone. However, when p values were corrected to account for multiple comparisons, they did not pass the significance threshold. Effect sizes for interventions implemented by other interventionist types (e.g., educator, computer mediated instruction) did not significantly differ from caregiver-implemented intervention effects. Figure 5 displays summary effects and confidence intervals by interventionist type.”</p>	
--	--	--	--	---	--

Schaaf et al. (2018) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Overall autism characteristics (autistic behaviours)	<p>“Moderate evidence supported improvements in impairment-level outcomes of improvement in autistic behaviors and skills-based outcomes of reduction in caregiver assistance with self-care activities.”</p> <p>Note that the authors use the following definition of moderate evidence: Moderate evidence: 1 RCT or 2 or more studies with lower levels of evidence with some inconsistency of findings in well-conducted studies also resulting in a designation of moderate evidence.</p>	Summarised inconsistent effect

Social-communication (caregiver assistance with social skills)	"Child outcomes in play, sensory–motor, and language skills and reduced caregiver assistance with social skills had emerging but insufficient evidence."	Summarised null effect
Sensory (sensory-motor)		Summarised null effect
Communication (language skills)		Summarised null effect
Play		Summarised null effect
Adaptive behaviour (functioning; reduction in caregiver assistance with self-care activities)	<p>"The evidence is strong that ASI intervention demonstrates positive outcomes for improving individually generated goals of <u>functioning</u> and participation as measured by Goal Attainment Scaling for children with autism."</p> <p>"Moderate evidence supported improvements in impairment-level outcomes of improvement in autistic behaviors and skills-based outcomes of reduction in caregiver assistance with self-care activities."</p>	Summarised inconsistent effect
Community participation (participation)	"The evidence is strong that ASI intervention demonstrates positive outcomes for improving individually generated goals of functioning and <u>participation</u> as measured by Goal Attainment Scaling for children with autism."	Summarised positive effect

Schoen et al. (2019) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
---------	---	---------------------

General outcomes	<p>“In Stage 3, the remaining three studies were rated using the CEC quality indicators and standards for an evidence-based practice. Two randomized controlled trials respectively met 100% and 85% of the CEC criteria items. One additional study met more than 50% of the criteria. Based on CEC criteria, ASI can be considered an evidence-based practice for children with autism ages 4–12 years old.”</p> <p>Note: For two of the three studies, the effect size of the main effect met the authors’ definition of not “a substantially important effect.”</p>	Summarised inconsistent effect
-------------------------	---	--------------------------------

Srinivasan et al. (2018) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication	"Overall, out of the 21 ES estimates we calculated only 3 ES had CI that did not include 0 (Table 2C). Taken together, there is limited evidence supporting the use of equine therapies for facilitating Social-communication skills in individuals with ASD."	Summarised inconsistent effect
Sensory	"Out of the total 56 ES calculated from data presented in the 4 studies, 42 ES were significant (CI did not include 0, see Table 2C). Overall, the review suggests promising positive (small to large sized) effects of equine therapies on sensory skills in ASD."	Summarised positive effect
Cognition (cognitive)	"Only 1 Level I study (Borgi et al., 2016) assessed the effects of a 6-month equine therapy intervention on cognitive skills, specifically executive functioning and found that compared to a waitlist control group children with ASD reduced the latency of their first move (ES = 0.76, but CI includes 0) during a problem solving task following THR."	Summarised null effect
Motor	"Although 43 of the 44 calculated ES in this set of studies reported ES that were significantly different from 0 at a 95% CI, note that the Wuang study alone contributed to around 40 ES estimates (Table 2C). Taken together, presently there is only weak evidence for positive treatment effects (varying in magnitude from small to large) of equine therapy on motor skills"	Summarised inconsistent effect
Social emotional/challenging behaviour (behavioural skills)	"Our own calculations suggested that out of the 19 ES computed for behavioral skills, the CI of 11 ES did not include 0 (Table 2C). Overall, current literature provides modest evidence for the use of equine therapies to alleviate behavioral impairments in ASD"	Summarised inconsistent effect
Quality of life	"While large improvements (ES range = 2.05 – 2.43) were found on the custom-developed QOL questionnaire following a 3-month THR intervention, the other two studies reported lack of definitive improvements in QOL of subjects due to the equine interventions provided (Lanning et al., 2014; Kern et al., 2011). Moreover, out of the total 7 ES calculated from these studies, the CI of only 2 ES did not include 0 (Table 2C)...To summarize, the current state of literature in this	Summarised inconsistent effect

	field does not allow us to comment on the effect of equine therapy on QOL and functional participation of individuals with ASD.”	
Community participation (functional participation)	“In terms of functional participation, following a 3-month HIP intervention, children increased their participation (ES range: 0.62–0.81) in age-appropriate leisure and self-care activities on the Child Activity Card Sort test (Ajzenman et al., 2011) (Note: our ES estimates based on data from the report are more conservative and CI of ES include 0, see Tables 2B & 2C).”	Summarised inconsistent effect

Steinbrenner et al. (2020) – Narrative synthesis¹

Outcome	Verbatim summary from systematic review	Categorised outcome
Discrete Trial Training (DTT)		
Social-communication (social)	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Social-communication (joint attention)	Positive effect for toddlers, pre-schoolers, and Elementary School.	Summarised positive effect
Communication	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Cognition (cognitive)	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for Elementary School.	Summarised positive effect
Play	Positive effect for pre-schoolers, and Elementary School.	Summarised positive effect

Adaptive behaviour (adaptive/self-help)	Positive effect for pre-schoolers, and Elementary School.	Summarised positive effect
School/ Learning Readiness	Positive effect for toddlers.	Summarised positive effect
Academic	Positive effect for pre-schoolers, and Elementary School.	Summarised positive effect
Functional Communication Training		
Social-communication (social)	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Communication	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Play	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Adaptive behaviour (adaptive/self-help)	Positive effect for pre-schoolers, Elementary School, and High School.	Summarised positive effect
School/ learning readiness	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Naturalistic Teaching Strategies		
Social-communication (social)	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Social-communication (joint attention)	Positive effect for toddlers, pre-schoolers, and Elementary School.	Summarised positive effect

Communication	Positive effect for toddlers, pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
Cognition (cognitive)	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Motor	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Play	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Adaptive behaviour (adaptive/self-help)	Positive effect for toddlers, and pre-schoolers.	Summarised positive effect
School/learning readiness	Positive effect for toddlers, pre-schoolers, and Elementary School.	Summarised positive effect
Academic	Positive effect for toddlers, and pre-schoolers.	Summarised positive effect
Auditory Integration Training		
General outcomes	Identified as having 'insufficient' evidence.	Summarised null effect
Ayres Sensory Integration (ASI)		
Social-communication (social)	Positive effect for pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
Communication	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Cognition (cognitive)	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect

Motor	Positive effect for pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
Adaptive behaviour (adaptive/self-help)	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Academic	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Music Therapy		
Social-communication (social)	Positive effect for pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
Communication	Positive effect for toddlers, pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
Motor	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Play	Positive effect for pre-schoolers.	Summarised positive effect
Adaptive behaviour (adaptive/self-help)	Positive effect for toddlers.	Summarised positive effect
School/learning readiness	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Sensory Diet		

General outcomes	Identified as having 'insufficient' evidence.	Summarised null effect
Technology-based Interventions		
Social-communication (social)	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Social-communication (joint attention)	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Communication	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Cognition (cognitive)	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Motor	Positive effect for toddlers, pre-schoolers, and Elementary School.	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
Play	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Adaptive behaviour (adaptive/self-help)	Positive effect for toddlers, pre-schoolers, and Elementary School.	Summarised positive effect
School/learning readiness	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect

Academic

Positive effect for pre-schoolers, Elementary School, Middle School, and High School.

Summarised positive effect

Augmentative and Alternative Communication (AAC)		
Social-communication (social)	Positive effect for toddlers, pre-schoolers, Elementary School, and High School.	Summarised positive effect
Social-communication (joint attention)	Positive effect for toddlers, pre-schoolers, and Elementary School.	Summarised positive effect
Communication	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Motor	Positive effect for High School.	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Play	Positive effect for toddlers, pre-schoolers, and Elementary School.	Summarised positive effect
Academic	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Animal-assisted Interventions		
General outcomes	Identified as having 'insufficient' evidence.	Summarised null effect
Cognitive behavioural/instructional Strategies		
Social-communication (social)	Positive effect for Elementary School, Middle School, and High School.	Summarised positive effect
Communication	Positive effect for Elementary School, Middle School, and High School.	Summarised positive effect
Cognition (cognitive)	Positive effect for Elementary School, and Middle School.	Summarised positive effect

Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for Elementary School, Middle School, and High School.	Summarised positive effect
Adaptive behaviour (adaptive/self-help)	Positive effect for Elementary School, Middle School, and High School.	Summarised positive effect
School/learning readiness	Positive effect for Elementary School, Middle School, and High School.	Summarised positive effect
Academic	Positive effect for Elementary School, Middle School, and High School.	Summarised positive effect
Social Skills Training		
Social-communication (social)	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Communication	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Cognition (cognitive)	Positive effect for pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Play	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Adaptive behaviour (adaptive/self-help)	Positive effect for Elementary School, Middle School, and High School.	Summarised positive effect
School/learning readiness	Positive effect for Elementary School and Middle School.	Summarised positive effect

Parent-implemented/mediated		
Social-communication (social)	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Social-communication (joint attention)	Positive effect for toddlers and pre-schoolers.	Summarised positive effect
Communication	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Cognition (cognitive)	Positive effect for toddlers, pre-schoolers.	Summarised positive effect
Motor	Positive effect for toddlers, pre-schoolers.	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for toddlers, pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Play	Positive effect for toddlers, pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
Adaptive behaviour (adaptive/self-help)	Positive effect for toddlers, pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
School/learning readiness	Positive effect for toddlers, pre-schoolers, and Elementary School.	Summarised positive effect
Academic	Positive effect for toddlers, pre-schoolers.	Summarised positive effect
Peer-mediated/implemented		
Social-communication (social)	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect

Social-communication (joint attention)	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Communication	Positive effect for pre-schoolers, Elementary School, Middle School, and High School.	Summarised positive effect
Cognition (cognitive)	Positive effect for Elementary School and Middle School	Summarised positive effect
Social emotional/challenging behaviour (challenging/interfering behaviour)	Positive effect for Elementary School	Summarised positive effect
Play	Positive effect for pre-schoolers, Elementary School, and Middle School.	Summarised positive effect
School/learning readiness	Positive effect for pre-schoolers and Elementary School.	Summarised positive effect
Academic	Positive for Elementary School, Middle School, and High School.	Summarised positive effect

¹ This systematic review only reported positive outcomes with no data presented for inconsistent/null findings.

Sutherland et al. (2018) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Communication	"Communication. Eight studies reported on communication outcomes (Baharav & Reiser, 2010; Boisvert et al., 2012; Ingersoll et al., 2016; Meadan et al., 2016; Pickard et al., 2016; Ruble et al., 2013; Wainer & Ingersoll, 2014). Positive impacts on communication, including improved initiations and responses, as measured through formal and observation measures were reported by Baharav and Reiser (2010). Similarly, the Boisvert et al. (2012) study reported better use of transition words after telehealth therapy compared with baseline and that the students' performance was more consistent in telehealth condition compared with face to face condition.	Summarised inconsistent effect

	<p>Ingersoll et al. (2016) used structured observations as well as standardised questionnaires and found that both groups (self directed online learning and therapist assisted online learning) showed improvements, with the therapist assisted group showing significant increases in their standard scores on the social domain of the Vineland Adaptive Behaviour Scales – 2nd edition while children in the self-directed condition did not. Pickard et al. (2016), in their article about the same study as described by Ingersoll et al. (2016), reported that parents in the therapist assisted group were more likely to report gains in Social-communication than the self-directed condition parents. Ruble et al. (2013) used “Psychometrically Equivalence Tested Goal Attainment Scaling (PET - GAS)” to measure outcomes across a wide range of individual communication, social and learning goals for 49 teacher– child dyads. Results showed similar mean PET -GAS change when comparing the face to face coaching with telehealth coaching and that both groups were better than the non-coached group. The communication outcomes were less robust for the three children in the Meadan et al. (2016) with the authors suggesting there were “no clear results across dyads for children’s communication behaviour in the multiple-baseline analysis”</p>	
Social emotional/ challenging behaviour (behaviour)	<p>“Behaviour. Lindgren et al. (2016) used FA and FCT to reduce challenging behaviour, and found that the mean percentage reduction in problem behaviour was more than 90% for the three groups (home based, centre based telehealth and homebased telehealth). Suess et al. (2016) also reported on a reduction in problem behaviours following telehealth training and coaching.”</p>	Summarised positive effect
Caregiver satisfaction (satisfaction and acceptability)	<p>“Satisfaction and acceptability. Parent satisfaction was a reported outcome for nine of the 14 studies (Baharav & Reiser, 2010; Hepburn et al., 2016; Ingersoll & Berger, 2015; Meadan et al., 2016; Pickard et al., 2016; Reese, Braun, et al., 2015; Schutte et al., 2015; Suess et al., 2016; Wainer & Ingersoll, 2015). All studies reported high levels of programme acceptability and parent satisfaction with the telehealth component of the intervention or assessment. In addition, two studies that involved direct telehealth involvement with individuals on the spectrum (Hepburn et al., 2016; Schutte et al., 2015) reported high participant satisfaction with the methods used.”</p>	Summarised positive effect
Caregiver communication and interaction (fidelity)	<p>“The remaining studies reported high levels of parent fidelity for interventions provided via telehealth (Hepburn et al., 2016; Ingersoll et al., 2016), with a number reporting that the fidelity of programmes taught to parents online was improved when telehealth coaching was provided (Ingersoll & Berger, 2015; Meadan et al., 2016; Wainer & Ingersoll, 2015).”</p>	Summarised positive effect

Tachibana et al. (2018) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Overall autism characteristics (autism general symptoms)	Individual intervention (Analysis I)	3	SMD = -0.31, 95CI [-0.63, 0.01]	I ² = 0%	Null pooled effect
Social-communication (qualitative impairment in social interaction)	Individual intervention (Analysis I)	2	SMD = -0.15, 95CI [-0.40, 0.10]	I ² = 0%	Null pooled effect
Social-communication (reciprocity of social interaction towards others)	Individual intervention (Analysis I)	5	SMD = 0.59, 95CI [0.25, 0.93]	I ² = 18%	Positive pooled effect
	Group intervention (Analysis I)	3	SMD = 0.45, 95CI [0.02, 0.88]	I ² = 18%	Positive pooled effect
Social-communication (initiating joint attention)	Individual intervention (Analysis I)	4	SMD = 0.48, 95CI [-0.14, 1.10]	I ² = 78%	Null pooled effect
	Group intervention (Analysis I)	2	SMD = 0.15, 95CI [-0.38, 0.68]	I ² = 15%	Null pooled effect
Social-communication (imitation)	Individual intervention (Analysis I)	Not specified	SMD = 0.54, 95CI [-0.25, 1.33]	I ² = 62%	Null pooled effect
Social-communication (responding to joint attention)	Individual intervention (Analysis I)	3	SMD = 0.63, 95CI [-0.14, 1.39]	I ² = 97%	Null pooled effect
RRB (restricted repetitive and stereotyped patterns)	Individual intervention (Analysis I)	3	SMD = -0.21, 95CI [-0.52, 0.09]	I ² = 39%	Null pooled effect

behaviours, interests and activities)					
Communication (qualitative impairment in communication)	Individual intervention (Analysis I)	1	SMD = -0.03, 95CI [-0.35, 0.29]	N/A	Null pooled effect
Expressive language	Individual intervention (Analysis I)	7	SMD = 0.13, 95CI [-0.06, 0.33]	I ² = 0%	Null pooled effect
	Group intervention (Analysis I)	1	SMD = -0.03, 95CI [-0.54, 0.48]	N/A	Null pooled effect
Receptive language	Individual intervention (Analysis I)	7	SMD = 0.17, 95CI [-0.09, 0.42]	I ² = 28%	Null pooled effect
	Group intervention (Analysis I)	1	SMD = 0.14, 95CI [-0.65, 0.37]	N/A	Null pooled effect
Cognition (developmental quotient)	Individual intervention (Analysis I)	4/5 ¹	SMD = 0.36, 95CI [0.05, 0.66]	I ² = 20%	Positive pooled effect
Adaptive behaviour	Individual intervention (Analysis I)	7	SMD = -0.05, 95CI [-0.25, 0.14]	I ² = 39%	Null pooled effect
	Group intervention (Analysis I)	1	SMD = 0.44, 95CI [-0.07, 1.65]	N/A	Null pooled effect
Caregiver communication and interaction (parental synchrony)	Individual Intervention (Analysis I)	3	SMD = 0.99 [0.70, 1.29]	N/A	Positive pooled effect

Caregiver social emotional wellbeing (parenting stress)	Individual intervention (Analysis I)		2	SMD = -0.30, 95CI [-0.93, 0.32]	I ² = 0%	Null pooled effect
	Group intervention (Analysis I)		2	SMD = -0.29, 95CI [-0.81, 0.22]	I ² = 0%	Null pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Intervention format	Individual, group	Core autism characteristics (autism general symptoms), social-communication (reciprocity of social interaction towards others), expressive language, receptive language, cognition (developmental quotient), adaptive behaviour	Not specified	"The results suggested that the two intervention methods did not have significantly different effects on autism general symptoms. The results of the main analyses also suggested that the two intervention types did not have significantly different effects on other secondary outcomes (developmental quotient, expressive language, receptive language, reciprocity of social interaction towards others, and adaptive behaviour)."		Intervention format (individual, group) did not relate to intervention effects on Overall autism characteristics, social-communication, expressive language, receptive language, cognition, or adaptive behaviour.

¹Both numbers reported.

Tarver et al. (2019) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Social emotional/challenging behaviour	Parent-reported disruptive behaviour	9	SMD = 0.67, 95CI [0.49, 0.85]	I ² = 0%	Positive pooled effect
	Parent-reported hyperactivity	3	SMD = 0.31, 95CI [0.07, 0.56]	I ² = 0%	Positive pooled effect
Caregiver social emotional wellbeing (parenting stress)	-	7	SMD = 0.37, 95CI [0.17, 0.57]	I ² = 0%	Positive pooled effect
Caregiver social emotional wellbeing (parenting efficacy)	-	5	SMD = 0.39, 95CI [-0.17, 0.95]	I ² = 81%	Null pooled effect

Tiede & Walton (2019) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Overall autism characteristics (symptoms of ASD)	-	9	g = -0.38, 95CI [-0.71, -0.04]	Q = 26.1 I ² = 67%	Positive pooled effect
Social-communication (joint attention)	Initiating joint attention	15	g = 0.14, 95CI [-0.01, 0.28]	Q = 16.0 I ² = 7%	Null pooled effect
Social-communication (social engagement)	-	12	g = 0.65, 95CI [0.37, 0.93]	Q = 34.2 I ² = 64%	Positive pooled effect

Expressive language	-		12	$g = 0.32$, 95CI [0.07, 0.56]	$Q = 22.9$ $I^2 = 54\%$	Positive pooled effect
Receptive language	-		10	$g = 0.28$, 95CI [-0.02, 0.58]	$Q = 24.9$ $I^2 = 64\%$	Positive pooled effect
Cognition (cognitive development)	Composite IQ		5	$g = 0.48$, 95CI [0.22, 0.74]	$Q = 5.3$ $I^2 = 30\%$	Positive pooled effect
Cognition (nonverbal IQ)	-		7	$g = 0.21$, 95CI [0.01, 0.41]	$Q = 6.1$ $I^2 = <1\%$	Positive pooled effect
Play	-		8	$g = 0.23$, 95CI [0.04, 0.41]	$Q = 7.7$ $I^2 = 11\%$	Positive pooled effect
Adaptive behaviour	-		5	$g = 0.09$, 95CI [-0.24, 0.42]	$Q = 9.1$ $I^2 = 56\%$	Null pooled effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review		Categorised outcome
Intervention amount	-	Joint attention, adaptive behaviour, expressive language, receptive language, cognitive development, overall autism characteristics,	Not specified	<p><i>Joint attention:</i> "Dosage significantly moderated the results such that increased hours of professional contact resulted in more positive joint attention outcomes ($\beta = 0.17$ $p = 0.02$, 95% CI = 0.02 to 0.32."</p> <p><i>Adaptive behaviour:</i> "A marginally significant effect was found for dosage; more professional</p>		Greater total hours related to greater intervention effect on joint attention. Total hours of intrervention not

		social engagement, play		<p>contact hours were associated with more positive findings ($\beta = 0.30$, $p = 0.06$, 95% CI = -0.02 to 0.62)."</p> <p><i>Expressive language:</i> "Dosage did not moderate effects ($\beta = 0.09$, $p = 0.35$, 95% CI = -0.10 to 0.29)."</p> <p><i>Receptive language:</i> When study quality and dosage were added as moderators, neither dosage ($\beta = 0.15$, $p = 0.35$, 95% CI = -0.16 to 0.46) nor study quality ($\beta = -0.28$, $p = 0.36$, 95% CI = -0.87 to 0.32) significantly moderated the effects.</p> <p><i>Cognitive development:</i> "Dosage ($\beta = 0.06$, $p = 0.79$, 95% CI = -0.36 to 0.47) and study quality ($\beta = -0.09$, $p = 0.80$, 95% CI = -0.82 to 0.63) did not significantly moderate the effects."</p> <p><i>Overall autism characteristics:</i> "Neither dosage ($\beta = 0.13$, $p = 0.54$, 95% CI = -0.28 to 0.54) nor study quality ($\beta = -0.07$, $p = 0.86$, 95% CI = -0.89 to 0.74) moderated the results."</p>	related to intervention effect on adaptive behaviour expressive or receptive language, cognitive development, Overall autism characteristics, social engagement, or play.
--	--	-------------------------	--	---	---

				<p><i>Social engagement:</i> “Neither dosage ($\beta = 0.17$, $p = 0.20$, 95% CI = -0.09 to 0.44) nor study quality ($\beta = 0.25$, $p = 0.42$, 95% CI = -0.36 to 0.85) moderated the results.”</p> <p><i>Play:</i> “Dosage did not significantly moderate the results ($\beta = -0.11$, $p = 0.21$, 95% CI = -0.27 to 0.06”</p>	
--	--	--	--	---	--

Treurnicht Naylor et al. (2011) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Social-communication (cognitive functioning and Social-communication)	“Buday et al. showed that children exposed to recorded music were more likely to remember and imitate signed and spoken words compared with those given rhythm cues. The difference, however, amounted to an average of only one word [35]. Kim et al. examined improvisational music therapy versus play sessions on joint attention behaviors in autistic boys [36]. A large and significant effect size was found for the Early Social-communication Scales—a structured assessment of individual differences in nonverbal communication skills [54]—driven by positive impacts of music therapy on quality and quantity of eye contact and turn-taking behaviors relative to gesturing and behaviors indicating intent.”	Summarised positive effect
Adaptive behaviour	“No significant difference was found using the Pervasive Developmental Disorder Behavior Inventory [55]—a pediatric measure of maladaptive and adaptive behavior [36].”	Summarised null effect

Outcome	Context	Studies included	Verbatim summary from systematic review		Categorised outcome
General outcomes (socialization, engagement, maladaptive behaviours, reaction time in problem-solving situations)	-	13	<p>"Only Jenkins et al²³ found no evidence for statistically significant</p> <p>beneficial impact of TR on the affect, linguistic competence, spontaneous initiations, or problem behavior of autistic children. Given the</p> <p>results of their study, these authors believe that TR should be treated as</p> <p>a leisure activity rather than therapy. However, we are of the opinion that their study, being only a single report, should not belittle the significance of the evidence on the beneficial effects of EAAT."</p>		Summarised inconsistent effect
			Effect size	Heterogeneity	
Social-communication (social)	-	3	SMD = .220, 95CI [-.130, .580]	Chi ² = 0.55 I ² = 0.0%	Null pooled effect
Communication	-	3	SMD = .191, 95CI [-.165, .547]	Chi ² = 0.48 I ² = 0.0%	Null pooled effect
Adaptive behaviour	-	3	SMD = .742, 95CI [-.010, 1.494]	Chi ² = 5.87 I ² = 66.0%	Null pooled effect

Tupou et al. (2019) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
General outcomes (child outcomes)	[single case design studies] "Due to the wide variety of outcomes measured across the nine single-case design studies, it is not possible to make direct comparisons. Results were coded as positive for five studies (Gibson et al.2010; Harjusola-Webb and Robbins 2012; Kernetal 2007; McBride and Schwartz 2003; Olive et al. 2007). Mixed results or minimal improvements were reported in four studies (Fleury and Schwartz 2017; Garfinkle and Schwartz 2002; Kern and Aldridge 2006; Van Der Heyden et al. 2002). For example, Kern and Aldridge (2006) reported positive results across all participants, but for only two of the three intervention phases and Fleury and Schwartz (2017) reported minimal improvement in child verbal initiations, but positive results for all other measured child outcomes."	Summarised inconsistent effect
Overall autism characteristics (autism severity and/or symptoms)	[group design studies only] "Four (57%) of the seven group studies reported on measures of autism severity and/or symptoms (D'Elia et al. 2014; Eikeseth et al. 2012; Strain and Bovey 2011; Young et al. 2016) using the Autism Diagnostic Observation Schedule (ADOS; Lord et al.2008), or the Childhood Autism Rating Scale (CARS; Schopleretal. 2002). D'Elia et al. (2014) reported decreases in autism diagnoses across both EGs and CGs, as measured by the ADOS, with a larger decrease observed in the EG. Similarly, in the study by Strain and Bovey (2011), the EG demonstrated a greater decrease in CARS scores than the CG. The Eikeseth study (2012) reported a significant decrease in CARS scores for the EG, but did not report comparison data for the CG. The authors of the final study (Young et al.2016) did not report any significant change in CARS scores."	Summarised positive effect
Social-communication (social skills)	[group design studies only] "Two (29%) of the group studies (Strain and Bovey 2011; Young et al. 2016) reported on social skills, which were measured via the Social Skills Rating System (SSRS; Gresham and Elliott 1990) and the Autism Screening Instrument for Educational Planning (ASIEP; Krug et al.2008). Both studies reported positive results, with the EG making greater improvements than the CG in both cases"	Summarised positive effect

Communication (communication and/or language)	<p>[group design studies only] "Child communication and/or language was measured in five (71%) of the group studies (Boulware et al. 2006; D'Elia et al. 2014; Fleury and Schwartz 2017; Strain and Bovey 2011; Young et al. 2016) via a range of different instruments including (a) Communication, Social, and Symbolic Behavior Scales (CSBS; Wetherby and Prizant 2002); (b) MacArthur Communication Developmental Inventories (CDI; Fenson et al. 1993; Fenson et al. 1994); (c) Preschool Language Scale (PLS; Zimmerman et al. 1991); (d) Expressive One Word Picture Vocabulary Test (EOWPVT; Brownell 2000a); (e) Receptive One Word Picture Vocabulary Test (ROWPVT; Brownell 2000b); and (f) a researcher-delivered book vocabulary assessment (Fleury and Schwartz 2017). Participants demonstrated improvement on at least one communication/language outcome across all five of these studies."</p>	<p>Summarised positive effect</p>
Cognition (cognition or educational strengths)	<p>[group designs only] "Aspects of child cognition or educational strengths and weaknesses were reported as outcomes in four (57%) of the group studies (D'Elia et al. 2014; Eldevik et al. 2012; Strain and Bovey 2011; Young et al. 2016). Intellectual functioning was measured in one study (Eldevik et al. 2012) using the Bayley Scales of Infant Development (BSID; Bayley 2006) for participants younger than 42 months of age, and the Stanford-Binet Intelligence Scale (Thorndike et al. 1986) for participants older than 42 months. Overall, the EG made significantly greater gains than the CG on composite scores for both instruments. Another study (D'Elia et al. 2014) measured psycho-educational skills using the Psychoeducational Profile: Third Edition (PEP-3; Schopler et al. 2005) and found that EG participants made significant improvements over time across most categories. Finally, child cognitive development was measured in two (29%) of the seven group studies (Strain and Bovey 2011; Young et al. 2016) using the Mullen Scales of Early Learning (Mullen 1995) and the cognitive domain of the Bayley Scales of Infant Development (BDI; Bayley 2006). In the Strain and Bovey (2011) study, EG scores were significantly higher than CG scores after intervention; however, no significant change in scores was reported in the Young et al. study."</p>	<p>Summarised inconsistent effect</p>
Social emotional/challenging behaviour (adaptive/maladaptive behaviour)	<p>[group design studies only] "Five (71%) of these group design studies that measured adaptive/maladaptive behavior reported positive results (Boulware et al. 2006; D'Elia et al. 2014; Eikeseth et al. 2012; Eldevik et al. 2012; Strain and Bovey 2011), while the remaining study was coded as having no effect because there were no significant changes in participant scores for the EG (Young et al. 2016)."</p>	<p>Summarised positive effect</p>

Adaptive behaviour (functional skills)

[group design studies only] "Functional skills were measured as outcomes in two (29%) of the group studies (Boulware et al. 2006; Schwartz et al. 2004) and were assessed using (a) Bayley Scales of Infant Development (Bayley 2006); (b) Assessment, Evaluation, and Programming System for Infants and Children (AEPS; Bricker 1994); (c) a researcher-developed functional outcomes index (Schwartz et al. 2004); and (d) a researcher developed functional outcomes scale (Boulware et al. 2006). Participating children from both studies demonstrated gains across at least one functional outcome, and participants from the Schwartz et al. (2004) study made gains across all six of the functional outcomes measured."

Summarised positive effect

Verschuur et al. (2014) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
General outcomes (child behaviours)	“Of the 35 studies targeting child behaviors, 15 studies (42.9 %) reported positive outcomes and 20 studies (57.1 %) reported mixed outcomes.” [Outcomes include communication and language skills; play skills; adaptive functioning; maladaptive behaviours; autism symptoms]	Summarised inconsistent effect
Caregiver social emotional wellbeing (caregiver behaviours)	“Of the 13 studies targeting caregiver behaviors, 7 studies (53.8 %) reported positive outcomes and 5 studies (38.5 %) reported mixed outcomes.” [Outcomes include caregiver fidelity of implementation of PRT/NLP; parental stress; parental affect; parental self-efficacy; parent verbalisations]	Summarised inconsistent effect

Virués-Ortega (2010) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
Social-communication (socialisation)	-	11	Inverse-variance weighted random-effects meta-analysis: ES = 0.95, 95CI [0.53, 1.37]	$I^2 = 66\%$	Positive pooled effect
Communication	-	11	Inverse-variance weighted random-effects meta-analysis: ES = 1.45, 95CI [1.02, 1.88]	$I^2 = 68\%$	Positive pooled effect
Communication (general language skills)	-	6 intervention groups from 5 studies	Inverse-variance weighted random-effects meta-analysis:	$I^2 = 86\%$	Positive pooled effect

			ES = 1.07, 95CI [0.34, 1.79]		
Expressive language	-	10 intervention groups from 9 studies	Inverse-variance weighted random-effects meta-analysis: ES = 1.47, 95CI [0.85, 2.08]	I ² = 80%	Positive pooled effect
Receptive language	-	11 intervention groups from 10 studies	Inverse-variance weighted random-effects meta-analysis: ES = 1.48, 95CI [0.96, 1.97]	I ² = 81%	Positive pooled effect
Cognition (IQ)	Overall	20 intervention groups from 19 studies	Inverse-variance weighted random-effects meta-analysis: ES = 1.19, 95CI [0.91, 1.47]	I ² = 75%	Positive pooled effect
	Clinic-based programs	16 intervention groups from 15 studies	Inverse-variance weighted random-effects meta-analysis: ES = 1.23, 95CI [0.95, 1.51]	-	Positive pooled effect
	Parent-managed programs	4	Inverse-variance weighted random-effects meta-analysis:	-	Positive pooled effect

			ES = 1.02, 95CI [0.12, 1.93]		
Cognition (non-verbal IQ)	-	11 intervention groups from 10 studies	Inverse-variance weighted random-effects meta-analysis: ES = 0.65, 95CI [0.17, 1.13]	I ² = 78%	Positive pooled effect
Motor	-	3	Inverse-variance weighted random-effects meta-analysis: ES = 0.71, 95CI [0.19, 1.22]	I ² = 0%	Positive pooled effect
Adaptive behaviours	Overall	16 intervention groups from 14 studies	Inverse-variance weighted random-effects meta-analysis: ES = 1.09, 95CI [0.70, 1.47]	I ² = 68%	Positive pooled effect
	Clinic-based programs	12 intervention groups from 11 studies	Inverse-variance weighted random-effects meta-analysis: ES = 1.17, 95CI [0.70, 1.47]	-	Positive pooled effect
	Parent-managed programs	4 intervention groups from 3 studies	Inverse-variance weighted random-effects meta-analysis:	-	Positive pooled effect

				ES = 0.97, 95CI [0.61, 1.739]	
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review	Categorised outcome
Intervention amount	-	Cognition (IQ), Communication (language), Adaptive behaviour (adaptation)	Cognition (IQ): 19 Communication (language): 4 Adaptive behaviour (adaptation): 17	<p><i>Cognition (IQ)</i>: "Dose-response meta-analysis of studies' total treatment duration suggested that high total treatment duration did not improve treatment gains above average levels (Fig. 3)."</p> <p><i>Communication (language)</i>: "Both results for receptive and expressive language demonstrated clear dose-response trends for intervention total duration (Fig. 3)."</p> <p><i>Adaptive behaviour (adaptation)</i>: "Dose-response meta-analyses demonstrated a clear increase in effect sizes by treatment total duration (Fig. 3)."</p>	Greater total hours related to greater intervention effect on language and adaptive behaviour, but not cognition.

Waddington et al. (2016) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
General outcomes (child behavioural functioning and development)	<p>"The four articles using the CBRS (*Vismara et al. 2009a, b; *Vismara et al. 2013a; *Vismara et al. 2008, and the one article (*Fulton et al. 2014) using the ESDM behavior rating scale reported positive results on these measures. Results from articles using the VABS, the MSEL, and the MCDI were mixed. Two articles found positive results for the overall VABS (*Dawson et al. 2010; *Estes et al. 2015), while three articles reported negative results (*Eapen et al. 2013; *Fulton et al. 2014; *Vivanti et al. 2014). Five articles reported positive results for the overall MSEL (*Dawson et al. 2010; *Eapen et al. 2013; *Fulton et al. 2014; *Vivanti et al. 2013; *Vivanti et al. 2014), while one (*Rogers et al. 2012) reported negative results. Two articles reported positive results for the MCDI (*Vismara et al. 2012; *Vismara et al. 2013a), while one article reported negative results (*Rogers et al. 2012). Results for the remaining measures were negative."</p>	Summarised positive effect
Overall autism characteristics (autism severity and core diagnostic outcomes)	<p>"Seven articles (*Dawson et al. 2010; *Estes et al. 2015; *Eapen et al. 2013; *Fulton et al. 2014; *Rogers et al. 2012; *Vivanti et al. 2013; *Vivanti et al. 2014) reported on autism severity using either the ADOS (Lord et al. 2002) or the Social-communication Questionnaire (SCQ; Berument et al. 1999). Of the five articles using the ADOS (*Dawson et al. 2010; *Estes et al. 2015; *Rogers et al. 2012; *Vivanti et al. 2013; *Vivanti et al. 2014), only one reported positive results following intervention (*Estes et al. 2015). Of the articles using the SCQ, one reported positive results (*Eapen et al. 2013), and the other negative results (*Fulton et al. 2014) following intervention. Three articles (*Dawson et al. 2010; *Estes et al. 2015; *Vismara et al. 2008) reported on participants' change in diagnosis from ASD to PDD-NOS or Bno diagnosis^ following intervention. Two articles reported positive results in this regard (*Dawson et al. 2010; *Vismara et al. 2008), while *Estes et al. (2015) reported negative results."</p>	Summarised null effect
Social-communication (social interaction and communication)	<p>"Six articles reported at least one child outcome measure that was based on direct observation of the child's social interaction and communication skills (*Rogers et al. 2012; *Vismara et al. 2012; *Vismara et al. 2009a; *Vismara et al. 2013a; *Vismara et al. 2008; *Vismara et al. 2012). These measures included spontaneous verbal utterances, imitation skills, social orienting, and joint attention. All articles reported positive results for these outcome measures, with the exception of</p>	Summarised positive effect

	*Vismara et al. (2009b) and *Rogers et al. (2012) who found negative results on a measure of imitation skills. *Rogers et al. (2012) also found negative results on a measure of social orienting and joint attention following intervention."				
Caregiver communication and interaction (fidelity to intervention)	"Six articles (*Rogers et al. 2012; *Vismara et al. 2012; *Vismara et al. 2009a, b; *Vismara et al. 2013a; *Vismara et al. 2008) included a measure related to the extent to which parents implemented ESDM therapy correctly. Five articles (*Vismara et al. 2012; *Vismara et al. 2009a, b; *Vismara et al. 2013a; *Vismara et al. 2008) reported positive results in that the majority of parents (at least five out of eight) achieved an acceptable level of treatment integrity (80 % correct implementation) within six to eight sessions. However *Rogers et al. (2012) reported negative results with no significant differences in scores for treatment integrity in the ESDM group compared with the TAU group."				Summarised positive effect
Caregiver social emotional wellbeing (parental stress and sense of competence)	"Three articles (*Estes et al. 2014; *Vismara et al. 2012; *Vismara et al. 2013a) reported on additional parent outcome measures including the Maternal Behavior Rating Scale (MBRS; Mahoney et al. 1998), the Questionnaire of Resources and Stress (QRS; Konstantareas et al. 1992), and the Parenting Sense of Competence Questionnaire (PSOC; Johnston and Mash 1989). Positive results were reported for the MBRS and the QRS, but negative results were reported in the PSOC (*Estes et al. 2014)."				Summarised positive effect
Caregiver satisfaction (social validity)	"Five articles (*Fulton et al. 2014; *Vismara et al. 2012; *Vismara et al. 2013a, b; *Vismara et al. 2009b) reported positive results on a measure of feasibility, acceptability, or satisfaction with the intervention. *Rogers et al. (2012) also reported positive results on a measure of working alliances between parents and therapists."				Summarised positive effect
Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review	Categorised outcome
Child characteristics	No meta-analysis, narrative review only	Unspecified intervention outcomes	2	"Rogers et al. (2012) found that nonsocial orienting was a significant predictor of increased scores on the MSEL and decreased	Greater pre-intervention imitation was

				<p>ADOS social affect scores when both the ESDM and TAU groups were combined and that social orienting was a significant predictor of reduced ADOS restricted and repetitive behavior scores. However, contrary to their hypothesis, imitation skills were not a significant predictor of treatment outcomes. In contrast, *Vivanti et al. (2013) found that scores in an imitation task were a significant predictor of positive intervention outcomes, as well as functional object use, and goal understanding."</p>	<p>inconsistently related to intervention effects. Functional use of objects, and goal understanding related to greater intervention effects. Pre-intervention cognitive ability and social attention not related to intervention outcomes.</p>
Child age	No meta-analysis, narrative review only	MSEL scores	2	<p>"*Rogers et al. (2012) found that higher number of hours of intervention when both the ESDM and TAU groups were combined, predicted significantly better scores on the ADOS, MSEL, MCDI and Nonsocial orienting measures. They also found that chronological age negatively predicted MSEL scores after intervention. These results suggest that higher intervention hours and lower chronological age predicted better intervention outcomes in this sample. However, *Vivanti et al. (2013) found that intensity of treatment and chronological age</p>	<p>Child age inconsistently related to intervention effects.</p>
Intervention amount	No meta-analysis, narrative review only	Scores on the ADOS, MSEL, MCDI and Nonsocial orienting measures.	2		<p>Total hours of intervention inconsistently related to intervention effects.</p>

				did not predict treatment outcomes in a group of 21 children receiving group ESDM therapy.”	
--	--	--	--	---	--

Watkins et al. (2019) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome
General outcomes	Single case experimental designs	25	Tau-U = 0.91, 95CI [0.97, 0.99]	Q = 544.69 I ² = 93.94%	Positive pooled effect
Social-communication	Single case experimental designs	20	Tau-U = 0.94, 95CI [0.87, 0.97]	Q = 84.57 I ² = 79.90%	Positive pooled effect
RRB	Single case experimental designs	2	Tau-U = .99 [SD = .01] NAP = .99 [SD = .00]	Not specified	Positive pooled effect
Social emotional/challenging behaviour (classroom behaviour, challenging behaviour, and repetitive behaviour)	Single case experimental designs	15 effect sizes from 11 studies	Tau-U = 0.99, 95CI [0.98, 1.00]	Q = 304.65 I ² = 95.08%	Positive pooled effect
Social emotional/challenging behaviour (classroom behaviour)	Single case experimental designs	4	Tau-U = 0.97 [SD =0.05]	Not specified	Positive pooled effect
Play	Single case experimental designs	2	Tau-U = .92 [SD = .06] NAP = .96 [SD = .03]	Not specified	Positive pooled effect

Moderators	Context	Outcome	Studies Included	Verbatim summary from systematic review	Categorised outcome
Intervention practice	Function based, visual supports, peer mediated, self-monitoring, peer network	All outcomes	Not specified	"Analysis of Tau-U scores revealed that FBA interventions resulted in significantly better outcomes than PMI and that all interventions produced significantly higher effects than those involving peer networks."	Function based, visual supports, peer mediated, and self-monitoring, interventions had greater intervention effects than peer network interventions.
Intervention agent	Teachers, peers, researchers	All outcomes	Not specified	"Regarding the intervention agent, teachers who delivered the intervention by themselves produced results with significantly higher effects than interventions delivered by any other agent(s). Studies targeting classroom behaviors resulted in significantly larger effects than those targeting Social-communication."	Interventions delivered by teachers had a greater intervention effect than interventions delivered by researchers or peers.

Weitlauf et al. (2017) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
Auditory Integration-Based Approaches		

Communication (language)	"Two small, short-term RCTs of auditory integration-based approaches assessing language outcomes reported no significant differences between groups in receptive language outcomes;34, 35 one RCT (in a publication reporting 2 unique studies) reported significant parent-rated improvements in spontaneous speech.18 We have low confidence in the conclusion that these approaches do not improve language outcomes (low strength of evidence) (Table 6)."	Summarised null effect
Ayres Sensory Integration (ASI)		
Sensory (sensory-related outcomes)	"Sensory-related and motor skill outcomes improved in children receiving an SI-based intervention compared with those receiving usual care or other treatment (statistically significant improvements in three of four studies addressing the outcome). We have low confidence in this conclusion (low strength of evidence)"	Summarised positive effect
Motor		Summarised positive effect
Environmental Enrichment		
Expressive language	"These approaches do not affect expressive language. We have low confidence in this conclusion (low strength of evidence)."	Summarised null effect
Cognition (nonverbal cognitive skills)	"Environmental enrichment approaches improved nonverbal cognitive skills. We have low confidence in this conclusion (low strength of evidence)."	Summarised positive effect

Weston et al. (2016) – Meta-analysis

Outcome	Context	Studies included	Effect size	Heterogeneity	Categorised outcome

Overall autism characteristics (symptoms related to ASD)	Self-reported	9	$g = 0.25$, 95CI $[-0.03, 0.53]$	$\text{Tau}^2 = 0.07$ $\text{Chi}^2 = 13.39$ $I^2 = 40\%$	Null pooled effect
	Clinician-reported	6	$g = 0.65$, 95CI $[0.10, 1.21]$	$\text{Tau}^2 = 0.21$ $\text{Chi}^2 = 9.36$ $I^2 = 47\%$	Positive pooled effect

Wiese et al. (2016) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome
General outcomes (behaviour and social interaction)	"The results of the studies are summarised in Appendix 2, with the studies grouped according to the NHMRC hierarchy of methodological quality. ²² From the summary of the results found in each study, it can be seen that most, but not all, studies found that results were beneficial; however, the lack of significance shows that overall, the result of equine-based therapy on behaviour and social interaction were mixed."	Summarised inconsistent effect

Zagona & Mastergeorge (2018) – Narrative synthesis

Outcome	Verbatim summary from systematic review	Categorised outcome

Social-communication	<p>"PMII studies have demonstrated effectiveness for increasing the social-communication skills for learners with ASD (e.g., Ganz et al., 2012; Kasari et al., 2012; Lee et al., 2007). All of the studies included in this review documented positive outcomes and increases in social-communication skills in both the frequency and duration of these skills. Additionally, several studies demonstrated a functional positive relationship upon introduction of PMII. In addition, several of these studies reported increases in the number of initiations and responses used by individuals with ASD (Jung et al., 2008; Owen-DeSchryver et al., 2008; Strasberger & Ferreri, 2014). Other studies documented increased duration of the interactions of the child with ASD and the peer (Katz & Girolametto, 2013; Lee et al., 2007; Schmidt & Stichter, 2012). In one study, the children with ASD increased number of gestures, verbal utterances, vocalizations, and activations of their communication device (Trottier et al., 2011). Additionally, Kasari and colleagues (2012) found that an intervention that was peer-mediated was more effective than one that was implemented by paraprofessionals for improving the amount of times the student with ASD was engaged with peers, as compared to being unengaged with others."</p>	<p>Summarised positive effect</p>
-----------------------------	---	-----------------------------------

Footnote: δ = Delta; ES = effect size; I^2 = Cochran's I^2 statistic; MD = mean difference; NAP = nonoverlap of all pairs; PND = percentage of nonoverlapping data; Q = Cochran's Q statistic; RRB = restricted and repetitive interests and behaviours; RVE = robust variance estimation; SE = standard error; SMD = standardised mean difference; τ^2 = tau-squared; wES = weighted mean effect size.

S18: Information on adverse effects of interventions that was extracted from the systematic reviews

Focus of Systematic Review	Frequency of consideration and identification	Evidence for adverse effects	
		Systematic review	Author statement (verbatim quote)
Behavioural interventions	Considered in 1/8 systematic reviews (identified in 0)	-	-
Developmental interventions	Considered in 0/5 systematic reviews	-	-
Naturalistic developmental behavioural interventions	Considered in 0/7 systematic reviews	-	-
Sensory-based interventions	Considered in 2/9 systematic reviews (identified in 1)	Lang et al. (2012)	<p>"The results of 14 studies (56%) were classified as negative because no benefit to any participant on any dependent measure was found. Of those 14 studies, 4 suggested that SIT may have contributed to increases in stereotypy and problem behavior (Carter, 2005; Davis et al., 2011; Devlin et al., 2011; Kane et al., 2004). Across the studies reporting negative findings, eight were rated as providing a suggestive level of certainty (e.g., Watling & Dietz, 2007), one was rated at the preponderance level (Devlin et al., 2011) and five were rated as providing a conclusive level of certainty. All five studies with a conclusive level of certainty and negative findings involved wearing a weighted vest. The results of eight studies were classified as mixed because some but not all participants improved or some but not all dependent variables improved. For example, Ayres and Tickle (1980) classified six participants as "good responders" to SIT and four as "poor responders". Across the studies with mixed results, six were classified at the suggestive level of certainty and two were classified at the conclusive level of certainty (Hodgetts et al., 2011b; Van Rie & Heflin, 2009). The results of three studies were classified as positive all</p>

			with a suggestive level of certainty (Fazlioglu & Baran, 2008; Linderman & Stewart, 1999; Thompson, 2011).” (p.1015)
TEACCH	Considered in 0/2 systematic reviews		
Technology-based interventions	Considered in 3/11 systematic reviews (identified in 2)	Miguel-Cruz et al. (2017)	<p>“Table 1. Summary of the included studies evaluating the level of evidence per diagnosis” indicates results were “Positive (47%), mixed (27.7%), negative (16.7%), NR (8.6%).” (p.434)</p> <p>“The highest level of clinical evidence in the papers involving children with ASD was an RCT that got a PEDro score of 5 [15]. According to the Sackett criteria [26], this paper offers a level of evidence of 3 that an intervention with a NAOTM robot did not have an effect on reducing repetitive and maladaptive behaviours in children with ASD. In contrast, a significant reduction in repetitive and maladaptive behaviours was observed in the group that received treatment based on interaction with a therapist. Similarly, the group that interacted with a human showed a significant reduction in negative affect and an increase in interested affect, whereas the robot group showed a reduction in positive affect.” (p.436)</p>
		Mazon et al. (2019)	<p>“Sample sizes across studies ranged from 5 to 23 participants per group, with an average around 10 participants per group. According to the Jadad scale, 5 of out the 6 studies scored 0 and the remaining study scored 1, thanks to the inclusion of a statement about dropouts (6 participants were excluded due to refusal or distress; Bekele et al., 2014).” (p.243-244)</p>
Animal-assisted interventions	Considered in 2/7 systematic reviews (identified in 1)	Hill et al. (2019)	<p>The following statements appear under “undesirable behaviours”¹ in Table 5 of the systematic review:</p> <p>“↑ tantrums, anxiety, and aggression” (Mey 2017)</p> <p>“↑ Some anxiety expressed towards dog (student C)” (Stevenson et al., 2015)</p> <p>“↑ Self-stimulating behaviours (hand flapping) (frequency/-duration)” (Matin 2002)</p>

Cognitive behaviour therapy	Considered in 0/4 systematic reviews	-	-
Other interventions	Considered in 0/2 systematic reviews	-	-
Child outcomes	Considered in 0/9 systematic reviews	-	-
Intervention characteristics	Considered in 0/16 systematic reviews	-	-

S19: Information on the amount of intervention received for all included systematic reviews

Author (year)	Information on the amount of intervention received			
Akemoglu et al. (2020)	<i>This review included 12 studies; intervention amount (total hours) was extracted from Table 2 of the original article.</i>			
Intervention(s): Parent-implemented telehealth interventions – Communication intervention; Early Start Denver Model (ESDM); Parents Early Start Denver Model (P-ESDM); Reciprocal Imitation Training (RIT); Decide, Arrange, Now, Count, and Enjoy (DANCE); Improving Parents as Communication Teachers (imPACT); Internet-based Parent-implemented Communication Strategies (i-PiCS); Prepare, Offer, Wait, and Respond (POWR).	0.5h 1h Not specified for 4 studies	0.5h 1.5h	0.5h 1.5h	0.75h 1.75 to 2h

Bejarano-Martin et al. (2020)

Intervention(s): Focused intervention practices - Discrete trial training (DTT); Pivotal Response Training (PRT), Contingent imitation; discrete trial training (DTT) plus social interaction, mediated learning with active engagement; picture exchange communication system (PECS); video modelling; prompting and reinforcement; physical and verbal cues; token economy and prompting; photographic schedules.

This review included 43 studies, intervention amount was extracted from Tables 1 and 2 of Appendix C of the original article.

Group Designs:

6 weeks total
1h/week for 32 weeks
2h/week for 8 weeks
10h/week for 6 weeks
Not specified for 2 studies

8 weeks total
1.5h p/week for 24 weeks
3h/week for 10 weeks
21h/week for 12 weeks

1h/week for 10 weeks
2h/week for 4 weeks
3.5h/week for 10 weeks
259h total

1h/week for 12 weeks
2h/week for 8 weeks
4h/week for 44 weeks

Single Case Designs:

1h sessions (4.5h total)
0.7h sessions (12h total)
1h sessions (14h total)
1h sessions (23h total)
38h total
5.5h/week
Not specified for 2 studies

9h total
1.5h sessions (12h total)
15h total
23.7h total
0.3h sessions (58.7h total)
10 weeks

1.5h sessions (10.5h total)
0.1h sessions (13.3h total)
1h sessions (16.7h total)
1h sessions (28h total)
0.25h sessions (80h total)

10.7h total
0.5h sessions (14h total)
0.3h sessions (21h total)
37.5h total
0.3h sessions (87h total)

Binns & Oram Cardy (2019) Intervention(s): Developmental social pragmatic interventions - Child Talk; Hanen More than Words; Developmental Individual-Difference Relationship-Based (DIR); Milton and Ethel Harris Research Initiative Treatment (MEHRIT) - DIR based; Pediatric Autism and Communication Therapy (PACT); Joint attention mediated learning; Play and Language for Autistic Youngsters (PLAY) project - DIR based; Social communication, emotion regulation, transactional support (SCERTS).	<i>This review included 10 studies (14 articles); intervention amount was extracted from Table 2 of the original article.</i>			
	5 X 2h parent sessions, 2 X 45 minute individual sessions and 2 X 1h/week group sessions for 7 weeks 1 session/month for 6 months and 'less frequent' follow-ups for 6 months Biweekly sessions for 6 months and monthly follow-ups, 18 sessions total over 12 months	1 X 1.5h session, other sessions not specified, over 3 months 15 sessions (minimum) over 4 to 12 months (average 7 months) 2h/week for 12 months	3 sessions/week for 6 months and 2 sessions/week for 3 months 1h/week for 32 weeks	8 X parent sessions and 3 X home sessions over 3.5 months 1 X 3h session/month for 12 months
Boshoff et al. (2020) Intervention(s): Developmental Individual-Difference Relationship-Based (DIR)/Floortime™ model and interventions based on the principles of the DIR/Floortime™ Model- Milton and Ethel Harris Research Initiative Treatment (MEHRIT); Floor time play (FTP); Play and Language for Autistic Youngsters (PLAY); the PLAY Project Home Consultation Program.	<i>This review included 9 studies; intervention amount was extracted from Table 3 of the original article.</i>			
	3h/week for 7 weeks 3h/month for 12 months 11.6h/week for 1-96 months	10h/week for 10 weeks 14.2h/week for 52 weeks	15.2h/week for 12 weeks <10h to >15 h/week for 52 weeks	0.5 to 1h/week for 10 months 2h/week with therapist and 25h/week with parents, for 52 weeks
Case & Yun, (2019)	<i>This review included 18 studies; intervention amount (total hours) was extracted from Table 3 of the original article.</i>			

Intervention(s): Fundamental motor skills including fundamental motor skills instruction, adapted physical education instruction, physical activities and fitness exercises, young athletes motor program, multisport camp training, adaptive soccer program, physical education program with fundamental motor skill instruction, intensive fundamental motor skill instruction, Sports, Play, and Active Recreation for Kids (SPARK); equestrian assisted training; technology interventions including sports active video game participation, video-based makota arena training, robot imitation and movement activities, simulated developmental horse riding; physical activity interventions including physical activity/table tennis, rhythm training and movement-based games, aquatic exercise training.	1h	5h	6h	7.5h
	9h	9h	12h	12h
	12h	16h	26.67h	27h
	28h	365h	36h	40h
	45h	160h		
Chang & Locke (2016) Intervention(s): Peer-mediated interventions.	<i>This review included 5 studies; intervention amount was extracted from Table 1 of the original article.</i>			
	4h/day for 2 weeks	1 to 2 X 30 minute sessions/week (10 sessions total)	2 sessions/week for 6 weeks	12 X 30 minutes/day over 3 months
	3 X 25 to 30 minute sessions/week for 6 months			

Ferguson et al. (2019) Intervention(s): Telehealth interventions with behavioural principles- functional analysis (FA); functional communication training (FCT); naturalistic and incidental teaching; behaviour support strategies (e.g., positive behaviour support); preference assessments; Early Start Denver Model (ESDM); Improving Parents as Communication Teachers (imPACT).	<i>This review included 28 studies; intervention amount was extracted from Table 1 of the original article.</i>			
	5 minute sessions	1 to 2h	2 X sessions	3 X 30 minute sessions
	4 online sessions	1h meeting and 3 X 15 minute sessions	1h weekly sessions	1.5h/week
	12 weekly sessions	11 X 75 minute sessions (group 1), 11 X 75 minute sessions and 2 X 30 minute sessions/week (group 2)	11 X 75 minute sessions (group 1), 11 X 75 minute sessions and 2 X 30 minute sessions/week (group 2)	1 X 45 minute coaching and 2 X 5 to 7 minute sessions/week
	6 months	2 day training conference, 2h training, and 1h follow-up (phase 1), 3h seminar, 2h group supervision, 1h tele-conference and 1h video of parent training session (phase 2)		
	Not specified for 15 studies			
Flippin et al. (2010) Intervention(s): Picture exchange communication system (PECS).	<i>Intervention amount was not specified.</i>			
Fuller & Kaiser (2020)	<i>This review included 29 studies; intervention amount was extracted from Table 4 of the original article.</i>			

Intervention(s): “Early interventions” – Not specified.	1h/week for 1 week 0.69h/week for 52 weeks 1h/week for 6 weeks 1h/week for 16 weeks 2h/week for 6 weeks 2.5h/week for 6 weeks 4h/week for 40 minutes 30h/week for 104 weeks	0.5h/week for 4 weeks 0.69h/week for 52 weeks 1h/week for 10 weeks 1.25h/week for 12 weeks 2h/week for 24 weeks 2.6h/week for 10 weeks 15h/week for 20 weeks	0.5h/week for 10 weeks 0.75h/week for 52 weeks 1h/week for 12 weeks 1.33h/week for 12 weeks 2h/week for 52 weeks 3h/week for 8 weeks 20h/week for 1 week	0.6h/week for 20 weeks 0.46h/week for 104 weeks 1h/week for 12 weeks 1.77h/week for 9 weeks 2h/week for 52 weeks 3h/week for 10 weeks 25.6h/week for 104 weeks
Fuller, Oliver et al. (2020) Intervention(s): Early Start Denver Model (ESDM).	<i>This review included 12 studies, intervention amount was extracted from Table 2 of the original article.</i>			
Geretsegger et al. (2014) Intervention(s): Music therapy.	20 minute sessions over 5 days 18 X 10 minute sessions over 5 weeks 3 X assessment sessions, 16 X intervention sessions, 1	6 X sessions over 3 days (Group 1 and 2) 1 session/day over 10 weeks (10 sessions total) 30 minute weekly sessions	10 X sessions over 2 weeks 24 X 15 minute sessions 2 sessions/day over 12 weeks	6 X individual sessions over 2 weeks (Intervention 1 and 2) or no training (Intervention 3) 16 X weekly sessions and standard care over 16 weeks

	final assessment session and 20 X 30 minute weekly standard treatment sessions over 7 months	over 8 months (24 sessions total)		
Griffith et al. (2020) Intervention(s): Interactive apps.	<i>This review included 35 studies (from 34 articles); intervention amount was extracted from Table 2 of the original article.</i>			
	9 minutes 4 trials 8 trials 1 week 10 sessions over 2 to 3 weeks 6 weeks 9 weeks 16 weeks 1 year	20 minutes 4 X 5 minute trials 5 days 12 trials 4 weeks 8 weeks 12 weeks 22 weeks 1 year	3 trials 5 trials 5 days 10 days 6 weeks 8 weeks 14 weeks 6 months	4 trials 6 X 1 minute trials 2 X 10 minute sessions over 2 weeks 3 weeks 6 weeks 2 months 15 weeks 1 academic year

Hampton & Kaiser (2016) Intervention(s): Early interventions- Early Intensive Behavioural Intervention (EIBI); Early Intervention Preschool (EIP); Early Start Denver Model (ESDM); Joint Attention Mediated Learning (JAML); Joint Attention; Structured Play Engagement; and Regulation (JAML); Learning Experiences and Alternative Program (LEAP); Milton and Ethel Harris Research Initiative Treatment (MEHRIT); More Than Words (MTW); Pediatric Autism and Communication Therapy (PACT); Play and Language for Autistic Youngsters; PRT, Pivotal Response Training (Play and Language for Autistic Youngsters); Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH); Scottish Early Intervention Preschool; Parent training model (PSwA); Focused playtime (FPI); Speech remediation; Teach Town basics; Early Social Interaction (ESI); Parent training, Behaviour analytic.	<i>This review included 26 studies; intervention amount was extracted from Table 5 of the original article.</i>			
	2.5h/week for 6 weeks	2.15h/week for 10 weeks (24h total parent training)	1h/week for 12 weeks	1h/week for 12 weeks (12h total parent training)
	1.5h/week for 12 weeks (18h total parent training)	2.33h/week for 12 weeks (12h total parent training)	1h/week for 14 weeks (14h total parent training)	3.3h/week for 14 weeks
	1h/week for 16 weeks (16h total parent training)	1.25h/week for 20 weeks (25h total parent training)	2h/week for 40 weeks (40h total parent training)	4h/week for 45 weeks
	0.5h/week for 52 weeks (26h total parent training)	0.5h/week for 52 weeks (27h total parent training)	0.61h/week for 52 weeks (36h total parent training)	0.75h/week for 52 weeks (36h PT total parent training)
	1h/week for 52 weeks	2h/week for 52 weeks (104h total parent training)	2h/week for 52 weeks (104h total parent training)	25.6h/week for 52 weeks
	30h/week for 52 weeks	40h/week for 52 weeks (70h total parent training)	20h/week for 54 weeks	30h/week for 63 weeks, 21h PT
	17h/week for 104 weeks	20h/week for 104 weeks (24h total parent training)		
Hardy & Weston (2020)	<i>Intervention amount was not specified.</i>			

Intervention(s): Canine-assisted therapy.				
Hill et al. (2019) Intervention(s): Canine-assisted therapy- animal-assisted therapy; animal-assisted activities; animal-assisted education; animal-assisted play therapy.	<i>Intervention amount was not specified.</i>			
Ho et al. (2014) Intervention(s): Cognitive behavioural approaches - Cool Kids; Building Confidence Family Cognitive Behaviour Therapy (FCBT); Social Skills Training for Children and Adolescents with Asperger Syndrome and Social-Communications Problems; Thinking about you, thinking about me; Coping Cat CBT program; Facing your fears; Group Cognitive Behaviour Therapy.	<i>This review included 10 studies; intervention amount was extracted from Table 2 of the original article.</i>			
	9h total over 9 weeks	12h total over 6 weeks (8h with therapist)	12h total over 6 weeks, 12 therapist hours	17.5h (child), 2.5h (parent) over 16 weeks (17.5h with therapist)
	18h total over 12-16 weeks	<30h total over 12 weeks (12h with therapist)	24h total over 26 weeks (6.9h with therapist)	9h (child), 12h (parent), 4h (family) over 16 weeks (8h with therapist)
	9h (child), 12h (parent), 4h (family) over 16 weeks (8h with therapist)	24h total over 16 weeks (13.7h with therapist)		
Kent et al. (2020) Intervention(s): Play-based interventions- [Generic] play intervention; Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER); Lego therapy; Social stories; behavioural approaches; peer training; teacher training; Social	<i>This review included 19 studies; intervention amount was extracted from Table 3 of the original article.</i>			
	10 X 4h	9 sessions/day	4 X 30 minute sessions/day and 1 X 90 minute session	3 X 30 minute sessions/week over approximately 6 months
	2 X 20 minute sessions/week	12 X 60 minute weekly sessions	30h over 5 weeks and 10h/week parent delivered	30 minutes/day for 5 to 6 weeks

Emotional NeuroScience Endocrinology (SENSE) Theater principles; video modelling.	60 X 15 minute sessions over 8 weeks	16 X 30 to 45 minute sessions over 8 weeks	1h/week over 10 weeks	8 to 10 sessions over 1 term
	2 X 30 minutes/week for 12 weeks	5 X 60 to 90 minutes over 3 months	2 X 1h/week over 12 weeks	1h/week for 18 weeks
	Weekly sessions including 10–15 min observation and 1h training			
	Not specified for 2 studies			
Khan et al. (2019) Intervention(s): Web-based interventions - apps; serious games; videoconferencing; virtual environment with playable games; Web-based cognitive behavioural therapy intervention.	<i>This review included 10 studies; intervention amount was extracted from Table 2 of the original article.</i>			
	30 minutes daily for 4 weeks	2 X 60 minutes/week over 5 weeks (10 sessions total)	2 X 1.5h sessions and 6 X 1h sessions over 10 weeks	6 X weekly sessions and 2 X biweekly sessions over 10 weeks
	1 X 60 minute session/week for 10 weeks, (10 sessions total)	3 X 65 minute sessions/week for 10 weeks	2 X 40 minute sessions/week for 10 weeks (8 to 12 sessions total)	2h/week for 8 to 12 weeks
	5 minutes/day or 10 min every other day for 2 months	20 minutes/day for 6 months		
Knight et al. (2013) Intervention(s): Computer assisted instruction; simultaneous prompting; differential reinforcement; error	<i>Intervention amount was not specified.</i>			

correction and feedback procedure; delayed prompting procedure; stimulus prompting.				
Lang et al. (2012) Intervention(s): Sensory-integration therapy- weighted vests; swinging or rocking stimulation; brushing with a bristle or a feather; joint compression or stretching; alternative seating; jumping or bouncing; blanket or "body sock"; playing with a water and sand sensory table; chewing on a rubber tube; and playing with specially textured toys.	<i>This review included 25 studies; intervention amount was extracted from Table 1 of the original article.</i>			
	10 minutes	2 x 30 minute sessions (experimental group) OR 2 x 30 minute (control group)	5 minute sessions for 17 days	2 X 1h sessions/week for 16 sessions
	18 X 45 minutes for 6 weeks	1h/week for 11 weeks (participant 1), 1h/week for 7 weeks (participant 2)	30 minutes/day for 10 weeks	7 sessions/day for 5 weeks
	2 X sessions/week for 1 year	6 X 15 minutes/day	4 X 30 minute sessions/day	
	Not specified for 14 studies			
Logan et al. (2017) Intervention(s): Aided AAC systems- dedicated speech generating devices (SGDs); iPad®/iPod® Touch configured as SGDs; picture exchange communication system (PECS); low-tech aids (e.g., boards or books) incorporating pictures and photos.	<i>Intervention amount was not specified.</i>			
Makrygianni & Reed (2010) Intervention(s): Behavioural early intervention programs.	<i>This review included 14 studies; intervention amount was extracted from Appendix A of the original article.</i>			
	8 months	12.5h/week for 20.3 months	20h/week for 12 months	20.4h/week for 9 months

	24.52h/week for 58 months	25.6h/week for 24 months	30h/week for 35 months	30.4h/week for 9.5 months
	32.4h/week for 25.5 months	32.5h/week for 14.21 months	37.5h/week for 36 months	37.58h/week for 48 months
	40h/week for 24 months	40h/week for 30 months		
Mazon et al. (2019) Intervention(s): Technology based interventions including (but not limited to) computer and robot-based interventions.	<i>This review included 31 studies; intervention amount was extracted from Tables 2 to 4 of the original article.</i>			
	Single session Single session Single session 1 week	Single session Single session Single session 2 weeks	Single session Single session Single session 3 weeks	Single session Single session Single session 1 week (Experiment 1), 4 weeks (Experiment 2)
	4 weeks 8 weeks 12 weeks 12 weeks (Experiment 1), 12 weeks (Experiment 2)	6 weeks 8 weeks 12 weeks 10-20 weeks	8 weeks 10 weeks 12 weeks 40 weeks	8 weeks 12 weeks 12 weeks
McCoy et al. (2016) Intervention(s): Role play; video modelling; computer-based instruction.	<i>This review included 29 studies; intervention amount was extracted from Tables 1 to 3 of the original article.</i>			
	2 X 4 minutes	37 sessions (average) X 35 seconds	1 X 45 minute session/day	2 X 7h sessions
	1 X 40 minute session for 5 days	1 session X 10 days	4 to 8 X 45 minute sessions	2 X 1.5h/week
	3 to 6 X 45 minute sessions/week	10 sessions	10 weeks	12 X 45 minute sessions
	1 X 40 minute session for	2 to 4 X 15 to 20	1 to 5 X 60 minutes/week,	2 to 3 X 60 minute

	22 days	minutes/week	range of 3 to 25 sessions	sessions/week (6 to 9 sessions total)
	1 session 3 X weekly for 1 to 4 weeks	10 X 1.5 to 2h sessions for 5 weeks	40 minute sessions for 6 weeks	1h/week for 6 weeks
	12 X 10 to 25 minute sessions for 6 weeks	30 minute sessions X 3 days/week over 8 weeks	1 X 90 minutes/week for 10 weeks	31 to 45 minute sessions X 2 to 3 days/week for 10 weeks
	1 X 2h session/week for 11 weeks	0.5 to 1h for 12 weeks	24 sessions over 15 weeks	2 X 1.5h sessions over 20 to 28 weeks
	Not specified for one study			
Miguel-Cruz et al. (2017) Intervention(s): Robots.	<i>Intervention amount was not specified.</i>			
Moon et al. (2020) Intervention(s): Mobile device applications - including (but not limited to) FindMe game app, Therapy Outcomes By You (TOBY), Camp Discovery.	<i>Intervention amount was not specified.</i>			
Murza et al. (2016) Intervention(s): Joint attention interventions - Assessment, Evaluation and Programming System (AEPS) for Infants and Children; Caregiver	<i>This review included 16 studies; intervention amount was extracted from Table 2 of the original article.</i>			
	15 X sessions and 30 minutes parent implementation daily	15 to 18 X 30 minute sessions for 5 to 6 weeks	30 X 24 minute sessions over 6 weeks	24 X 30 minute sessions over 8 weeks

Education Model (CEM); Caregiver Mediated Model (CMM); Hanen More Than Words (HMTW); Joint Attention Mediated Learning (JAML); Joint Attention Symbolic Play Engagement and Regulation (JASPER); Milton and Ethel Harris Research Initiative (MEHRI); Preschool Autism Communication Trial (PACT); parent training modules; and workshop training.	40 X 20 minute sessions over 8 weeks 30 minutes/day for 6 months Not specified for 4 studies	30 minutes/day for 11 weeks 104 X 150 minute sessions over 6 months	2 X 30 minutes sessions for 12 weeks 52 X 120 minute sessions (clinic) and 365 X 180 minute sessions (home) over 1 year	12 X 60 minute sessions over 12 weeks 48 X 120 minutes clinic sessions over 6 months and 30 minutes/day suggested at home and 18 booster sessions over the next 6 months
National Autism Center (2015) Intervention(s): Behavioural interventions; Cognitive Behavioural Intervention Package; Comprehensive Behavioural Treatment for Young Children; Pivotal Response Training; Augmentative and Alternative Communication Devices; Developmental Relationship-based Treatment; Functional Communication Training; Music Therapy; Picture Exchange Communication System; Social Communication Intervention; Technology-based Intervention; Theory of Mind Training; Animal-assisted Therapy; Auditory Integration Training; DIR/Floor Time; Facilitated Communication; Movement-based	<i>Intervention amount was not specified.</i>			

Intervention; Sensory Intervention Package.				
Naveed et al. (2019)	<i>This review included 33 studies; intervention amount was extracted from Table 2 of the original study.</i>			
Intervention(s): Cognitive behavioural strategies (CBT); Social emotional Neuroscience Endocrinology (SENSE) theatre; Preschool Autism Communication Trial (PACT); Parent mediated intervention for Autism Spectrum Disorders in South Asia (PASS); Project Impact; Peer interventions; Qigong Sensory Treatment (QST); Joint Attention, Symbolic Play, Engagement, and Regulation programme (JASPER); Play project; LEAP project i.e. Learning Experiences and Alternative Program for Preschoolers and Their Parents; Hanen's more than words (HMTW) intervention program; Peer network intervention procedure; family centered music therapy; The Managing Repetitive Behaviours Programme; psychoeducation program; autism preschool program; Video-feedback Intervention to promote Positive Parenting adapted for Autism; Social ABCs; Parent mediated intervention for Autism	15 X 23.22 minute sessions	12 X 10 minute sessions over 6 weeks	7 X 15 minute sessions over 7 weeks	80 X 20 minute sessions over 8 weeks
	8 X 90 minute sessions over 8 weeks	8 X 120 minute sessions over 8 weeks	10 X 240 minute sessions over 8 weeks	10 X 60 minute sessions over 10 weeks
	20 X 60 minute sessions over 10 weeks	21 X 75 minute sessions over 10 weeks	10 X 240 minute sessions over 10 weeks	5 X 75 minute sessions over 12 weeks
	12 X 90 minute sessions over 12 weeks	13 X 90 minute sessions over 12 weeks	90 X 20 minutes over 12 weeks	10 X 180 minute sessions over 12 weeks
	9 X 90 minute sessions over 13 weeks	14 X 90 minute sessions over 14 weeks	16 X 35 minute sessions over 16 weeks	16 X 40 minute sessions over 16 weeks
	18 weeks	20 X 15 minute sessions over 20 weeks	20 X 90 minute sessions over 20 weeks	20 X 90 minute sessions over 20 weeks
	12 X 17.5 minutes over 24 weeks	12 X 120 minute sessions over 24 weeks	97 X 27.5 minute sessions over 24 weeks	48 X 105 minute sessions over 24 weeks
	12 X 60 minutes over 24 weeks	32 X 1500 minute sessions over 32 weeks	12 X 180 minute sessions over 48 weeks	834 X 180 minute sessions over 182.5 weeks
	Not specified for one study			

Spectrum Disorders in South Asia (PASS) plus; enhancing interactions tutorial; Social Tools And Rules for Teens socialization (START); COMPASS for Hope; Program for the Education and Enrichment of Relational Skills (PEERS) curriculum; Therapeutic Out-come By You (TOBY) application.				
Nevill et al. (2018) Intervention(s): Child's Talk Project; Hanen's More than Words (HMTW); DIR/Floortime; Parent Focus Training; Joint Attention Symbolic Play Engagement and Regulation (JASPER); Pivotal Response Training (PRT); Video Intervention to promote Positive Parenting for children with Autism (VIPP-AUTI); Home-based program; Building Blocks; Focused Playtime Intervention; Play and Language for Autistic Youngsters (PLAY) Project; Preschoolers with Autism; Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH); Social Communication, Emotion Regulation, and Transactional Supports (SCERTS); Parent-mediated	<i>This review included 19 studies; intervention amount (dose of parent training) was extracted from Table 2 of the original article.</i>			
	2.25h total	5 X 1 to 1.5h sessions over 3 months and 2 group sessions (approximately 7 to 9.5h total)	2 X 30 minute sessions/week for 10 weeks (10h total)	1 session/month for 6 months and 3 X bimonthly sessions (approximately 12h total over 9 sessions)
	3 sessions/week for 8 weeks (12h total)	1 X workshop, 1 X training, and 1 X follow-up session (approximately 13.5h total)	12 X 1 p/week (16h total)	1 X 90 minute session/week for 12 weeks and 3 X 90 minute parent coaching sessions (18h total)
	1.5h/week for 12 weeks (18h total)	8 X 2.5h weekly group sessions and 3 X individual sessions (approximately 23h total)	1 X 3h session every 6 weeks for 12 months (24h total)	2 X 1h sessions/week for 12 weeks (24h total)
	10 X 1h sessions and 10 X 1.5h sessions over 20 weeks (25h total)	3h monthly sessions for 1 year (36h total)	2h semi-monthly sessions over 40 weeks (40h total)	1 to 1.5h/week for 40 weeks (45 to 65h total)

Communication-focused Treatment (PACT).	2h sessions biweekly for 6 months and booster sessions for 6 months (96h total)	3 sessions/week for 6 months and 2 sessions/week for 3 months (88.56h total on average)	2h/week for 1 year (104h total)	
Ona et al. (2020) Intervention(s): Pivotal Response Treatment (PRT).	<i>This review included 5 studies (7 articles); intervention amount was extracted from table 3 of the original article.</i>			
	5h/day for 4 days (20h total) 8 X 90 minute groups and 4 X 60 minute groups (total 12 weekly groups) Not specified for 2 studies	2 X 60 minute sessions /week for 3 months (24h total)	2 X 60 minute sessions/ week for 3 months (24h total)	247h (approximately)
Oono et al. (2013) Intervention(s): Parent mediated interventions – Developmental Individual-Difference Relationship-Based (DIR) techniques; massage intervention; management of challenging behaviour; early intensive behavioural intervention; Pivotal Response Treatment (PRT).	<i>This review included 17 studies across 18 articles, intervention amount was extracted from the "Characteristics of Studies" Table of the original article.</i>			
	1h 6 minutes	1 session/day for 5 days over 2 weeks	5h/week over 2 sessions (parent training) and 10 to 15hrs (child class)	3 X 45 minute sessions/ week (24 sessions total)
	1 X 90 minute session/week for 12 weeks	1 day workshop, 3h training and 15.2h/week for 3 months	5 X weekly 3h classes and 3h/week for 10 weeks, total 12 weeks	8 group sessions and 3 home sessions over 3.5 months
	20 weeks	1 session/month for 6 months and less frequent	bi-weekly 2h sessions for 6 months, monthly booster	1 X 2h session/fortnight over 40 weeks (up to 20

	<p>1 to 1.5h/week for 40 weeks over 12 months</p> <p>3h group sessions, 7 X weekly 30 minute support sessions and parent delivered intervention for 15 minutes</p>	<p>sessions over the next 6 months</p> <p>3h every 6 weeks for 12 months</p>	<p>sessions, (average total 9.5h over 18 sessions)</p> <p>2h/week over 12 months therapist delivered and 3h/day parent delivered</p>	<p>sessions)</p> <p>2h sessions on 5 days/week for 2 years</p>
<p>Parsons, Cordier, Vaz et al. (2017)</p> <p>Intervention(s): Web-based training in behavioural interventions; Online and Applied System for Intervention Skills (OASIS) training intervention Research-to-practice; Improving Parents as Communication Teachers (ImPACT) on the Web; Implementation discrete-trial instructions using video training materials; Parent Early Start Denver Model (P-EDSM) training; Functional communication training.</p>	<p>4-8 h over 3 weeks</p> <p>1 X 80 minutes/week for 12 weeks (group 1), 1 X 80 minutes/week for 12 weeks and 2 X 30 minutes/week (group 2)</p> <p>Not specified for 2 studies</p>	<p>1h/week</p> <p>1 X 80 minutes/week for 12 weeks (group 1), 1 X 80 minutes/week for 12 weeks and 2 X 30 minutes/week (group 2)</p>	<p>1h/week for 12 weeks</p> <p>1 X 80 minutes/week for 12 weeks (group 1), 1 X 80 minutes/week for 12 weeks and 2 X 30 minutes/week (group 2)</p>	<p>1.5h/week for 12 weeks</p>
	<p><i>This review included 20 studies (21 articles); intervention amount was extracted from Table 3 of the original article.</i></p>			

Parsons, Cordier, Munro et al. (2017) Intervention(s): Pragmatic language interventions - The Junior detective Program; Milton and Ethel Harris Research Initiative Treatment (MEHRIT); Building Blocks Program; Social Emotional NeuroScience Endocrinology (SENSE) theatre; Social Skills Group Intervention- High Functioning Autism; FindMe App; Therapeutic Horse Riding; FaceSay; Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER); Improvisational music therapy; SummerMAX; Mind Reading; Skillstreaming; Emotion Recognition Training; Seaver-NETT.	2 X 20 minute sessions/day for 8 weeks (2h total)	2 X 10 to 25 minute sessions /week for 6 weeks (2 to 5h total)	1 X 1h session/week for 4 weeks (4h total)	1 X 30 minute session/week for 12 weeks (6h total)
	10 X 45 minute sessions over 10 weeks (7.5h total)	1 X 30 minute session/ day for 5–6 weeks (12.5 to 15h total)	1 X 2h session/week for 7 weeks (total 14h) and home practice	1 X 60 minute session/week for 15 weeks (15h total) and home practice
	3 X 45 minute sessions/week for 8 weeks (18h total)	1 X 90 minute child session/week for 12 weeks (18h total) and 1 X 30 minute parent session/week for 12 weeks (6h total)	2 X 1h sessions/week for 12 weeks (24h total)	1 X 2h session/week for 12 weeks (24h total)
	2 X 90 minute sessions /week for 12 weeks (36h total)	1 X 2h session/fortnight for 20 fortnights (40h total)	1 X 4h clinic session/week for 10 weeks (40h total) 1 X 15 minute home session/day for 10 weeks (17.5h total)	1 X 5 minute session/day for 6 months or 3 to 4 X 10 minute sessions/week for 6 months (30 to 40h total)
Peters-Scheffer et al. (2011) Intervention(s): Early Intensive Behavioural Intervention (EIBI).	1 X 2h session/week for 40 weeks (80h total) and 1 X 3h session/week for 40 weeks (120h total)	5 X 70 minute sessions on 5 days per week for 5 weeks (145h total) and 1 X 90 minute parent session/week for 5 weeks (7.5h total)	5 X 70 minute sessions on 5 days per week for 5 weeks (145h total) and 1 X 90 minute parent session/week for 5 weeks (7.5h total)	1 X 2h clinic session/week for 12 months (104h total) 3h/day parent at home (1095h total)
	<i>This review included 10 studies (11 articles); intervention amount was extracted from Table 1 of the original article.</i>			
Peters-Scheffer et al. (2011) Intervention(s): Early Intensive Behavioural Intervention (EIBI).	12.5h/week for 20.3 months (experimental group) or 12 h/week for 21.4 months	19.45h/week for 15.36 months (experimental group) or 10.7h school-	24.52 h/week for > 2 years (experimental group) or 5h/week parent training and	25-40 h/week (experimental group) or 15 h/week (comparison group 1) or

	(comparison group)	based and 0.44h other (comparison group)	1 h/week supervision for 3-9 months (comparison group)	30h/week (comparison group 2)
	25.6 h/week for >2 years	28h/week (experimental group) or 29.08h/week (comparison group)	30.4 h/week (experimental group) or 12.7 h/nursery placement (comparison group 1) or 8.5h/week (comparison group 2)	>30h/week for >2 years (experimental group), <10 h/week for >2 years (comparison group)
	32.4 h/week for >2 years (experimental group) or 25.6 h/week for >2 years (comparison group)	38.6 h/week for >2 years (experimental group) or 31.67 h/week for >2 years (comparison group)		
Postorino et al. (2017) Intervention(s): Parent training for disruptive behaviour.	<i>This review included 8 studies, intervention amount is reported in Table 4 of the original article:</i>			
	4 X 15 to 105 minute sessions over 8 weeks	6 X 60 minute sessions over 6 weeks	8 X 60 to 75 minute sessions over 10 weeks	9 sessions over 9 weeks and 3 optional sessions
	9 X 60 to 90 minute sessions over 10 weeks	11 X 60 to 90 minute sessions over 24 weeks and 4 X 60-90 minute optional/booster sessions	11 X 60 to 90 minute sessions over 24 weeks and 6 X 60-90 minute optional/booster sessions	16 X 120 minute sessions over 16 weeks
Reichow et al. (2018) Intervention(s): Early intensive behavioural intervention (EIBI).	<i>This review included 5 studies; intervention amount was extracted from the 'Characteristics of included studies' table of the original article.</i>			
	>24 h/week for 24 months	>25 h/week for 24 months	25 to 30 h/week for 36 months	>30 h/week for 24 months
	35 to 40 h/week for 47			

	weeks per year for 36 months			
Sandbank et al. (2020a) Intervention(s): <u>Animal-assisted therapy</u> - Canine Assistance; Presence of a Therapeutic Service Dog; Therapeutic Horseback Riding <u>Behavioural</u> - Behavioral Parent Training; Discrete Trial Training with Motor Vocal Imitation Assessment; Early Intensive Behavioral Treatment; Functional Behavior Skills Training; Home-based behavioral treatment; Home-based Early Intensive Behavioral; Intervention (EIBI); Intensive Applied Behaviour Analysis (ABA); Intensive Early Intervention; Low Intensity Behavioral Treatment; Managing Repetitive Behaviors; Picture Exchange Communication System (PECS); Peer-Mediated Intervention; Rapid Motor Imitation Antecedent; Regular Intensive Learning for Young Children with Autism; Schedules, Tools, and Activities for Transitions (STAT); Social Skills Group; Stepping Stones Triple P Positive Parenting Program; Strategies for Teaching Based on Autism Research (STAR) <u>Developmental</u> - Adapted Hanen More Than Words; Developmental, Individual-Difference, Relationship-Based (DIR)-Floortime; Hanen More Than Words; Joint Attention Mediated Learning (JAML); MEHRIT (Milton and Ethel Harris Research Initiative Treatment); Parent-Mediated Communication Focused Treatment; Parent-mediated intervention for autism spectrum disorder in South Asia (PASS); Play and Language For Autistic Youngsters (PLAY)/ DIR Floortime; Scottish Early Intervention Program; Social Communication Intervention for Children with Autism and Pervasive Developmental Disorder; Video-feedback Intervention to Promote Positive Parenting adapted to autism (VIPP-AUTI) <u>Naturalistic developmental behavioural intervention (NDBI)</u> - Advancing Social-Communication and Play (ASAP); Caregiver-based intervention program in community day-care centers; Denver Model; Early Social Interaction Project (SCERTS); Early Start Denver Mode (ESDM); Home-based Building Blocks Program; home-based intervention program; IMPACT Online; Interpersonal Synchrony; Joint Attention Intervention Joint		<i>Intervention amount was not specified.</i>		

Attention Symbolic Play Engagement Regulation (JASPER); Joint Engagement Intervention; Joint Engagement Intervention with Creative Movement Therapy; Parent-Early Start Denver Model (P-ESDM); Parent-training intervention; Pivotal Response Treatment (PRT); Reciprocal Imitation Training; Social ABCs Cognitive behaviour therapy

Sensory based- Developmental Speech and Language Training through Music; Family-Centered Music Therapy; Improvisational Music Therapy; Music Therapy; Qigong (QST) Massage Treatment; Qigong Massage Treatment; Rhythm Intervention Sensorimotor Enrichment; Sensory Enrichment; Thai Traditional Massage; Tomatis Sound Therapy; Vestibular Stimulation via a Platform Swing

Technology based- ABRACADABRA; Emotiplay Serious Game; FaceSay; FindMe iPad App; Gaming Open Library for Intervention in Autism at Home (GOLIAH); Gaze-contingent attention training; Social Skills Training using a robotic behavioral intervention system; The Transporters animated series; Therapy Outcomes By You (TOBY) App; Transporters DVD; Transporters Program for Children with Autism

Treatment and Education of Autistic and related Communications Handicapped Children (TEACCH)

Other- "Autism 123"; Balance Training Intervention; Circle of Friends; Cognitive Method; Collaborative Model for Promoting Competence and Success (COMPASS); Comprehensive Inclusion Program; Group Psychoeducational Program for Mothers; Home-based intervention; Hyperbaric Oxygen Therapy; Individual Parent Sleep Education; Interactive Book Reading; LEAP (Learning Experiences and Alternative Program for Preschoolers); NeuroModulation Technique (NMT); Outdoor Adventure Program; Parent Education and Counselling (PEAC); Parent-Child Interaction Therapy (PCIT) or Child-directed interaction therapy (CDIT); Positive Family Intervention (Positive Behavior Support +parent optimism training); Primary Care Stepping Stones Triple P; Professionally supported intervention; Psychoeducation Intervention; Psychomotor Intervention Program; Reading Mastery; Sleep Education Pamphlet; Sung computer-based intervention; Thought-bubble Training for Theory of Mind; Water Exercise Swimming Program.

Sandbank et al. (2020b) Intervention(s): Behavioural; developmental; naturalistic developmental behavioural intervention (NDBI); Treatment and Education of Autistic and related Communications Handicapped Children (TEACCH); sensory-based; animal-assisted; technology-based.	<i>This review included 60 studies, intervention amount (total intervention hours) was extracted from Table 1 of the original article.</i>			
	0.9h (intervention group 1), 0.6h (intervention group 2)	1.125h (group 1), 1.125h (group 2)	8.17h	8.55h
	11.03h (intervention group 1), 9.6h (intervention group 2)	13.4h	14.3h (intervention group 1), 17.35h (intervention group 2)	17.56h (intervention group 1), 18.44h (intervention group 2)
	20h 27h	25h 36h	25.8h 37.63h	26.93h 36h (intervention group 1), 72h (intervention group 2)
	75h 205.66h 473.95h 1023.4h 1393.2h 2600h 3415h Not specified for 17 studies	90h 214h 478.08h 1040h 1456h 2662.4h 5287.5h	105.35h 247h 591.68h 1083.6h 1768h 3120h 6429.8h	132.4h 354.75h 627.16h 1144h 2137.88h 3276h
Schaaf et al. (2018) Intervention(s): Ayres Sensory Integration® (ASI).	<i>This review included 5 studies; intervention amount was extracted from Supplemental Table 2 of the original article.</i>			
	25 to 50 minute sessions	2 X 30 minute sessions weekly for 12 weeks (intervention group), 1h/week for 12 weeks (control group)	1h/week (intervention group) or 1.5h/week (control group)	18 X 45 minute sessions over 6 weeks

	30 X 1h sessions over 10 weeks			
Schoen et al. (2019) Intervention(s): Ayres Sensory Integration® (ASI).	<i>This review included 3 studies; intervention amount was extracted from Table 3 of the original article.</i>			
	18 X 45 minute sessions over 6 weeks	1.5h/week for 8–10 months	3 X 1h/week (30 sessions total)	
Srinivasan et al. (2018) Intervention(s): Equine therapy - therapeutic horseback riding; simulated horseback riding; hippotherapy.	<i>This review included 15 studies, intervention amount was extracted from Table 1A of the original article.</i>			
	1 session/week for 4 weeks	1 session /week for 5 weeks	1 session/week for 5 weeks	1 session/week for 9 weeks
	1 session/week for 10 weeks	1 session/week for 10 weeks	1 session/week for 9 to 12 weeks	1 session/week for 12 weeks
	1 session/week for 12 weeks	1 session/week for 12 weeks	1 session/week for 18 weeks	1 session/week for 24 weeks
	2 session/week for 12 weeks	1 session/week for 25 weeks	2 sessions/week for 20 weeks	
Steinbrenner et al. (2020) Intervention(s): Antecedent-based interventions - augmentative and alternative communication (AAC); behavioural momentum intervention; Cognitive Behavioural/Instructional Strategies; Differential Reinforcement of Alternative, Incompatible, or Other Behaviour; Direct Instruction; Discrete Trial Training (DTT); Exercise and	<i>Intervention amount was not specified.</i>			

Movement; Extinction; Functional Behavioural Assessment; Functional Communication Training (FCT); Modeling; Music-Mediated Intervention; Naturalistic Intervention; Parent-implemented intervention; peer-based instruction and intervention; prompting; reinforcement; response interruption/redirection; self-management; sensory integration; social narratives; social skills training; task analysis; technology-aided instruction and intervention; time delay; video modelling; visual supports.

Sutherland et al. (2018)

Intervention(s): Program Improving Parents as Communication Teachers (imPACT); internet-based Parent Implemented Communication Strategies (iPICS); general communication intervention; imitation training; Telehealth diagnostic services; 'Telehealth Facing Your Fears' Intervention'; functional behaviour assessment and functional communication training; school age intervention using web-based

Intervention amount was not specified.

education; language intervention.

Tachibana et al. (2018)

Intervention(s): Social communication intervention - Hanen's More Than Words; Early Start Denver Model (ESDM); Parent training; Joint Attention Symbolic Play Engagement and Regulation (JASPER); Preschool Autism Communication Trial (PACT); Treatment and Education of Autistic and related Communications Handicapped Children (TEACCH)-based group social skills; Reciprocal Imitation Training; Caregiver-based intervention program in community day-care centers; Preschool-based joint attention intervention; Caregiver Mediated Joint Engagement Intervention; Improvisational music therapy; intervention targeting development of socially synchronous engagement; Developmental, Individual-Difference, Relationship-Based(DIR)/ Floortime intervention; Functional Behavior Skills Training (FBST); Building Blocks; Parent delivery of the Early Start Denver Model (P-ESDM); Joint Attention Mediated Learning (JAML) intervention; Focused Playtime

This review included 33 articles; intervention amount was extracted from supplementary Table 2 of the original article.

30 minutes/day x 5 days/week for 2 weeks	4 sessions of 10 to 15 minute classroom observations + 1h training over 4 weeks	2 X 30 minute sessions weekly over 6 weeks (10 sessions total)	3h parent session every 6 weeks for 12 weeks
30 minutes weekly for 12 weeks	2 X 30 minute sessions weekly for 12 weeks (24 sessions total)	12 X 1h sessions over 12 weeks	8 X group and 3 X home sessions over 3.5 months
16 weeks	3 X 45 minute sessions weekly (total 24 sessions)	12 X 90 minute sessions over 12 weeks	1.5h/week for 12 weeks
8 to 10h of parent education, 1.5h individual and 12 to 14h of group sessions over 6 weeks	2 X 20 minutes daily for 5 days/week (aim of 80 sessions total) over 8 weeks	15 weekly sessions and 30 minutes of home practice over 4-12 months (M=7 months)	1h/day for 3 days/week for 10 weeks
1h/day for 3 days/week for 10 weeks	2h group sessions weekly for 4 months	10 X 60 minute individual sessions and 10 X 90 minute group sessions	2h biweekly sessions for 6 months, monthly sessions for 6 months (18 sessions total) and 30 minutes/day of home practice for 12 months
2h weekly for 6 months (20 sessions total)	2h/fortnight for 40 weeks (max 20 sessions)	5 X 3h seminar and 3h weekly home consults for 10 weeks	Monthly sessions and 30 minutes of daily home practice for 12 months

Intervention (FPI); Education and Skills Training Program for Parents; Parent education and behaviour management (PEBM) Skills training intervention or control for the non-specific aspects of the PEBM parent education and counselling intervention; Home TEACCHing Program.	40 X 2hr weekly sessions, 6 playgroups and 6 parent support/training groups 2 X 2h sessions daily for 5 days/week for 2 years Not specified for 3 studies	2h/week and approximately 3h/day 'interacting with their child' for 12 months 24.52h/week for 1 year and reduced hours over a second year	15.2h/week for 3 months	10h/week in classroom, 1.5h/month parent training, and 38h parent education over 6 months
Tarver et al. (2019) Intervention(s): Behavioural parent interventions – Research Units in Behavioural Intervention (RUBI) Parent Training Manual; Child directed interaction therapy (CDIT); Compass for help (C-HOPE); Parent management training; parent-child interaction therapy (PCIT); Primary care stepping stones Tripe P (PCSSTP); Stepping stones triple P (SSTP).	<i>This review included 11 articles representing 9 RCTs, intervention amount was extracted from Table 2 of the original article.</i>			
	4 X 40 minute sessions 8 X 60 to 120 minute sessions 11 X 60 to 90 minute sessions, 2 optional and 2 booster sessions	4 X 15 to 105 minute sessions 1 X 360 minute workshop and 6 X 60 minute weekly sessions	8 X 60 to 75 minute sessions 11 X 60 to 90 minute sessions	9 sessions 12 sessions
Tiede & Walton (2019) Intervention(s): Naturalistic Developmental Behavioural Interventions - Early Start Denver Model (ESDM); Early Social Interaction Project (ESI); intervention emphasizing joint attention and	<i>This review included 27 unique studies, intervention amount (professional hours) was extracted from Appendix 1 of the original article.</i>			
	6h 12h	8h 12h	9h 12h	10h 13.75h

imitation skill-building (JA/Imitation); Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER); Learning Experiences Alternative Program (LEAP); Pivotal Response Treatment (PRT); Reciprocal Imitation Training (RIT); Focus parent training program; parent training.	14h	15h	16h	16h
	16.8h	20h	21.6h	26h
	30h	34h	39h	40h
	81h	113h	156h	184h
	585h	792h	1581h	
Treurnicht Naylor et al. (2011) Intervention(s): Music therapy.	<i>This review included 17 studies; intervention amount was extracted from Table 1 of the original article.</i>			
	1 X 15-20 minute session	1 X 23 minute session	1 X 30 minute session	1 X 45-60 minute session
	1 X <60 minute session	2 X 20 minute sessions over 1 week	8 sessions over 2 weeks	8 X 60 minute sessions over 8 weeks
	8 X 45 minute sessions over 8 weeks	12 sessions over 28 weeks	12 X 30 minute sessions over 24 weeks	16 X 30-45 minute sessions over 8 weeks
	16 X 30-45 minute sessions over 20 weeks	20 X 30-40 minute sessions over 20 weeks	24 X 30 minute sessions over 48 weeks	39 X 60 minute sessions over 13 weeks
	42 to 168 X 30 minute sessions over 12 weeks			
Trzmiel et al. (2019) Intervention(s): Equine-assisted therapy - hippotherapy, therapeutic riding.	<i>This review included 15 studies; intervention amount was extracted from Table 3 of the original article.</i>			
	9 to 12 X 45 to 60 minutes	24 X 60 minutes	4 sessions over 1 month	6 X 180 minutes over 6 weeks
	4 X 2 30 minute sessions	9 X 60 minutes over 9	10 X 45 minutes over 10	10 X >45 minutes over 10

	over 2 X 1 month periods	weeks	weeks	weeks
	12 X 45 minutes over 12 weeks	24 X 45 minutes over 12 weeks	12 X 60 minutes over 12 weeks	12 X 60 minutes over 12 weeks
	25 X 60 to 70 minutes over 6 months	10 X 30 minutes over 10 weeks	> 40 minute sessions (6 weeks intervention, 6 week break, 4 weeks intervention, 6 weeks break, 8 weeks intervention)	
Tupou et al. (2019)	<i>This review included 16 studies; intervention amount was extracted from Table 1 of the original article.</i>			
Intervention(s): Comprehensive treatment programmes - Developmentally Appropriate Treatment for Autism (DATA); Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH); Early Intensive Behavioural Intervention (EIBI); Learning Experiences and Alternative Program for Preschoolers (LEAP); Comprehensive Autism Program (CAP); EIBI intervention described as being based on Lovaas' UCLA model. Skills focused interventions targeting - communication, play skills, peer interaction, and reading skills.	1 X 15 minutes/day for 12 sessions	2h at home and 2h at school (experimental group) or 2h 'of each type at school' for 24 months (control group)	4 X 0.33h/week, data were collected over 1 month	2 to 10 minutes/day for 2.5 months (mean)
	30 to 35 minutes/week for 14.5 (mean) sessions/month	5 X 0.83h/week	4 X 0.55h/week for 1.2 months	2 X daily, data collected over 36 sessions
	30 (Eric), 56 (Ben), 63 (Phillip), or 71 (Lucas) sessions over 8 months	2 X 3h/week (Integrated playgroup), 3 X 6h/week (individualized instruction), 7h/week for 9 to 21 (mean = 13.5) months (family/home support)	17 (mean) sessions over 2 years (integrated into the daily preschool program)	5 X 13.6h/week (experimental group), at least 5h/week for 25 months (control group)

	18 h/week (integrated into the daily preschool routine) data collected for 6 months	3 X 15 minutes/day, integrated throughout the school day for 16 h/week for one school year	20h/week for 16 months (mean)	15 to 37h/week (mean = 23) and additional hours/week at home over 24 months
Verschuur et al. (2014) Intervention(s): Pivotal Response Treatment (PRT); Natural Language Paradigm; facilitated social play training; and socio-dramatic play training.	<i>This review included 43 studies; intervention amount was extracted from Table 1 of the manuscript.</i>			
	2 X 10 minute individual and 2 X 10 minute group sessions 2 X 45 minutes sessions/week	30 minute sessions 3 to 6 X 10 minute sessions 1 to 2 X weekly	2 X 30 minute sessions weekly 2 X 60 minute sessions weekly	3 X 15 minutes modelling and 15 minute video feedback 2h sessions
	3 to 4 X 30 minutes training	4 X 30 minute training sessions and 10 minutes practice and feedback	4 X 30 minute training session and 10 minutes practice and feedback	6 sessions
	10 to 15 X 8 minute video modelling sessions and 20 X 30 minute intervention sessions	5 to 9 X 15 minute parent training sessions and 4 X 15 minute home sessions/week	8 X 20 minute peer training sessions and 3 to 4 X 10 minute generalisation sessions	7 X 20 minutes peer training and 7 X 20 minutes peer delivered intervention
	3 X 2h	1 to 3 X 10 minute sessions on 1 day/week for 3 months	1 X 6h group training and 1 to 4 X coaching sessions	1 X 30 minute and 9 X 45 to 55 minute sessions
	10 minute session weekly	10 X 1h sessions over 10 weeks	12 X 1h over 12 weeks	16h
	10 X 90 minute group sessions and 1 X 50 minute	2 X 8h group training and 3 X 15 minutes video	12 X 1h parent education sessions and 12 X 1hr	5 X 5h sessions

	individual session over 10 weeks	feedback sessions	support groups over 12 weeks	
	6h/week for 5 weeks training and 10h parent delivered intervention	8 to 10h/week over 4 months	3 X 1h sessions weekly followed by 3 X sessions weekly for 8 weeks	4 to 5 X 10 minute individual sessions and group staff training
	5 X 5h parent training days, 3 to 25h caregiver training	2 X 2.5hr/week for 12 weeks (Intervention), 4 X 2.5h sessions (Condition 1), 4 X 2.5h sessions for 2 children and 8 X 2.5h sessions for 1 child (Condition 2), or 16 X 2.5h sessions for 2 children and 12 X 2.5h sessions for 1 child (Condition 3)	2 X 60 minute sessions/week for 2.6 years (average)	5 X 6h groups and 15h/week intervention for 12 months (Cohort 1), 1 week parent training and 15h/week intervention for 6 months, 10h/week for 3 months then 5-6h/week for 3months (Cohort 2)
	not specified for 4 studies			
Virués-Ortega (2010)	<i>This review included 22 studies; intervention amount was extracted from Table 1 of the original article.</i>			
Intervention(s): Applied Behavior Analytic (ABA) intervention - UCLA model, general ABA.	12 weeks 27h/week for 41.61 weeks 30h/week for 53 weeks 19.45h/week for 68.9 weeks	20h/week for 12 weeks 40h/week for 48.18 weeks 35h/week for 53 weeks 12h/week for 88.91 weeks	5.85h/week for 31.6 weeks 49.14 weeks 45h/week for 53 weeks 18.72h/week for 105.12 weeks	12.2h/week for 41.61 weeks 20h/week for 53 weeks 32.5h/week for 62.24 weeks 25.6h/week for 105.12 weeks
	40h/week for 106 weeks 23.5h/week for 148.10 weeks 40h/week for 407.34 weeks	40h/week for 106 weeks 31.28h/week for 198.85 weeks	32.4h/week for 109.5 weeks 37.58h/week for 211.25 weeks	37.5h/week for 141 weeks 24.52h/week for 250.67 weeks

Waddington et al. (2016) Intervention(s): Early Start Denver Model (ESDM).	<i>This review included 15 articles (12 studies); intervention amount was extracted from Table 1 of the original article.</i>			
	1 workshop (4 full days)	1h/week with child for minimum 9 weeks, 10h and 3h training seminars and 4h supervision	15 to 20h/week group and 1h/week individual sessions	1h/week for 12 weeks
	1h/week for 12 weeks	1h/week for 12 weeks	1h/week for 12 weeks	1.5 h/week for 12 weeks
	1.5h/week for 12 weeks	15-20h/week (group) + 1h/week (individual) for 11.8 months	15-25h/week group intervention for 12 months	15 to 25h/week of group intervention for 1 year
	15h/week (therapist implemented) and 16h/week (parent implemented) for 2 years	15h/week (therapist implemented) and 16h/week (parent implemented) for 2 years	15h/week (therapist implemented) and 16h/week (parent implemented) for 2 years	
Watkins et al. (2019) Intervention(s): Interventions in inclusive settings - visual cues; social scripts; Social Stories; video modelling; communication books; peer-mediated intervention (PMI), self-monitoring; peer networks; individualised interventions based on the results of a functional behaviour assessment (FBA); social skills groups; initiations training; high probability request sequences; music therapy;	<i>This review included 28 studies; intervention amount was extracted from Table 1 of the original article.</i>			
	13 X 2 to 5 minute sessions	4 X 15 minute sessions	3 X 10 minutes/week (Mean =13 sessions)	5 X weekly (Mean = 9 sessions per setting)
	1–3 X 20 minutes/day for 5 days (Mean = 10 sessions)	5 X weekly for up to 3weeks (Mean = 10 sessions)	5 X 5 minutes/week (Mean = 37 sessions) and 4 to 22 minutes before training 10 sessions (mean)	1 X 30 minutes/week (Mean = 7 sessions)
	2 X 20 minutes/week for 6 weeks	2–3 X 30 to 40 minutes/week (Mean = 7 sessions)	11 (mean) X 25 to 35 minute sessions over up to 14 weeks	10 X 30 minute sessions

and behavioural strategies were implemented in one study each.	10 X 30 minute sessions	21 X 15 minute sessions	2 to 3 sessions weekly (Mean = 13 sessions)	2 to 3 X weekly (11 sessions total)
	5 X 10 minutes/week for up to 15 weeks (Mean = 35 sessions)	3 X 10 minutes/week for 13 weeks (Mean = 13 sessions per activity)	2 X 30 to 45 minutes/week for 8 weeks	1 X 30 minutes/week for up to 10 weeks (Mean = 13 sessions)
	1 to 4 X 10 to 20 minute sessions/week for 10 weeks (Mean = 10.5 sessions per behaviour)	16 X 40 minute sessions	2 to 3 X 90 minutes/week (mean = 26 sessions)	5 X 10 minutes/week for up to 34 weeks (mean = 25 sessions)
	5 X 10 minutes/week for up to 34 weeks (Mean = 25 sessions)	5 X 45 minutes/week (Mean = 37 sessions)		
	not specified for 1 study			
Weitlauf et al. (2017) Intervention(s): Sensory integration-based; environmental enrichment-based; auditory integration-based; music therapy; massage-based; other/additional such as tactile-based tasks, and weighted blankets.	<i>This review included 24 studies; intervention amount (total duration of treatment) was extracted from Appendix G of the original article.</i>			
	24 to 48h 2 weeks 8 weeks 16 weeks 5 months 6 months	1 week 25 days (2 blocks) 8 weeks 4 months 5 months 7 months	1 week 6 weeks 10 weeks 4 months 5 months 8 to 10 months	2 sessions/day for 10 days 45 days 12 weeks 5 months 6 months 12 X 30 minutes weekly
Weston et al. (2016) Intervention(s): Cognitive behavioural therapy.	<i>This review included 48 studies; intervention amount was extracted from Appendix A of the original article.</i>			
	15 sessions	up to 20 X 60 minute sessions (mean = 17.4)	10 to 50 sessions (mean=27.5 sessions)	weekly parent training, summer program, and 25

	weekly parent training, summer program, and 25 whole day sessions over 5 weeks	sessions)		whole day sessions over 5 weeks
	4 X 50 minutes 9 X 60 minutes 16 X 75 minutes 12 X 90 minutes 12 X 90 minutes 14 X 90 minutes 16 X 60 to 90 minutes 20 X 90 minutes 7 X 120 minutes 15 X 120 minutes 9 x 150 minutes	6 X 20 minute sessions 18 X 50 minutes 10 X 60 minutes and 1 booster session 16 X 75 minutes 12 X 90 minutes 14 X 90 minutes 14 X 90 minutes 16 X 60 to 90 minutes 32 X 90 minutes 8 X 120 minutes 20 X 120 minutes 36 X 180 minutes	5 X 30 minutes/week for 14 weeks 6 X 60 minutes 12 X 60 minutes 20 X 75 minutes 12 X 90 minutes 14 X 90 minutes 16 X 90 minutes 16 X 90 minutes 5 X 120 minutes 9 X 120 minutes 21 X 60 minutes (group) and 3 X 60 minutes (individual)	12 X 40 minutes and 6 to 12 minutes daily 8 X 60 minutes 15 X 60 minutes 25 X 75 minutes 12 X 90 minutes 14 X 90 minutes 16 X 60 to 90 minutes 16 X 90 minutes 6 X 120 minutes 12 X 120 minutes 7 X 75 minute group and up to 13 X 60 to 70 minute individual sessions
Wiese et al. (2016) Intervention(s): Equine-assisted therapy - Therapeutic horse-riding (THR); Hippotherapy; and Equine-assisted activities.	<i>This review included 8 studies; intervention amount was extracted from Appendix 1 of the original article.</i>			
	1 X 60 minute session weekly for 6 weeks 1 X 60 minute session weekly for 12 weeks	1 X 60 minute session weekly for 9 weeks 1 X 45 minute session weekly [6 weeks intervention (6 week break) 4 weeks intervention (6	1 X 45 minute session weekly for 12 weeks 1 X 60 minute session weekly for 12 weeks with 2-month follow-up	1 X 60 minute session weekly for 10 weeks 24 X 45 minute sessions over 3 months

		week break) 8 week intervention]		
Zagona & Mastergeorge (2018) Intervention(s): Peer-mediated instruction and intervention.	<i>Intervention amount was not specified.</i>			

S20: Information on the influence of the amount of intervention on intervention effects.

Systematic review	Focus of systematic review (specific focus)	Summary of evidence
Makrygianni & Reed (2010)	Practice/category (Behavioural category)	Summary: Higher intensity (hours per week) related to greater intervention effect on cognition and adaptive behaviour, but not language. Intervention duration (months) not related to intervention effect on cognition, adaptive behaviour, or language.
Virués-Ortega, et al. (2010)	Practice/category (Early intensive behavioural intervention practice)	Summary: Greater total hours related to greater intervention effect on language and adaptive behaviour, but not cognition.
Tiede & Walton (2019)	Practice/category (NDBI category)	Summary: Greater intervention effect on joint attention, but not on outcomes relating to core autism characteristics, social-communication, expressive or receptive language, cognition, play, or adaptive behaviour.
Waddington et al. (2016)	Practice/category (Early Start Denver Model practice)	Summary: Total hours of intervention inconsistently related to intervention effects.
Fuller, Oliver, et al. (2020)	Practice/category (Early Start Denver Model practice)	Summary: Duration of intervention (total weeks) not related to child outcomes. Intensity of intervention (hours per week) not related to child outcomes. Total hours of intervention not related to child outcomes.
Bejarano-Martín et al. (2020)	Outcomes (Social-communication)	Summary: Total hours inconsistently related to intervention effects on social-communication.
Fuller & Kaiser (2019)	Outcomes (Social-communication)	Summary: Total hours not related to intervention effects on social-communication. Intervention duration (weeks) not related to intervention effects on social-communication.
Sandbank et al. (2020b)	Outcomes (Communication)	Summary: Total hours not related to intervention effects on communication.
Hampton & Kaiser (2016)	Outcomes (Communication)	Summary: Total hours not related to intervention effects on expressive language (spoken language).

Case & Yun (2019)	Outcomes (Motor skills)	Summary: Greater total hours related to greater intervention effects on motor skills.
Naveed et al. (2019)	Intervention delivery characteristics (Non-specialist mediated)	Summary: Intervention duration (weeks) not related to intervention effects. Number of intervention sessions not related to intervention effects.
Nevill et al. (2018)	Intervention delivery characteristics (Parent-mediated)	Summary: Total hours not related to intervention effect on autism core characteristics, socialisation, communication, or cognition.

Note: The effect of the amount of intervention on child and family outcomes was not reported in any systematic reviews focusing on developmental, sensory-based, TEACCH, technology-based, animal-assisted, CBT, and other interventions.

S21: Information on the influence of different intervention delivery characteristics on intervention effects.

Characteristic	Systematic review	Summary of evidence
Setting	Parsons, Cordier, Munro et al. (2017)	Intervention setting not related to intervention effects on social-communication.
	Kent et al. (2020)	Intervention setting (clinic, home) not related to the intervention effect on play.
Format	Parsons, Cordier, Munro et al. (2017)	Intervention format (individual, group) not related to intervention effects on social-communication.
	Kent et al. (2020)	Intervention format (individual, group) did not relate to intervention effects on play.
	Tachibana et al., (2018)	Intervention format (individual, group) did not relate to intervention effects on overall autism characteristics, social-communication, expressive language, receptive language, cognition, or adaptive behaviour.
Agent	Bejarano-Martín et al. (2020)	Interventions involving caregivers or teachers had a similar positive effect to those involving clinicians alone.
	Fuller & Kaiser (2020)	Intervention agent (clinicians, caregivers, school staff) not related to intervention effects on communication.
	Parsons, Cordier, Munro et al. (2017)	Positive intervention effect for interventions with active caregiver involvement, but not for interventions with parent education alone.
	Murza et al., (2016)	Intervention agent (caregiver, non-caregiver) not related to intervention effects on social-communication.
	Sandbank et al. (2020b)	Intervention agent (clinician, caregiver, educator, technology, combination, other) not related to intervention effects on communication.
	Hampton & Kaiser (2016)	Interventions involving clinicians and caregivers related to greater intervention effect on expressive language (spoken language) than clinicians or caregivers alone.
	Naveed et al. (2019)	Intervention agent (caregivers, peer, teacher, school staff, childcare worker) not related to intervention effects on autism core characteristics (including joint attention). Parent-implemented

		interventions related to greater effect on child joint engagement than peer/educator-implemented interventions.
	Watkins et al. (2019)	Interventions delivered by teachers had a greater intervention effect than interventions delivered by researchers or peers.

S22: Synthesis of evidence from umbrella review regarding effect of parent-mediated, peer-mediated, and telepractice delivery of interventions on child and family outcomes

Interventions		Core autism characteristics				Related skills and development								Education and Participation				Family wellbeing					
	No. of Systematic Reviews	Overall autism characteristics	Social communication	Restricted and Repetitive Interests and Behaviours	Sensory behaviours	Communication	Expressive Language	Receptive Language	Cognition	Motor	Social-emotional/ challenging behaviour	Play	Adaptive Behaviour	General Outcomes	School/ Learning Readiness	Academic Skills	Quality of life	Community participation	Caregiver communication and interaction strategies	Caregiver social emotional wellbeing	Caregiver satisfaction	Caregiver financial wellbeing	Child satisfaction with intervention
Parent-mediated	6	+	+	+		+	O	O	+	+	+	+	O		+	+			+	?	+		
		L	L	L		L	H	H	L	L	L	L	H		L	L			H	H	H		
Peer-mediated	4		+	+		+			+		+	+			+	+							
			LLLL	L		LL			L		L	L			LL	L							
Telepractice	4		?			?					+			+					+	+	+		
			LM			LL					L			M					LLM	L	LL		

Note: + Positive therapeutic effect; ? Inconsistent therapeutic effect; O Null effect. Blank cell indicates no evidence available.

S23: Information on the influence of different child characteristics on intervention effects

Child characteristic	Systematic review	Summary of evidence
Child age	Makrygianni & Reed (2010)	Behavioural intervention (category): Child age not related to intervention effect on communication, cognition, or adaptive behaviour.
	Waddington et al. (2016)	NDBI Practice (Early Start Denver Model): Child age inconsistently related to intervention effects.
	Bejarano-Martín et al. (2020)	Social-communication outcomes: Age inconsistently related to intervention effects on social-communication.
	Fuller & Kaiser (2020)	Social-communication outcomes: Age related to intervention effects on social-communication. Intervention effects increased from 2 to 4 years of age, but then diminished as children got older. Greatest intervention effects at around 4 years of age.
	Parsons, Cordier, Munro et al. (2017)	Social-communication outcomes: Age not related to intervention effects on social-communication.
	Sandbank et al. (2020b)	Communication outcomes: Age not related to intervention effects on communication.
	Hampton & Kaiser (2016)	Expressive language: Age not related to intervention effects on expressive language (spoken language).
	Case & Yun (2019)	Gross motor: Age not related to intervention effects on motor skills.
	Naveed et al. (2019)	Effect of non-specialist mediated intervention: Age not related to intervention effects.
Core autism characteristics	Binns & Oram Cardy (2019)	Developmental interventions (category): The level of pre-intervention core autism characteristics inconsistently related to intervention effects on social-communication.
	Waddington et al. (2016)	NDBI Practice (Early Start Denver Model): Greater pre-intervention imitation was inconsistently related to intervention effects. Functional use of objects, and goal understanding related to greater intervention effects.

	Sandbank et al. (2020b)	Communication outcomes: Level of overall autism characteristics prior to intervention not related to intervention effects on communication.
Communication	Makrygianni & Reed (2010)	Behavioural intervention (category): Pre-intervention communication (language abilities) not related to intervention effect (behavioural intervention) on communication, cognition, or adaptive behaviour.
	Bejarano-Martín et al. (2020)	Social-communication outcomes: Child communication skills prior to intervention not related to intervention effects on social-communication.
	Sandbank et al. (2020b)	Communication outcomes: Greater language skills prior to intervention related to greater intervention effects on communication.
Cognition	Makrygianni & Reed (2010)	Behavioural intervention (category): Pre-intervention cognition (intellectual abilities) not related to intervention effect (behavioural intervention) on communication, cognition, or adaptive behaviour.
	Waddington et al. (2016)	NDBI Practice (Early Start Denver Model): Pre-intervention cognitive ability and social attention not related to intervention effects.
	Bejarano-Martín et al. (2020)	Social-communication outcomes: Child cognitive ability prior to intervention not related to intervention effects on social-communication.
Adaptive behaviour	Makrygianni & Reed (2010)	Behavioural intervention (category): Greater pre-intervention adaptive behaviour skills related to greater intervention effects on communication and adaptive behaviour, but not on cognition.

S24: Summary of Member Expertise and Declared Interests

This information has been made available to the editor but has been withheld for blind review.