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Systematic Review of factors that may influence the outcomes and generalisability of parent-mediated interventions for young children with autism spectrum disorder

Running title: Parent-mediated interventions

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Abstract

Parent mediated interventions have the potential to positively influence the interactions and developmental outcomes of children with Autism Spectrum Disorder (ASD). However, a range of factors relating to children, parents and caregivers, and study design may impact on outcomes and thus the generalizability of these interventions to the broader community. The objective of this review was to examine factors that may influence the feasibility, appropriateness, effectiveness, and generalisability of parent mediated interventions for children with ASD. We conducted a systematic review, yielding 41 articles. There was substantial variability in the intervention type, intensity, and study quality. Notably, 46 different inclusion/exclusion criteria were reported across studies including factors relating to children's development, access to other services, comorbidities, parental factors, and access to the intervention. Fifteen articles included examination of 45 different factors potentially associated with, or influencing, intervention outcomes including child (e.g., language skills, ASD severity, cognition) and parent (e.g., adherence and fidelity, education) factors. Although there is clear evidence for an increasingly sophisticated (e.g., systematic phased research for some interventions) and diverse (e.g., studies in geographical diverse contexts including low-resource communities) approach to research examining parent mediated interventions, there remains a need for improved study quality and measurement consistency in research, including a detailed examination of factors that may predict, moderate, and mediate intervention effectiveness for children and their parents.

Key words: Autism spectrum disorder, parent-mediated, caregiver-mediated, intervention

Lay Summary

Parent mediated interventions - in which parents adapt their own behaviour or deliver interventions to help their children learn – appear to be effective for some children with Autism Spectrum Disorder. In this review, we identified a range of child, parent, and study design factors that may influence intervention outcomes and ultimately the uptake of these approaches in the community. We suggest that research in this area could be further improved by ensuring that studies include diverse groups of children and parents, and by using study designs that help to establish not only if interventions work, but for whom they work best and why.

Systematic Review of factors that may influence the outcomes and generalisability of parent-mediated interventions for young children with autism spectrum disorder

Autism spectrum disorder (ASD) affects approximately 1 in 59 children, in most cases negatively impacting their learning and participation in life activities while conferring emotional and financial pressure on their families (CDC, 2014; McStay, Trembath, & Dissanayake, 2014). Accordingly, a variety of interventions have been developed to address children's difficulties including comprehensive approaches that target multiple developmental domains (e.g., social, communication, daily living skills), as well as focused interventions that target a specific skill area (e.g., requesting, joint attention) (Odom, Boyd, Hall, & Hume, 2010). Common to evidence-based comprehensive interventions are a set of elements including individualised goal selection, application of behavioural learning principles in intrinsically motivating naturalistic interactions, and the systematic evaluation of outcomes (Schreibman et al., 2015). Increasingly, parents (and other caregivers) are being placed at the centre of attempts to support their children's development, through parent-mediated interventions.

Parent-mediated interventions

In this review, parent-mediated interventions are defined as interventions that involve professionals training parents (here this term refers to all primary caregivers) to deliver strategies aimed at improving the management of their children's difficulties (Oono, Honey, & McConachie, 2013). The goal of these interventions is to harness parents' intrinsic strength, insight, and motivation to support their children's development, as parents are the most attuned and invested agents of change in their children's lives (Oono et al., 2013). Parent-mediated interventions also have the potential to facilitate an intensive, naturalistic, and tailored approach to the intervention, which is consistently recommended in good

practice guidelines (e.g., Roberts & Williams, 2016) and may be an important source of empowerment for parents (Guralnick, Hammond, Neville, & Connor, 2008). Furthermore, these interventions may provide a more economical and practical means for families to support their children's development, particularly in low resource settings (Divan et al., 2015). Accordingly, there has been rapid growth in research examining the effectiveness of parent-mediated interventions in the past 15 years (Guralnick et al., 2008; Nevill, Lecavalier, & Stratis, 2018).

Evidence for effectiveness

Individually, studies of parent-mediated interventions - which vary considerably with respect to program, population, location, and mode of delivery – point to a range of potential benefits for children and parents. However, recent systematic reviews (Nevill et al., 2018; Oono et al., 2013; Parsons, Cordier, Vaz, & Lee, 2017) imply that a conservative view regarding effectiveness is nevertheless currently appropriate. Nevill, Lecavalier, and Stratis (2018), for example, completed a meta-analysis of the efficacy of 19 randomized-control trials of parent-mediated interventions for children with ASD age 1-6 years. They reported only small improvements based on measures of ASD symptom severity, socialisation, and cognition; describing improvements in communication (including language) as trivial. Parsons et al. (2017) reviewed studies of parent-mediated interventions delivered remotely for parents of children with ASD living outside urban areas, noting preliminary evidence but a lack of well controlled studies and design limitations (including defining populations and a lack of standardised measures). The authors called for further research examining the appropriateness and feasibility of interventions. Oono, Honey, and McConachie (2013), completed a Cochrane Review of 17 studies involving 919 children with ASD, finding strong evidence of proximal impact on parent-child interactions (e.g., shared attention, parent synchrony). However, only small effect sizes were found for intervention effects on children

such as changes in their comprehension and ASD characteristics; findings were inconclusive regarding language and communication, adaptive behaviour, and parenting stress.

The need for further investigation

The fact that parent-mediated interventions have a strong theoretical and practical rationale, coupled with emerging evidence for the potential to positively influence parent-child interactions, has led to calls for further research. Of prime importance is the need for additional well-designed studies that minimise the risks of bias and adopt more consistent intervention paradigms and measures that allow for the aggregation of data for meta-analysis (Nevill et al., 2018; Oono et al., 2013; Parsons et al., 2017). Improving the quality and consistency of research in this manner should help to elucidate the capacity for these interventions to impact child and parent outcomes. However, as per findings from a now large body of clinician-mediated intervention research (Reichow, Hume, Barton, & Boyd, 2018), it is likely that increased precision in parent-mediated research will further reveal an emerging picture of individual variability in child and parent outcomes. Thus, it is timely that systematic reviews move beyond examining the effectiveness of interventions, to consider factors that may influence outcomes as well as the generalisability of findings to the broader clinical population. Doing so will provide the means to account for these factors in the design and conduct of future trials, and help address calls (e.g., Jonsson, Choque Olsson, & Bölte, 2016; McConachie et al., 2015) for greater attention to external validity in intervention research.

Intervention characteristics that may impact on outcomes and generalisability

In considering the evidence for the effectiveness of parent-mediated interventions, including implications for practice, it is important to first consider the nature of the interventions and the populations for whom they have been developed. Previous reviews

(e.g., Nevill et al., 2018; Parsons et al., 2017) have examined a range of participant (e.g., number, age, gender, parent education, and geographical location) and intervention (e.g., label, dosage, delivery format) characteristics, noting a high degree of heterogeneity. However, these characteristics have been inconsistently documented across reviews, and little attention has been given to how these and additional factors may combine to impact intervention outcomes, including the experience of those involved. For instance, at a practical level, consideration must be given to the feasibility of parent-mediated interventions, including geographical location, the time required to deliver the intervention with fidelity, and the costs for families such as time, transportation, and lost earnings. Equally, or perhaps more importantly, is the need for closer consideration of the factors that may have an impact on the appropriateness of parent-mediated interventions for individual families.

Participant characteristics that may impact outcomes and generalisability

Families are diverse with respect to culture and language, socioeconomic status, geographical location (e.g., urban, rural, remote), the presence of siblings with or without developmental challenges, and varying levels of parenting stress. Presumably, parent-mediated interventions must be flexible enough to accommodate diverse circumstances. In particular, parent-mediated interventions need to be tailored to parental capacity with careful consideration of the presence of other family stressors, since a high demand for parental involvement can place strain on caregivers (Schwichtenberg & Poehlmann, 2007) adversely influencing children's behaviour and significantly reducing the effectiveness of early intervention (Osborne, McHugh, Saunders, & Reed, 2008; Robbins, Dunlap, & Plienis, 1991). The demands placed on the parent to master a number of complex strategies (Osborne et al., 2008) may also be too onerous, making the investment too challenging for some parents.

Design characteristics that may influence outcomes and generalisability

A further consideration regarding the evidence for the effectiveness of parent-mediated interventions is the extent to which study samples reflect the broader community of children with ASD and their parents. Although restrictive inclusion and/or exclusion criteria in studies are often critical to enhancing internal validity, such an approach may reduce external validity, particularly in children with ASD who have a high prevalence of comorbidities including intellectual disability, speech-language disorders (e.g., language impairment, childhood apraxia of speech), and medical conditions (e.g., Fragile X, seizure disorders). Tager-Flusberg and Kasari (2013), for example, noted that the estimated 30% of children with ASD who remain minimally verbal (e.g., Norrelgen et al., 2015; Rose, Trembath, Keen, & Paynter, 2016) have often been excluded from research due to their variability in presentation and challenges in achieving a reliable and valid assessment of their skills. Similarly, while achieving compatibility between the parent-mediated approach and the needs, values and past experiences of families and communities is vital to the success of parenting interventions, Aboriginal and ethnic minority communities continue to be greatly underserved and are generally underrepresented in research on neurodevelopmental disorders (Ratto et al., 2017). Given the premise that parent-mediated interventions have the potential to reach the broad community, it is imperative that conclusions regarding evidence for the effectiveness of interventions include consideration of sampling techniques, including eligibility criteria.

Potential Mediating and Moderating Factors

The range of factors identified above pertaining to the feasibility and appropriateness of interventions may, alongside child related factors such as cognition, ASD severity, and adaptive behaviour, and fine-grained social-cognitive predictors identified in the broader

intervention research literature (Vivanti, Prior, Williams, & Dissanayake, 2014), mediate and moderate parent-mediated intervention outcomes for children and their families. To this end, recent meta-analyses have attempted to examine a few factors. Nevill, Lecavalier, and Stratis (2018), for example, found no significant difference in outcomes based on dose of treatment in their review of 19 randomized controlled trials. Earlier, Oono, Honey, and McConachie (2013) attempted to examine the possible moderating effects of intervention duration, intensity, type of intervention, parental education, and child intelligence quotient prior to intervention, but were limited by variability in reporting methods. Instead, the authors presented a descriptive summary of the findings of original studies. With the rapid growth of parent mediated research since the time of these reviews, there is an opportunity to identify factors that may potentially mediate and moderate intervention outcomes, to inform current practice and future research design, in advance of dedicated meta-analysis.

Taken together, previous research indicates that there is the potential for parent-mediated interventions to positively influence the lives of children with ASD and their families, yet there is inconsistent evidence regarding child outcomes, including findings of individual variability. To advance science and practice in the use of parent-mediated interventions to the point where they constitute a widely acceptable, feasible, and effective corpus of interventions, there is a need for further well-designed studies. Recent meta-analyses have examined intervention effectiveness and demonstrated this need (Nevill et al., 2018; Oono et al., 2013; Parsons et al., 2017), hence that was not the focus of this review. Instead, our objective was to inform the design of this future research by examining factors that may influence the outcomes and generalisability of these interventions. The specific aims of our systematic review were to (a) examine the nature of parent-mediated interventions for children with ASD presented in research including the populations for whom they have been designed, (b) explore the extent to which intervention studies have included samples

reflecting the diverse characteristics of children on the spectrum, including those with comorbidities, and (c) identify potential mediating and moderating factors that may influence the outcomes of these interventions.

Methods

Design

A systematic literature review was conducted in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). The protocol for the review was registered in advance on PROSPERO (Record ID 79163).

Search Strategy

The sixth author conducted initial searches in October 2017 of the Cochrane Library, MEDLINE, PsycINFO (psychology/psychiatry literature), EMBASE, Scopus, and Google Scholar, covering the period 2008-2018, with the 10-year period chosen to identify articles examining parent-mediated interventions that were recently, or currently, in development and use. Search terms included “Autis* or ASD” AND child* in combination with “Parent” OR “Caregiver” OR “Guardian” OR “Mother” OR “Father” AND “Implemented” OR “Administered” OR “Mediated” OR “Delivered” AND “Intervention” OR “Program” OR “Treatment” OR “Parent-Training.” As presented in Figure 1, a total of 2,745 articles were identified, with 823 articles remaining after duplicates were removed. The third and sixth authors independently reviewed titles and abstracts for the 823 records, yielding a total of 67 different articles. Of these, 43 were common to both reviewers, with 24 disagreements yielding total inter-rater reliability of 97.1% for the review of the 823 records. The fifth and sixth authors reviewed full text articles for all disagreements to confirm they did not meet the

inclusion criteria. The sixth author completed full text review of the 43 common articles, and in consultation with the broader team, identified 36 articles meeting the inclusion criteria. The 31 articles excluded after full-text screening were rejected for one or more of the following reasons: (a) there were no original empirical data available (e.g., review articles), (b) data were based on single-subject designs or case studies, (c) the study did not report child outcome data, (d) the sample did not exclusively comprise children with ASD, (e) the intervention manipulated dietary habits and did not directly intervene on behavior, (f) the intervention was not primarily parent-mediated, or (8) the study design did not include a control group. A further three articles were identified through hand searches of reference lists during the extraction phase. Finally, the searches were updated in September 2018, yielding an additional two articles. In total, 41 articles were deemed to have met the inclusion criteria. In cases where further analyses of study data were presented across more than one article, all articles were included (e.g., Siller et al., 2013; 2014).

< Insert Figure 1 about here >

Inclusion Criteria

Articles were accepted in our review if they met the following criteria: (a) written in English and published in a peer-reviewed journal; (b) employed a group design; (c) sample must have included children with ASD between 0-12 years old; (d) sample must have consisted primarily of children with ASD (studies that included children with other disabilities were included if findings were reported separately for children with ASD); (e) must have involved professionals training parents to deliver educational strategies aimed at improving management of their children's difficulties; (f) primary outcome(s) included pre-post changes in the children's adaptive behaviour (e.g., social, communication, daily living skills), ASD symptoms, and/or cognition; (g) secondary outcomes, if reported, were included

in data extraction in studies where they focused on parent outcomes; and (h) reported sufficient statistical information for extracting changes in outcome variables. Studies were excluded if they involved biomedical or physical interventions including diet, exercise, and medications. We also excluded studies involving interventions aimed primarily at reducing or preventing social, emotional, and behavioural problems.

Data Extraction

The sixth author extracted information from the articles including (a) research design, (b) participant characteristics (e.g., diagnosis, diagnostic confirmation methods, sample size, gender, age, intellectual functioning), (c) country where study was located, and primary language, (d) details of intervention program (e.g., intervention model, type and length of training caregivers received, who trained parents), (e) primary and secondary outcome measures, and (f) findings regarding variables possibly associated with intervention outcomes (i.e., predicting, mediating, or moderating). Data were summarised in tables, and two figures – summarising child and parent measures used across studies – were constructed by the fifth and sixth authors through a process of classification by consensus. To provide an indication of study quality, risk of bias was examined using the Effective Public Health Practice Project (EPHPP) tool (Thomas, Ciliska, Dobbins, & Micucci, 2004). The EPHPP tool provides a global rating of strong (score = 1), moderate (score = 2), or weak (score = 3) based on the extent to which the following potential risks were dealt with in the study: selection bias, study design, confounders, blinding, data collection methods, and withdrawals and dropouts (see 3rd column in Table 1).

Results

Study Characteristics

Table 1 summarises characteristics of the interventions. Of the 41 studies extracted, 36 reported the findings of randomized controlled trials (RCTs), while the remainder comprised non-randomised trials and cohort studies. Studies included between 8 and 152 children, ranging in age from 12 months to 12 years and 11 months across studies. Three studies reported on the use of Preschool Autism Communication (PACT), while one study presented its adapted form of *Parent-mediated intervention for Autism Spectrum Disorders in South Asia (PASS)*. Seven studies reported on the *Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER)* method, three on the parent mediated and telehealth *Early Start Denver Model (ESDM)*, and three on the *Improving Parents as Communication Teachers (ImPACT)* method. *Joint Engagement Intervention, Parent Advocacy Training and Focused Playtime Intervention (PAC+FPI)*, and *Social ABCs* methods were each utilised twice. The remaining studies used unique parent mediated interventions. The context for parent training varied across studies, with training occurring primarily in the home for 17 studies, primarily a clinic for 17 studies, and a mixture of home and clinic for 6 studies. The location of training in the study by Casenhiser, Shanker, and Stieben (2013) was not specified. Training ranged from reviewing a DVD with a run time of 66 minutes, including activities (Nefdt, Koegel, Singer, & Gerber, 2010) to 48 hours over 24 weeks (Shire et al., 2015), with the qualifications of parent trainers ranging from unspecified degrees through to therapists with doctoral qualifications. In the majority of cases, the amount of time the parents were expected to spend delivering the intervention to their children was not specified. In the few cases where it was reported, the expectation ranged from 15-30 minutes a day to 20 hours per week. Parent intervention fidelity, where reported, was measured in a variety of ways making comparisons across studies impractical. Using the EPHPP quality assessment tool, 27 studies received a rating of strong, nine a rating of moderate, and 5 studies a rating of weak reflecting the diverse range of study designs and control for potential risk of bias.

< Insert Table 1 about here >

Participant Characteristics

Sixteen of the 41 studies reported family income data, using multiple methods including income brackets or categorisations (e.g., below/above poverty line). A wide spectrum of annual incomes was represented (e.g., <15,000 to >75,000 in Nefdt et al., 2010). However, the majority of participants reported income of more than \$50,000 to \$60,000 (United States dollars) annually. The majority of parents across all studies also completed some education after secondary school, and most families who participated in these studies identified as white. The characteristics of the participants included in the current review, including family income, parent education, and ethnicity is included as supplementary material.

Table 2 summarises the variability in eligibility criteria used in the research of parent-mediated interventions. Note that all studies included some criteria regarding ASD diagnosis (e.g., community diagnosis, verification within the study). Twenty-three studies excluded potential participants on the basis of comorbid disorders (e.g., sensory impairment, genetic disorders), 20 had criteria pertaining to children's development (e.g., verbal and non-verbal communication abilities), and 9 excluded children on the basis of epilepsy, seizures, or medications. Many studies reported eligibility criteria for families of target children as well. For example, 8 studies excluded parents with psychiatric disorders, and 16 studies included criteria related to accessibility, adherence, or exposure including parents' agreement to adhere to intervention protocols, language proficiency, prior exposure to the intervention, and living in specific geographic regions.

<Insert Table 2 about here >

Potential mediating and moderating factors

Two sets of data extracted from the studies provide insight into potential mediating and moderating factors. First, albeit indirectly, the large number of different measures (see Figures 2 and 3) used across studies to characterise participants, monitor intervention delivery and uptake, and evaluate suggests study authors identified that a broad range of child and family factors may be relevant to intervention outcomes and generalisability. The most common measures for children involved video analysis of target behaviours, assessment of ASD characteristics, and adaptive behaviour (including communication). The most common measures beyond child skills related to fidelity of implementation, satisfaction and well-being, and additional services accessed. Second, and more directly addressing the issue, 15 of the 41 studies included analyses regarding potential mediating and moderating factors.

[Insert Figures 2 and 3 about here]

Table 3 presents a list of 45 factors pertaining to children and parents examined across studies, which are categorised descriptively as *broad* (e.g., age, non-verbal ability, ASD severity), *fine-grained* (e.g., joint attention, imitation), and *contextual* (e.g., service access during trials, intervention hours) factors. Table 3 also presents a categorical summary of the outcome in each case (significant versus non-significant finding) as reported by the original study authors. Note that the large number of factors is driven predominantly by the use of a variety of methods for examining a similar construct (e.g., parent fidelity and adherence), and have been retained to illustrate variability in measurement approaches. Furthermore, a variety of design and statistical methods were adopted across studies, ranging from simple reporting of associations to hypothesis driven examination of factors. Given that meta-analyses of the findings is beyond the scope of this review, readers are referred to the original studies for detailed information regarding the specific methods and findings.

[Insert Table 3 about here]

Broad child factors. A range of factors either related to child chronological age, ASD severity, language level, and non-verbal development at baseline yielded either mixed or non-significant findings. For example, in relation to non-verbal ability, Hardan et al., (2015) reported that baseline visual reception scores on the Mullen Scales of Early Learning (MSEL) were a significant predictor of changes in imitative and total utterances amongst children receiving parent-mediated Pivotal Response Training, whereas Green et al., (2010) using the same measure found no significant relationship with outcomes for children who participated in the Preschool Autism Communication Trial (PACT). In contrast, examination of ASD severity yielded consistent non-significant findings across two studies (Green et al., 2010; Oosterling et al., 2010) in which it was reported.

Fine-grained child factors. Five studies examined within domain skills such as vocal initiation, joint attention, responsivity to adult communication, smiling, and object exploration, linking these to hypothesised active ingredients within interventions. Here too, there were mixed findings. For instance, Rogers et al (2012) hypothesised that two key pre-intervention variables—*social orienting* and *imitation*—would moderate the effects of P-ESDM, as these behaviors are known to support social learning in preverbal toddlers and are distinguishing features of ASD in toddlers (Dawson et al., 2004). Contrary to prediction, these variables did not moderate the relationship between group assignment (P-ESDM versus a community intervention group) and outcome variables (autistic traits, language and motor ability)—however, imitation and *nonsocial* orienting had main effects on pre-post outcomes among the entire sample. Similarly, Carter et al (2011) investigated initiating joint attention and initiating behaviour requesting, and found non-significant effects.

Child contextual factors. Differences in children's recruitment pathways (referral source and location) were included to evaluate potential confounds/controls and showed mixed outcomes with recruitment from a larger study (Brian et al., 2016) associated with more positive outcomes than a community referral. In contrast, outcomes did not differ by site (location) in Carter et al., 2011. Kasari et al., (2010) reported that children's access to services (beyond the trial) did not predict any variables related to parent-child interaction, nor caregiver adherence, involvement, or competence in delivering the intervention. Rogers et al., (2012) reported mixed findings regarding the effect of intervention hours on outcomes, with a significant finding for vocabulary production on the MacArthur Bates Communicative Development Inventory, a trend ($p = .06$) for comprehension on the same measure, but non-significant findings for a range of other measures related to ASD severity, cognition, and social-communication skills.

Parent demographic factors. Similar to child predictors, parent variables were a mixture of background variables likely captured to characterise the sample, as well as those predicted theoretically to moderate or mediate outcomes. In terms of background variables, parental education and socio-economic status (based on parental occupation) were not associated with children's outcomes in two separate studies, although one additional study found mixed results based on parental income and parental education.

Parent intervention factors. Measures relating to fidelity or uptake that would theoretically predict better outcomes including broad measures of parent fidelity, skills, and engagement revealed a mixture of significant and non-significant findings. More fine-grained measures that linked to hypothesised changes in specific parent behaviour to support child learning tended to show associations with outcomes including joining, use of affect, use of mirrored pacing, and co-regulation linked to outcomes. For example, Casenhiser et al (2011) measured parent behaviours, targeted and hypothesised to improve child outcomes, including

co-regulation, expression of enjoyment of the child, sensory-motor support, joining, use of affect, support of reciprocity, and support of independent thinking and links to changes in children's social-interaction behaviours (e.g., language change, enjoyment of the interaction, and initiation of joint attention). Their results suggested positive changes in parent behaviours were associated with significant changes in the children's social-communicative functioning.

Parent contextual factors. Pickard et al. (2016) used qualitative inquiry to examine parents' perceptions of the intervention program (Ingersoll et al., 2016), indicating that therapist support to implement the program (as opposed to self-guided modules), time pressures, and having the capacity to access the training in a variety of formats may all impact the uptake and impact of the intervention. Turner-Brown et al., (2016) compared outcomes for rural and non-rural families involved in their trial of Family Implemented TEACCH for Toddlers (FITT), reporting no difference in ratings of parent satisfaction with the intervention, but that rural parents were significantly less likely to report higher levels of progress for their children's cognitive and language skill development compared to non-rural parents. The authors suggested this latter finding was driven by parents in rural areas rarely reporting their children made 'a lot of progress' in these areas.

Discussion

The objective of this review was to examine factors that may influence the outcomes and generalisability of parent mediated interventions. The findings have immediate clinical application, given that clinicians and service providers may use this information to inform decisions regarding the likely relevance of the interventions reviewed to their particular contexts. With respect to research, the findings extend those of previous reviews by highlighting the need for not only greater quality and consistency in study design, but also greater attention to the factors that likely influence outcomes and clinical uptake of the

interventions under evaluation. Here we consider these implications in the context of the four study aims.

Our first aim was to examine the nature of parent-mediated interventions presented in research to date. Our findings indicate a growing maturity in the field, with 41 studies and, importantly, the identification of several interventions (PACT, JASPER, and ESDM) for which multiple studies have been completed. At a practical level, the finding that training took place for up to 48 hours with studies conducted over periods of up to 2 years implies a considerable investment of staff and parent time in developing skills is generally required. While this investment pales in comparison to the potential benefits of parents infusing strategies across all aspects of the child's day, it may nevertheless be a practical barrier for parents who often face considerable time and financial pressure if seeking to complete this training in a fee-for-service community program. Challenges in completing the hours required may help to account for the fact that fidelity ratings were as low as 64% (where reported). To date, much of the research has focused on the development of these interventions in clinical-research settings, followed by translation to the community. Indeed, 17 of the 41 studies involved training parents in clinical settings (e.g., universities). An alternative approach, aimed at ensuring intervention is feasible for families, could be to develop parent-mediated approaches within existing accessible and financially viable community-based services. While the focus of this review was not on intervention outcomes, but rather factors that may influence intervention outcomes, the fact that interventions ranged from 1 to 48 hours of parent training implies there may be scope for greater efficiency in the delivery of some programs, warranting further research.

Our second aim was to explore the extent to which intervention studies have included samples reflecting the diverse characteristics seen amongst children with ASD and their families. Encouragingly, families with diverse annual incomes (where reported) have been

included in this research, although the majority of parents have reportedly had post-secondary school education. Accordingly, the findings reinforce calls and initiatives (e.g., Divan et al., 2015) for clinical-research to expand the scope of parent-mediation research to include families in low resource settings. Although a small number of studies examined the application of parent-mediated interventions in culturally, linguistically, and geographically diverse communities (e.g., Chiang, Chu, & Lee; Rahman et al., 2016; Zhou et al., 2018), the majority of studies to date have been conducted in the United States and United Kingdom and feature predominantly white children. Our findings extend previous research in highlighting the inconsistent and, at times, complex array of eligibility criteria adhered to in the various studies. While the most common eligibility criteria were related to ASD diagnosis, as would be expected, the fact that children or parents with a variety of co-occurring disorders were deemed ineligible in 23 studies suggests these samples may not reflect the broader community. The targeting of interventions to children with specified developmental levels in 20 studies has clinical and scientific merit (e.g., PACT targeting children with complex needs). However, there is a need for even greater transparency in the reporting of intervention findings, including in systematic reviews, to ensure this factor is taken into consideration, particularly when comparing the relative effects of different interventions (Iacono, Trembath, & Erickson, 2016).

Our third aim was to identify factors that may influence the outcomes of parent-mediated interventions. We identified the measurement of a wide array of potential child and parent factors that may be relevant to assessing, but also understanding, intervention outcomes for individual children and families. Consistent with the findings of Oono et al. (2013), we found that just over one third of studies examined potential mediating and moderating factors (using definitions by Vivanti, Prior, Williams, & Dissanayake, 2014). Child factors that were commonly included were those that were potential moderators and

were likely assessed to characterise the sample and/or for inclusion/exclusion criteria and included ASD characteristics, cognition, and adaptive behaviour. Consistent with broader intervention reviews (e.g., Stedman, et al., 2018), we likewise found a mixture of measures used to characterise the sample impacting on the ability to both characterise and compare samples and evaluate moderators/mediators. Across studies, mixed results were found, which may reflect at least in part the use of these same variables (e.g., non-verbal cognition restricted to > 12 months, Green et al., 2010) for inclusion/exclusion criteria restricting the variance. Several studies demonstrated the potential benefits of examining theoretically driven putative predictors of response to intervention, particularly those that are potentially amenable to change such as child behaviours (e.g., social orienting and imitation; Rogers et al., 2012). Greater investigation of theory-driven predictors is warranted to indicate which individual child a specific intervention is most likely to be effective for, and potential targets for success in an intervention (e.g., foundation skills).

The most common measures for parents focused on fidelity, well-being, satisfaction, accessing other treatments, and perceptions (e.g., buy-in). While many of these showed significant links to outcomes, again these may be non-specific predictors of which families would benefit from *any* intervention as opposed to who would benefit from a specific intervention. Of note, were the two studies (Brian et al., 2017; Green et al., 2010) that found no association between parental education and SES and outcome respectively; however as (where available) studies suggest relatively highly educated and higher income participants, the influence of these factors on outcomes warrants further attention. Consistent with Vivanti et al. (2014), we concur that family factors, particularly in parent-mediated interventions, require more fine-grained analysis to determine which families a specific intervention would be most effective for and may include variables absent from current investigations including family expectations of treatment, family self-efficacy, parent/therapist alliance, family stress,

father positive involvement, and social support. Furthermore, continuing to include measures of hypothesised change mechanisms (e.g., changes in parent behaviour) may be of value in determining at what level of generalisation an intervention is effective (e.g., if parent behaviour did not change it may explain non-significant results) and as well as the active ingredients (e.g., parent change in synchrony with child). Taken together, these findings suggest the need for both greater analysis of the impact of moderators typically collected to characterise samples with more systematic selection (as per calls by Stedman et al., 2018 for more consistent characterisations of samples), collection of theoretically-driven putative moderators beyond measures to characterise samples, along with the consideration of broader measurement of potential mediators at both the child and family levels.

Limitations

In considering the findings of this review, it is important to reiterate that the purpose was to examine factors that may influence outcomes and generalisability in the community, not to repeat previous reviews of intervention effectiveness. Thus, clinicians and researchers seeking to implement one or more of the documented approaches should review the original studies when considering if the approach in question is likely to be appropriate, feasible, and effective in the specific population and context. We also note that in keeping with our exclusion criteria, we did not include studies examining parenting programs primarily aimed at preventing or reducing social, emotional, and behavioural problems in children, such as Stepping Stones Triple P (Whittingham, Sofronoff, Sheffield, & Sanders, 2014). There is a substantial body of research examining interventions to reduce behaviours of concern (see Sanders, Kirby, Tellegen, & Day, 2014 for review) that is relevant to the population focus of this review, and may likewise inform future research and clinical directions. Finally, it is important to note that the studies reviewed include a collection of approaches, that we have categorised as parent-mediated as per the description provided by Oono et al., (2013). It

could be argued that there are sub-groups of interventions within this broader category, for instance those in which a parent is taught to administer an intervention a clinician would otherwise deliver (e.g., P-ESDM), versus those in which the intervention seeks to modify the parents behaviour in order to influence the child's development (e.g., PACT), and those that adapt the delivery of the approach using telehealth methods (e.g., ImPACT) for underresourced or remote communities. Presumably, differences in the expectations of parents may translate to differences in factors that drive parent willingness and capacity to engage.

Implications and Future Directions

This review provides a descriptive summary of factors that may influence outcomes and generalisation. From a research perspective, our approach of broadly summarising findings regarding potential mediators and moderators (i.e., significant, non-significant, mixed) is intended to be illustrative, as opposed to definitive, and there is a distinct need for a separate and detailed meta-analysis focusing specifically on mediators and moderators of intervention effectiveness. This is an addition to the call, raised by previous authors (e.g., Nevill et al., 2018; Oono et al., 2013; Parsons et al., 2017) and further supported in this review for higher quality, more consistent, and replication of studies to further establish the evidence base for parent-mediated intervention. For clinicians, we believe the key implications are that (a) while there is indeed a growing range of evidence-based parent-mediated approaches to select from, there is (b) a need for caution when selecting and applying approaches, given the range of factors that may impact relevance and outcomes in a given community. We also acknowledge that parenting beliefs and practices surrounding child rearing must also be considered as parent involvement and motivation are fundamental aspects of the parent-mediated approach. Clinicians are ideally placed to consider these factors, consistent with an evidence-based practice framework which draws on research

evidence, clinical experience, and a deep understanding of client and contextual factors. In fact, we suggest that clinicians, like parents, should play a key role in informing research directions regarding the further development and refinement of parent-mediated interventions, given the relevance and depth of insight regarding these issues.

Conclusion

With a growing body of research pointing to the potential benefits of parent-mediated interventions for supporting development in children with ASD, there is both a need, but also increasing capacity, to examine factors that may influence outcomes. The findings indicate that a range of personal (e.g., participant characteristics, co-occurring conditions), intervention (e.g., approach and intensity), and contextual (e.g., referral source) characteristics may be relevant. Yet, despite assessment of a broad range of factors in studies, to date relatively few have included analyses of these. Moving forward, there is a need for concerted effort to further identify and address relevant factors, with the view to ensuring that all children and their families have access to evidence-based and appropriate interventions.

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Table 1. Study Characteristics

Study	Design & Sample	Risk of Bias	Child age	Intervention ¹	Trainer qualifications	Amount Parent Training	Period of training	Amount parent administration	Parent Fidelity & Adherence	Parent Training Location
Bearss et al., (2013)	Cohort 16	1	43-83m	Modified RUPP developed program	Therapists with independent treatment fidelity	19-28.5 hrs	24w	Unspecified homework	87.3% of session objectives	USA; home, clinic, phone
Brian et al., (2016)	Cohort 20	3	12-32m	Social ABC's	Not specified. Trained in Social ABC's.	13 hrs	M=8.7m	Not specified. Integrated into daily activities	84.3% at 12 weeks, 80% at follow-up	Canada; Home, clinic, phone, email
Brian et al., (2017)	RCT 30 IC 32 CTR	1	16-30m	Social ABC's	Bachelor's-level degrees	18 hrs	12w	NA	67% at 12 weeks, 87% at follow-up	Canada; Home/Phone, community
Byford et al., (2015)	RCT 77 IC 75 CTR	1	24-60m	PACT	Speech and language therapists	36 hrs	24w + 6m support	30mins/day	Median 16/18 sessions completed	England; primarily clinic
Carter et al., (2011)	RCT 32 IC 30 CTR	1	15-25m	HMTW	Speech/language pathologist certified by the Hanen Centre	11 sessions	Not specified	Not specified. Integrated into daily activities	Not specified but training effect reported	USA; Clinic and home
Casenhiser et al (2013)	RCT 25 IC 26 CTR	1	24-59m	MEHRIT	Licensed speech-language pathologists or occupational therapists	2 hrs p/week	12m	3 hours per day interacting with child	Not specified but training effect reported	Canada; location not specified
Chiang et al., (2016)	Controlled Trial 18 IC 16 CTR	3	23-55m	Joint Engagement Intervention	Licensed clinical psychologists/licensed dance/movement interventionist	20 hrs	8w	Not specified	Mean rating of 20.39/32 on scale at 8 weeks	Taiwan; Clinic
Cook et al., (2017)	RCT 14 IC 17 CTR	2	4-6y	Parent-Mediated CBT	Provisionally registered psychologists, clinically registered psychologist	14 hrs	9w	Not specified	Not specified	Australia; Clinic
Green et al., (2010)	RCT 77 IC 75 CTR	1	24-60m	PACT	Speech and language therapists	36 hrs	24w + 6m support	30mins/day	Median 16/18 sessions completed	England; primarily clinic

Gulsrud et al., (2016)	RCT 43 IC 43 CTR	1	22-36m	JASPER	BA and PhD Candidate Trained interventionists	10 hrs	10w	Not specified	Not specified but training effect reported	USA; Clinic
Hardan et al., (2015)	RCT 27 IC 26 CTR	1	2-6y	Pivotal Response Training	Psychologists	12 hrs	12w	Not specified	84% parents met fidelity at 12 weeks	USA; Clinic
Harrop et al., (2017)	RCT 43 IC 43 CTR	1	22-36m	JASPER	BA and PhD Candidate Trained interventionists	10 hrs	10w	Not specified	Not specified but training effect reported	USA; Clinic
Ingersoll et al., (2016)	RCT 13 IC 15 CTR	2	19-73m	Telehealth ImPACT	Masters' level trained therapists	15 hrs web + 24 hrs in person	24w	Not specified	Higher fidelity and greater adherence in therapist assisted group	USA; Family home
Kasari et al., (2010)	RCT 19 IC 19 CTR	1	21-36m	Joint Engagement Intervention	Graduate students in educational psychology	24 sessions	8w	Not specified	Mean scores of 4.51/5 (involvement), 3.97/5 (adherence), and 4.35 (competence)	USA ² ; Clinic
Kasari et al., (2014)	RCT 73 IC 74 CTR	1	2-5y	JASPER	Trained interventionists	24 hrs	12w	Not specified	Positive mean ratings of 1.3/5 and 1.5/5 on parent checklists	USA; Family home
Kasari et al., (2015)	RCT 43 IC 43 CTR	1	22-36m	JASPER	BA and PhD Candidate Trained interventionists	10 hours	10w	Not specified	Not specified but training effect reported	USA; Clinic
Kuravackel et al., (2017)	Waitlist Control 10 TH 13 FF 10 CTR	1	39-153m	C-HOPE	Licensed psychologists, and a trained doctoral student in School Psychology	12 hrs	18m	Not specified	Not specified but increase (not treatment effect) in parenting competency reported	USA; Clinic
McConkey et al., (2010)	Non-RCT 36 IC 26 CTR	1	M _{Age-IC} = = 2.8y	Keyhole	Speech and language therapists	15-18 x 90min visits	6-11m	Not specified	Not specified	UK: Family home

Nefdt et al (2010)	RCT 14 IC 12 CTR	1	$M_{Age-IC} = 38.92m$ $M_{Age-CTR} = 38.43m$	Self-directed learning program (SDLP)	Interactive DVD	14 chapters (66mins run time)	1 w	Not specified	Mean fidelity rating for treatment group of 73.35%	USA; Family home
Oosterling et al., (2010)	RCT 40 IC 35 CTR	1	$M_{Age-IC} = 35.2m$	The Focus Parent Training	Psychologists and sociotherapists	35 hours	2y	30-60 mins/day plus integration into routines	Parenting skills examined but not fidelity	Netherlands; Clinic + home visits
Pajareya et al (2011)	RCT 15 IC 16 CTR	1	24-72m	DIR/Floortime	Trained interventionist	1 day workshop + 3 hour DVD Lecture + 1.5h visit	3m	20 hours per week	Not reported	Family Home mostly
Pickard et al., (2016)	RCT 13 IC 15 CTR	2	19-73m	Telehealth ImPACT	Masters' level trained therapists	15 hrs web + 24 hrs in person	24w	Not specified	Higher fidelity and greater adherence in therapist assisted group	USA; Family home
Pickles et al., (2016)	RCT 77 IC 75 CTR	1	24-60m	PACT	Speech and language therapists	36 hrs	24w + 6m support	30mins/day	Median 16/18 sessions completed	England; primarily clinic
Poslawsky et al., (2015)	RCT 40 IC 38 CTR	2	16-61m	VIPP-AUTI treatment	Professionals with degrees in nursing, social work or Psychology with 3+ years work experience	5 x 60-90min visits	12w	2 training sessions. Hours not specified	Treatment fidelity of interveners providing parent training was checked by the lead researchers in 20% of the cases	Netherlands; Family home
Rahman et al., (2016)	RCT 32 IC 33 CTR	2	24-108 months	PASS (Pact Adaptation)	Non-specialist health workers	12 hrs	24w	Not specified	81% participant adherence in completing the 12 session intervention.	India, Pakistan ;Clinic or Family home
Rogers et al., (2012)	RCT 49 IC 49 CTR	2	14-24m	P-ESDM	"Credentialed therapists"	12 hrs	12w	Not specified	Mean of 45.2/60 on ESDM Parent Fidelity	USA; Clinic

									Tool post-intervention	
Schertz et al., (2013)	RCT 11 IC 12 CTR	3	$M_{Age} = 26.1$ months	JAML	Interventionists with advanced degrees in counselling or childhood education	16 hrs	16 w	30 mins/day	90% of criteria on Parent Implementation Fidelity Checklist were adhered.	USA; Family home
Schertz et al., (2018)	RCT 73 IC 71 CTR	1	$M_{Age-IC} = 24.55m$ $M_{Age-CTR} = 24.79m$	JAML	Intervention coordinators	32hrs	32w	Minimum 30mins/day	Mean rating of 2.74/3 on parent fidelity checklist	USA; Family home
Shire et al., (2015)	RCT 30 IC 31 CTR	2	5-8y	JASPER + EMT vs JASPER + EMT + AAC	Speech clinician, special educator, and child psychologist	48 hrs	24w	Not specified	70% mastery at 24 weeks	USA ² ; Clinic
Shire et al., (2016)	RCT 43 IC 42 CTR	1	$M_{Age-IC} = 31m$ $M_{Age-CTR} = 32m$	JASPER	Trained clinician	10 hrs	10w	Not Specified	Not Reported	USA; Clinic
Siller et al., (2013)	RCT 36 IC 34 CTR	1	$M_{Age-IC} = 58.3m$ $M_{AgeCTR} = 55.9m$	PAC+FPI	Trained graduate and postdoctoral students in developmental psychology and counselling	18 hrs	12w	Not Specified	88.3% had fidelity above 80%	USA; Family-home
Siller et al., (2014)	RCT 36 IC 34 CTR	1	$M_{AgeIC} = 58.3m$ $M_{AgeCTR} = 55.9m$	PAC+FPI	Trained graduate and postdoctoral students in developmental psychology and counselling	18 hrs	12w	Not Specified	88.3% had fidelity above 80%	USA; Family-home
Solomon et al., (2014)	RCT 64 IC 64 CTR	1	$M_{Age-IC} = 49.85$ months $M_{Age-CTR} = 50.53$ months	PLAY	PLAY consultants (1 occupational therapist, 2 speech and language therapists, and 3 special educators)	36 hrs	12m	2 hrs/ day	Not Reported	USA; Family home

Stadnick et al., (2015)	RCT 16 IC 14 CTR	1	$M_{Age-IC} = 46.75m$	ImPACT	Clinicians with a masters' degree in psychology, or a doctoral degree in clinical psychology.	12 hrs	12w	Not Specified	Mean rating of 3.98/6 (IC) and 3.24/6 (C) on fidelity scale	USA; Clinic
Turner-Brown et al., (2016)	RCT 32 IC 17 CTR	1	$M_{Age-IC} = 29.6$ months $M_{Age-CTR} = 29.7$ months	FITT parent support, psychoeducation, individualized coaching	Licensed Clinical Social Workers	30 hrs	24w	Not Specified	Therapist ratings for parent implementation were on average 83%, fidelity was also rated at each session and was on average 94%.	USA; Clinic and home visits
Venker et al., (2012)	RCT 7 IC 7 CTR	2	$M_{Age} = 41$ months	More than Words	Graduate student clinicians and a Hanen-certified Speech Language Pathologist	25.5 hrs	7w	Not Specified	Not reported but an increase in targeted parent behaviour was reported	USA; Clinic
Vismara et al., (2013)	Cohort 8	3	18-45m	ESDM Telehealth	BCBA and another "qualified therapist"	18 hrs	12w	Not specified	Average of 7.33 weeks to fidelity, with a mean fidelity score of 3.68/5	United States and Canada; Family home
Wetherby et al., (2014)	RCT 40 IC 42 CTR	2	$M_{Age-IND} = 19.64$ months $M_{Age-Group} = 19.58$ months	Early Social Interaction	Trained interventionists	Highest possible Mean individual: 3.33 hours/week Mean group: 1 hour/week	36w (9m)	25 hours/week	Not reported	USA; Family home + community
Whitehouse et al., (2017)	RCT 41 IC 39 CTR	1	$M_{Age-IC} = 39.36m$ $M_{Age-CTR} = 40.25 m$	TOBY	Trained therapist	2 hrs	24w	20 mins/ day	IC: Median of 1,593 minutes on TOBY months 1-3; 23	Australia; Family home

										minutes months
										4-6
Woo et al., (2015)	RCT 22 IC 28 CTR	3	$M_{Age-IC} = 57.12m$ $M_{Age-CTR} = 54.48 m$	Sensori-motor exercises and instructions	Not reported	Training session + 6 hours of exercises	24w	15-30 mins a day	77% compliance based on parent-diaries	USA; Family home
Zhou et al., (2018)	Non-RCT 30 IC 28 CTR	1	$M_{Age-IC} = 26.65m$ $M_{Age-CTR} = 26.43m$	P-ESDM	Trained therapists	1 day workshop + 26 x 1.5hrs training	26w	Mean 4.57hrs p/week for intervention group	Not reported	China: Clinic

¹Abbreviations: AAC – Augmentative and alternative communication, BPT - behavioural parent training, CBT – Cognitive Behavioural Therapy, CEM – Caregiver Education Module, CMM - Caregiver-mediated module, CTR = Control/comparison group, ESDM - Early Start Denver Model, ESI - early social interaction, FF – Face to Face, FITT - Family Implemented TEACCH for Toddlers, FPI – Focused Playtime Intervention, IC – Intervention Condition, IRR – Inter-Rater Reliability, JASPER - Joint attention, symbolic play, engagement, and regulation, MEHRIT – Milton and Ethel Harris Research Initiative Treatment; MTW = More Than Words, PAC – Parent Advocacy Training, PACT – Preschool Autism Communication Trial, PE – Parent Education, PEG - Psychoeducation group, PEI - Psychoeducational intervention, RCT – Randomized Controlled Trial, RUPP - Research Units on Paediatric Psychopharmacology, SC – Standard Care, SD – Self Directed, SE – Sensory Enrichment, TA – Therapist Assisted, TH- Telehealth, TOBY - Therapy Outcomes By You. ² Location based on first author’s institution as study location not specified in article.

Table 2. Participant eligibility criteria reported in studies (in addition to autism)

Study	Other Programs	Sibling	Development	Epilepsy/ Medication	Parent Psychiatric Disorder	Comorbid Disorders	Medical/ Physical	Accessibility/ Adherence/Ex posure
Bearss et al (2013)	× ¹		√ ⁹	× ²³				
Brian et al (2016)			× ¹⁰			× ^{27,28}		
Brian et al (2017)	× ²		× ¹⁰			× ^{27,28}		
Byford et al (2015)		× ⁷	× ¹¹	× ²⁴	× ²⁶	× ²⁷		× ³⁷
Carter et al (2011)						× ²⁸		
Casenhiser (2013)						× ^{28, 29}		
Chiang et al (2016)			√ ¹² × ¹³			× ^{27,28}		
Cook et al (2017)	× ¹			× ²³		√ ³⁰ × ³¹		
Green et al (2010)		× ⁷	× ¹¹	× ²⁴	× ²⁶	× ²⁷		
Gulsrud et al (2016)							× ³³	
Hardan et al (2015)	√ ³		√ ¹⁴ √ ¹⁵			× ^{27,28}	× ³⁴	
Harrop et al (2017)							× ³³	
Ingersoll et al (2016)								× ³⁷
Kasari et al (2015)							× ³³	
Kasari et al (2014)			√ ¹¹			× ²⁸		
Kasari et al (2010)						× ²⁸		
Kuravackel et al (2017)		× ⁸						× ³⁷
McConkey et al (2010)	× ^{1, 4}							
Nefdt et al (2010)	√ ⁵		√ ^{16,17}					√ ^{38,39}
Oosterling et al (2010)			√ ¹⁸		× ²⁶			× ³⁷
Pajareya et al (2011)				× ²⁵	× ²⁶	× ^{27,28}		× ⁴⁰
Pickard et al (2016)								× ³⁷
Pickles et al (2016)		× ⁷	× ¹¹	× ²⁴	× ²⁶	× ²⁷		× ³⁷
Poslawsky et al (2015)				× ²⁴				
Rogers et al (2012)	× ¹		× ^{10,12}		× ²⁶	× ²⁷	× ^{34,35}	
Rahman et al (2016)		× ⁷	× ¹¹	× ²⁴	× ²⁶	× ²⁷		

Schertz et al (2013)		×		×											
Schertz et al (2018)		√	×		×										
Shire et al (2015)		√		×		√									
Shire et al (2016)									×						
Siller et al (2013)			√						√						
Siller et al (2014)			√							√					
Solomon et al (2014)		×			×		×		×		×				
Stadnick et al (2015)														√	
Turner-Brown et al (2016)		×						×						×	
Venker et al (2012)															
Vismara et al (2013)		×		√										×	
Wetherby et al (2014)															
Whitehouse et al (2017)				√				×						×	
Woo et al (2015)		×							×						
Zhou et al (2018)									×		×				×

Note. √ = Inclusion; × = Exclusion. Other Programs: ¹Participation in another educational program; ²No more than half time childcare; ³In a stable treatment; ⁴Not accessing speech therapy; ⁵No previous parent training in PRT; ⁶Not participating in Ayres sensory integration therapy or therapy that uses physical restraints; **Sibling:** ⁷Twin with ASD; ⁸Sibling with ASD in the same trial; **Development:** ⁹Receptive language age equivalent of ≥18 months; ¹⁰Gestational age of less than 35 weeks; ¹¹Maximum nonverbal age on standardised assessments; ¹²Developmental Quotient/Ratio IQ restrictions based on baseline assessment; ¹³Showing and spontaneous Initiation of Joint Attention items on ADOS = 0; ¹⁴Communication delay on the Preschool Language Scales-4th edition; ¹⁵Vocalise with intent when prompted; ¹⁶Chronological age < 60 months; ¹⁷Have < 20 functional words; ¹⁸Minimum nonverbal age equivalent to 12 months or younger on the Vineland Adaptive Behaviour Scales (VABS); ¹⁹Maximum 3 instances of joint attention in 10 minute play session; ²⁰Be minimally verbal; ²¹Less than 48 months of age; ²²Chronological age of less than 51 months; **Epilepsy/Medication:** ²³Restrictions associated with medication; ²⁴Epilepsy requiring medication; ²⁵Seizures; **Parent Psychiatric Disorder:** ²⁶Parent with a psychiatric disorder or severe familial issues; **Comorbid Disorders:** ²⁷Severe hearing/vision impairment in parent or child; ²⁸Known genetic disorder; ²⁹Neurodevelopmental disorder other than ASD; ³⁰Severe Psychiatric disorder; ³¹Metabolic disorder; ³²Brain injury; **Medical/Physical:** ³³Major physical difficulties; ³⁴Active medical problem; ³⁵Alcohol or drug exposure during the prenatal period; **Accessibility/Adherence/Exposure:** ³⁷Not proficient in the language the intervention is delivered in; ³⁸ On waiting list for services or at a distance from center; ³⁹Access to a video recorded and DVD player; ⁴⁰Reside within a specific range of treatment location; ⁴¹Minimum parental language cognitive/language skills; ⁴²Unavailability of at least 1 parent to participate in treatment; ⁴³Internet connection in their home; ⁴⁴Previous exposure to intervention; ⁴⁵Parents/caregivers understood the study content and requirements based on interview; ⁴⁶Failure to attend 1-day parent training, more than 3 unexcused absences from 1:1 treatment over 26 weeks; not completing intervention record and home videos as required 3 or more times in 26 weeks.

Table 3. Summary of factors examined for association with intervention outcomes

	Brian et al., (2016)	Brian et al., (2017)	Green et al., (2010)	Carter et al., (2011)	Casenhiser et al (2013)	Rogers et al., (2012)	Kasari et al., (2010)	Gulsrud et al., (2016)	Hardan et al., (2015)	Pajareya et al (2011)	Pickard et al., (2016)	Oosterling et al., (2010)	Schertz et al., (2018)	Turner-Brown et al., (2016)	Zhou et al., (2018)
Child: Broad															
Language level			×		×				×						
Non-verbal ability			×		✓				✓			×	✓		
ASD severity			×									×			
Chronological age			×			✓			×						
Gender									×						
Child: Fine Grained															
Initiations (vocal)	✓														
Initiating joint attention				×	✓										
Involvement					✓										
Enjoyment of interaction					×										
Compliance					×										
Attention to activities					×										
Initiating requests				×											
Imitation						✓									
Responsivity	✓														
Functional vocal utterances	✓														
Gestures												×			
Child smiling	✓														
Shared smiling	×														
Social orienting	×					✓									
Object exploration				✓											
Child engagement												×			
Child: Contextual															
Enrolment/referral source	✓			×											
Access to other services							×								
Intervention hours						✓									
Parent: Demographic															
Parent education		×													m
Socio-economic status			×												
Income															m
Parent: Intervention															
Adherence							×			×					
Involvement							m								
Competence							×								
Intervention fidelity	✓					×			×						
Language opportunities	✓														
Parent smiling	✓	✓													
Involvement					✓			✓							
Co-regulation					✓										
Enjoyment of child					✓										
Sensory-motor					✓										
Joining					✓										
Use of affect					✓										
Support of reciprocity					✓										
Independent thinking					✓										
Parent buy-in								✓							
Mirrored pacing								✓							
Environment arrangement								✓							
Parenting skills												×			

Parent: Contextual

Early access to the program

✓^a

Therapist support

✓^a

Time to complete training

✓^a

Training accessible

✓^a

Rural/non-rural location

✓

✓ = Indicates a significant finding with respect to at least one outcome measure or other variable. x = Indicates the variable was investigated but no significant finding identified. m = mixed findings with at least one significant and one non-significant.^a
Findings from qualitative analyses. Significance based on $\alpha \leq .05$.

Figures

Figure 1. Flow Diagram

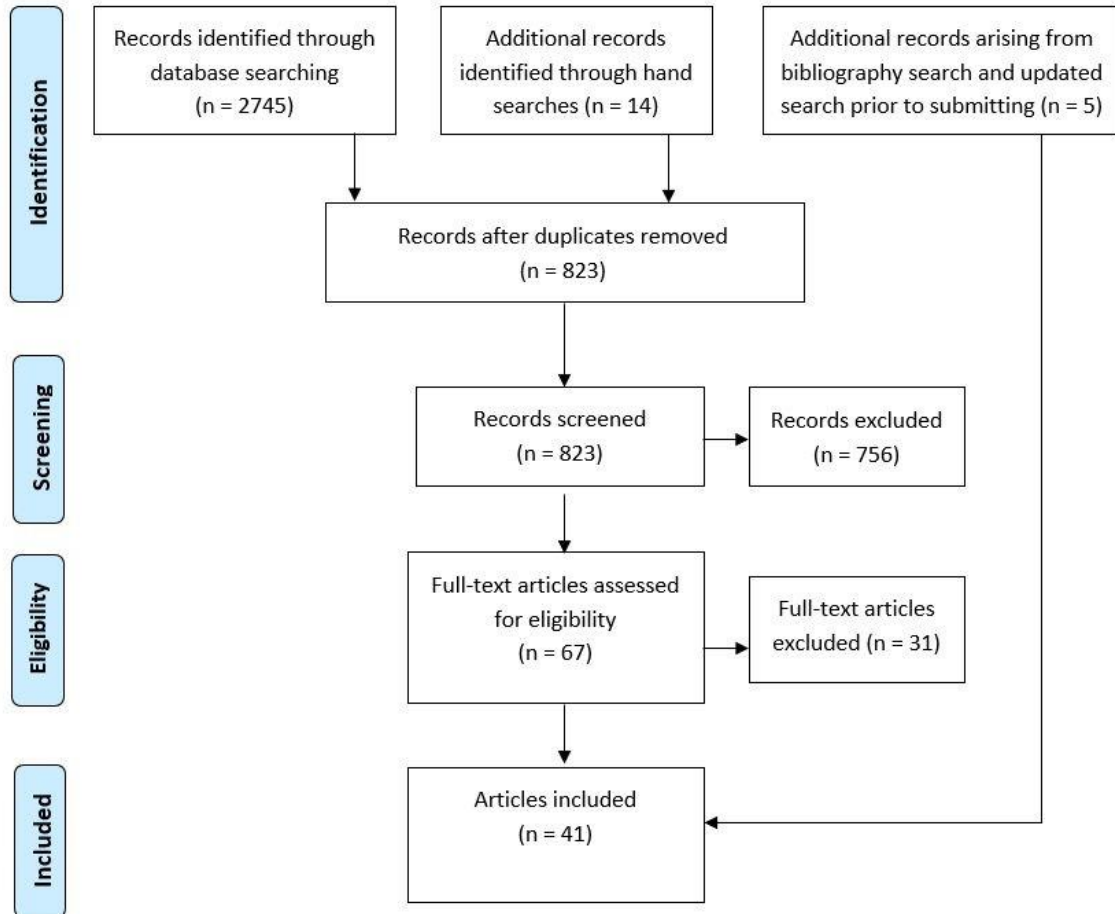


Figure 2. Child measures used in studies

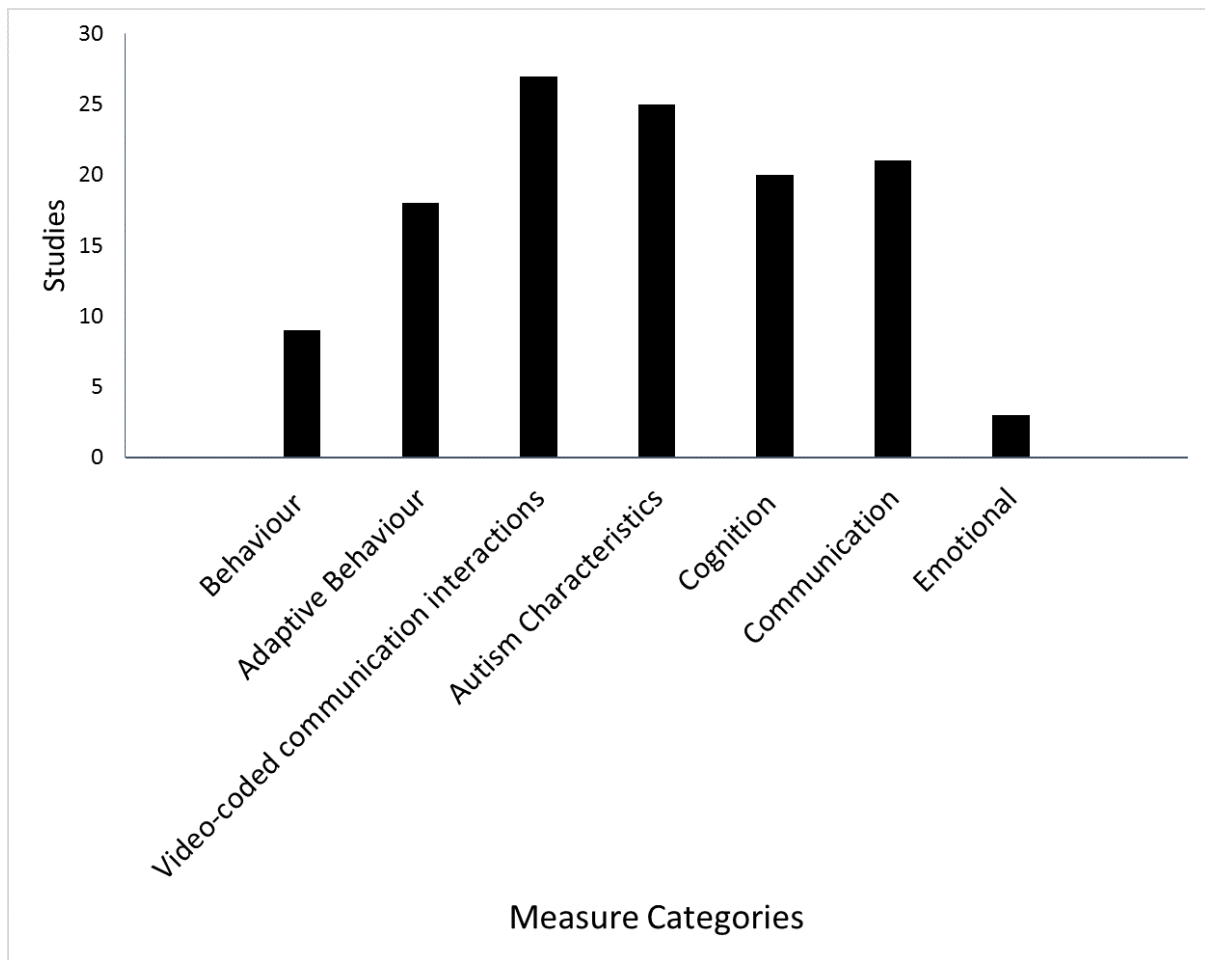


Figure 3. Additional measures used in studies

