Review Article

Autism & Developmental Language Impairments

Autism & Developmental Language Impairments
Volume 4(1): 1–18

DOI: 10.1177/2396941518824497
journals.sagepub.com/home/dli
SAGE

Developmental social pragmatic interventions for preschoolers with autism spectrum disorder: A systematic review

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Abstract

Background and aims: Developmental social pragmatic interventions are one treatment option for supporting the social communication and language skills of preschool children with autism spectrum disorder. Our first aim was to differentiate interventions using a developmental social pragmatic model from other developmental or naturalistic behavioral approaches. We applied explicit criteria outlining core features of developmental social pragmatic interventions to identify programs that use these core features. We then systematically reviewed 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. Additionally, we reviewed results exploring mediators and potential factors influencing children's response to developmental social pragmatic interventions.

Methods: A multistep comprehensive search strategy was used to identify developmental social pragmatic treatments and studies examining their effectiveness for preschool children with autism spectrum disorder. The characteristics of each study and their outcomes were then reviewed, and a modified Critical Appraisal Skills Programme tool was used to evaluate rigor.

Main contribution/Results: Six interventions that met criteria to be classified as developmental social pragmatic are examined within this review. Ten studies of varying methodological rigor met criteria for inclusion and collectively reported on the outcomes of 716 preschool-aged children with autism spectrum disorder. All of the studies examined foundational communication outcomes and all but one reported positive outcomes for at least one of the measures. Seven studies examined language outcomes. While results were positive for language use within natural contexts, they were mixed for overall, receptive, and expressive language. Parents' interaction styles significantly changed postintervention, namely in terms of increased responsiveness, synchronous behavior, use of affect, and decreased directiveness. Only two studies conducted formal mediation analysis and found that parent responsiveness and synchronous behavior were related to children's positive response to treatment.

Conclusions: This review suggests that developmental social pragmatic treatments positively impact children's foundational communication capacities (i.e. attention, social referencing, joint attention, initiation, reciprocity). Positive findings were not consistently found for supporting children's language. Further, methodologically rigorous studies are needed to draw definitive conclusions. Additional research exploring components of developmental social pragmatic treatments that might mediate response to treatment is needed.

Implications: This review provides synthesized information for clinicians, families, and researchers on the effectiveness of developmental social pragmatic interventions for improving children's foundational communication. It also suggests directions for future research and provides ideas for enhancing methodological rigor and promoting more homogeneity among treatment implementation and outcome assessments.

Keywords

Autism spectrum disorders, intervention/therapy, parent–child interaction therapy, preschool children, speech and language therapy

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Developmental social pragmatic (DSP) treatment models have been cited as one of the primary treatment approaches used to address the social communication and language challenges characteristic of children with autism spectrum disorder (ASD) (Ingersoll, Dvortcsak, Whalen, & Sikora, 2005; Prizant & Wetherby, 1998; Smith & Iadarola, 2015). These models are based on an integration of developmental psychology (Piaget, 1936), transactional models of development (Sameroff & Fiese, 2000), and the social pragmatic model of language acquisition (Bates, 1976; Bruner, 1975, 1983; Prutting, 1982). Like other interventions that are considered developmental, DSP interventions use the developmental sequences observed in typical development to inform assessment and treatment, with the assumption that the overarching principles of development are applicable to all children regardless of diagnosis (NRC, 2001). In alignment with social pragmatic theory, DSP interventions direct their emphasis away from focusing on the content and form of spoken language, and instead emphasize the importance of social engagement, communicative intent, and the flexible use of symbols within meaningful contexts (Gerber, 2003). Influenced by both transactional and social pragmatic models of development, DSP interventions also underscore the interpersonal aspects of communication and language development. They draw from the assumption that both social communication and language are learned within the context of affective social engagement with caregivers during natural interactions. Therefore, caregiver involvement—via training, coaching, and reflective practice—is a key component of DSP interventions. Some inherent features of DSP interventions include encouragement of caregivers to join in with children's ideas rather than promoting their own agenda during play, attunement, responsiveness, and natural reinforcement to all forms of children's communication and arrangement of the environment to support communication (Ingersoll, 2010). These interventions align with recommendations by the National Research Council that ASD interventions (a) emphasize the inclusion of developmentally appropriate activities and individualized goals, (b) include ongoing assessment of the child's developmental progress, (c) occur in inclusive settings, (d) include caregivers and family (e.g. parent training or coaching), and (e) are intensive (25 or more hours per week, when we consider both direct therapy and the amount of time parents implement the learned strategies at home) (NRC, 2001).

Previous reviews of interventions for children with ASD have included treatments classified as DSP within their evaluation (e.g. McConachie & Diggle, 2007; Odom, Boyd, Hall, & Hume, 2010; Oono, Honey & McConachie, 2013; Smith & Iadarola, 2015; Vismara & Rogers, 2010; Wagner, Wallace, & Rogers, 2014; Warren; Wetherby & Woods, 2008). However, we still do not clearly understand the effectiveness of this approach to intervention. One of the barriers to progress is that previous reviews have not used consistent or explicit criteria to differentiate interventions claiming to be using a DSP model from other developmental or naturalistic behavioral approaches. This leads to inconsistency within the current literature regarding which treatments are classified as DSP. Ensuring that treatments share not only the self-identified title of DSP intervention, but more specifically share DSP theoretical principles and practice elements, is important for ensuring more homogeneity among the DSP treatment studies being examined. Additionally, having a set of core common features among the interventions under evaluation can provide the advantage of examining potential mechanisms of action for efficacious DSP treatment models.

The aim of this systematic review was to build on the current literature, and add a level of specificity, in identifying DSP interventions used with children with ASD. Our first step was to develop a clear approach to classifying DSP interventions. With this in hand, we were then able to systematically evaluate whether DSP interventions are effective in (a) improving children's foundational social communication skills (e.g. regulation, attention, engagement, joint attention, reciprocity), (b) improving children's language, and (c) changing caregivers' interaction style or communication. Additionally, we were able to explore which (if any) participant characteristics or intervention variables may impact the effectiveness of DSP-based interventions.

Method

Search procedures

Phase one search strategy. With the aim of being comprehensive in our scan of the literature, a multistep search strategy was used. The first phase involved identifying treatment interventions that either self-identified as a DSP intervention or were identified as DSP within peer-reviewed journals. Two independent reviewers explored previously published articles discussing DSP theory or DSP-branded interventions (e.g. Brunner & Seung, 2009; Ingersoll, 2010; Smith & Iadarola, 2015) and compiled a list of those treatments referred to as DSP.

Phase two search strategy. Following the identification of brand named DSP treatment approaches, we conducted systematic searches for each treatment approach using the name of the treatment (e.g. ''DIR'' OR ''developmental, individual difference, relationship'' OR ''Floortime''; ''Responsive Teaching'')

and the key words (''Autism'' OR ''ASD'') AND (''Intervention'' OR ''Treatment''). The searches were completed between November 2017 and April 2018 within five electronic databases: PsychINFO, SCOPUS, ERIC, CINAHL, and PUBMED. Publication dates were unrestricted in our search; however, only articles published in English in peer-reviewed journals were included. This initial search limited us to only studies that had been conducted after the treatment had formally received a name and would not have identified new DSP treatment approaches or DSP treatments not given one of the aforementioned brand names. Therefore, we also elected to conduct a broader search of the literature.

Phase three search strategy. To cast a wider net, we entered the following key words into the search databases: (''Developmental Social Pragmatic'' OR ''Relationship-based'' OR ''Transactional'' OR ''Social-Developmental'') AND (''Autis*'' OR ''ASD'') AND (''Intervention'' OR ''Treatment'') AND (''Communication'' OR ''Language'') AND (''RCT'' OR ''Randomized Control Trial''). Publication dates were unrestricted but the search was limited to articles on children from 0 to 5 years published in English in peer-reviewed journals. When available (i.e. PUBMED), a randomized trial filter was applied to the search in lieu of RCT search terms. Because terms related to DSP-based treatments may not appear in the title, abstract, or keywords, search parameters were set to ''open field.'' Google Scholar and reference lists of articles that met inclusion criteria were also examined to identify any articles that might have been missed.

Selection criteria

Phase one selection criteria. The compiled list of self-identified and previously identified DSP interventions was independently screened by two speech-language pathologists (SLPs) to determine whether (a) the intervention targeted social communication or language development and (b) the intervention aligned with our DSP criteria (described below). Reviewers were asked to answer either *yes, no* or *unknown* for each of the DSP criteria outlined in Table 1.

Interventions that received *yes* responses for each of the DSP criteria were classified as *DSP* and those that met only some of the criteria were classified as *non-DSP*. Inter-rater agreement was substantial, $k = 0.886$. Based on recommendations from the Cochrane Collaboration, the disagreement was resolved by discussion between the authors (Higgins & Green, 2011).

An adaptation of Ingersoll's (2010) classification of DSP interventions was used to decide if a treatment was DSP or non-DSP. This classification system was selected because it included intervention elements that aligned with core elements of developmental and social pragmatic theories. We extended Ingersoll's (2010) DSP criteria by including an additional core feature within our classification system that is integral to social pragmatic theory. In order for a treatment to be considered a DSP intervention, the treatment had to meet the following criteria: (a) describe itself as based on developmental principles; (b) use a natural play-based setting; (c) ensure that teaching episodes are child initiated; (d) include child-selected teaching materials and activities; (e) target general social communication skills that are foundational to verbal communication; (f) use facilitation strategies (e.g. adult responsiveness, contingent imitation, indirect language stimulation, affective attunement); (g) use environmental arrangement to support communication and language (e.g. communicative temptations, playful obstruction, wait time); (h) reinforce communication using natural properties; (i) use reinforcement contingencies that reinforce all communicative behavior (treating all behavior as intentional); and (j) avoid use of explicit prompts that does not consider the child's intent (e.g. ''Say _____'').

We elected to include *avoidance of explicit prompts for communication* as a core feature of DSP interventions in our classification. This differentiation between DSP and non-DSP interventions was mentioned by Ingersoll (2010) but not included within her table comparing DSP and naturalistic developmental behavioral intervention (NDBI) techniques. We decided to include this in our categorization because use of prompts to elicit expressive language without consideration of speaker intent is explicitly avoided in DSP interventions (Gerber, 2003). Prompting for expected verbal outcomes rather than providing scaffolding to support children's spontaneous generation of speech is fundamentally different. This feature can differentiate DSP and NDBI interventions and thus should be included in DSP criteria when looking at mechanisms of change in DSP interventions. Treatment approaches that met all 10 criteria mentioned above were screened by two independent reviewers for phase two selection criteria.

Phases two selection criteria. To be included in phase two of this review, studies had to (a) be peer reviewed, (b) be published in English, (c) be a randomized control trial (RCT), (d) evaluate social communication and/or language treatment effects of DSP-based treatment for children or for caregivers, (e) report effects using quantitative data, and (f) include preschool children (0–5 years) with a diagnosis of ASD. We excluded studies where only a minority of the participants fell within the age range of 0–5 years or when diagnostic groups (those without ASD, or those with co-occurring diagnosis

Table 1. Interventions proposed to be DSP and evaluation of how they incorporate core features of DSP interventions.

Intervention	Previously identified as DSP	Natural setting	Child-initiated episodes	Child-selected materials	Targets general social communication	Adult responsiveness as key strategy	Arrange environment	Reinforce naturally	Reinforce all attempts	Only indirect prompts	Decision
Autism 123 Project (Wong & Kwan, 2010)	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No	Non-DSP
DIR (Greenspan & Wieder, 2006)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
Enhanced Milieu Training (Ingersoll, Meyer, Bonter, & Jelinek, 2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Non-DSP
Focused Playtime Intervention (Siller, Hutman, & Sigman, 2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
Focus Parent Training (Oosterling et al., 2010)	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Non-DSP
IMPACT (Ingersoll & Wainer, 2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Non-DSP
JAML (Schertz, Odom, Baggett, & Sideris, 2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
JASPER (Kasari, Freeman, & Paparella, 2006)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Non-DSP
MEHRIT (Casenhiser, Shanker, & Stieben, 2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
More than words (Sussman, Drake, Lowry, & Honeyman, 2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
PACT (Green et al., 2010)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
Play Project (Solomon et al. 2014)[12]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
RDI (RDIConnect, 2017)	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	Non-DSP
Responsive Teaching (Mahoney & Perales, 2003)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
Son-rise (Kaufman, 1994)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Non-DSP
SCERTS (Prisant, Wetherby, Rubin, Laurent, & Rydell, 2005)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
The Denver Model (Rogers & DiLalla, 1991)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	DSP
The Scottish Centre Program (Salt et al., 2002)	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Non-DSP
Stronger Families Project (Keen, Roger, Doussin, & Braithwaite, 2007)	Yes	Yes	Yes	UN	UN	UN	UN	UN	UN	UN	Non-DSP

DSP: developmental social pragmatic; UN: unknown.

such as untreated seizure disorder and ASD or Cerebral Palsy and ASD) were combined in the data reporting (e.g. Siller, Hutman, & Sigman, 2013).

Data collection

The first author developed a coding manual for extracting and analyzing data from the articles meeting inclusion criteria. After completion of data collection, a graduate SLP student independently verified 30% of the included studies and perfect inter-rater agreement was attained $k = 1.0$. When two studies reported intervention outcomes for the same group of participants, data for both studies were consolidated and reported as a single entry in the table (e.g. Casenhiser, Binns, McGill, Morderer, & Shanker, 2015; Casenhiser et al., 2013). If a study contained more than one experiment, only the experiments meeting inclusion criteria were incorporated into our analysis (e.g. Green et al., 2010).

The following information was extracted from each study: (a) participant characteristics (number, sex, and age), (b) research design, (c) intervention characteristics (setting, practitioners, dosage), (d) dependent variables and intervention outcomes for children (i.e. foundational social communication outcomes involving regulation, attention, joint attention, engagement, reciprocity, and child language outcomes), (e) dependent variables and intervention outcomes for parent language, (f) effect size estimates, and (g) measurement tools. Where effect size was not reported, Cohen's d was calculated for each variable using means and *SDs* (Cohen, 1988).

Assessment of evidence-based quality

An integration of the Critical Appraisal Skills Programme tool (CASP, 2018) and Dollaghan's (2007) scale for appraising communication treatment evidence was used to determine whether each article met one of three levels of evidence-based quality. CASP tools provide a framework for assessing the study quality through considering a series of appraisal criteria designed to collectively answer three broad questions: (a) Is the study valid? (b) What are the results? and (c) Will the results help locally? Some of the appraisal criteria require a simple binary judgment; however, other ratings are more subjective. As several criteria were used to assess these CASP questions, they were then weighed and graded to derive both *validity* and *importance* (e.g. substantial effect size, social validity, maintenance) scores using a three-point scale. A score of *compelling* was assigned if all CASP questions on the topic being scored (i.e. validity or importance) received a response of *yes*. If a low risk of bias was noted or only minor details were questionable, a score of *suggestive* was provided. If there was a high risk of bias (a rating of *no* or *unknown response* to more than two questions on the topic), a score of *equivocal* was provided. These validity and importance ratings were then used to derive overall assessments of the quality of the evidence using Dollaghan's (2007) three-point scale:

1. **Compelling:** The evidence is such that unbiased experts would find little or nothing about the information to debate. Both the validity and importance of results are rated compelling. Altering one's current clinical approach should be seriously considered.
2. **Suggestive:** A rating of suggestive could be indicative of inconsistent quality open to debate on a few criteria. It requires at least a suggestive level of validity and certainty of results. Clinicians might reach different decisions about whether to use the information to support altering their current clinical practice.
3. **Equivocal:** An equivocal rating suggests low validity and questionable certainty of results. No change to clinical practice needs to be considered.

Methodological quality, risk of bias, and importance of results were independently assessed by two SLPs (one of whom was blind to the authors and dates of publications). Initial inter-rater agreement for overall quality ratings was $k = 0.78$ and 100% agreement was attained through item-by-item discussion between the reviewers (Higgins & Green, 2011).

Results

Systematically identifying DSP interventions

Eighteen treatment approaches were either self-identified as being a DSP-based intervention or identified in other literature as being DSP, and were examined during phase one of our search. A total of 10 brand named treatments met all of the DSP criteria, and thus were included in phase two of our search. See Table 1 for a list of all the treatments referred to as DSP and our analysis of their alignment with the DSP intervention components that we based on Ingersoll (2010).

We do not intend to imply that interventions receiving a response of *no* in any DSP category mean that the treatment *never* incorporates the DSP feature into their model, but rather that it is not a *core* feature of the intervention. For example, RDI focuses on establishing shared partnerships (RDIConnect, 2017). Therefore, having children select materials or initiate the teaching episodes is not a defining feature of the intervention. Similarly, JASPER is a treatment that incorporates having children initiate teaching episodes and selecting

activities, but this is reportedly only done after children have been primed to provide appropriate responses using discrete trial training (Kasari et al., 2006). Additionally, interventions such as Enhanced Milieu Training and IMPACT incorporate many DSP features that align with cognitive developmental psychology, but were missing core features that align with social pragmatic theory (e.g. treating all forms of communication as intentional and avoiding explicit prompting for communication). For example, Enhanced Milieu Training reports use of *elicited modeling* and *manding* to target social communication and language, and IMPACT promotes having clinicians only respond to correct communication attempts and withholding objects from the child until a correct response is attained. Similarly, although the Denver Model meets DSP criteria, the Early Start Denver Model, which evolved from the original Denver Model, did not because it incorporates behavioral principles in how challenges in language production are addressed (e.g. Picture Exchange Communication System; Rogers, 2017). Although these treatments might meet the criteria for DSP interventions aligned with cognitive developmental psychology, their failure to incorporate key social pragmatic aspects classified them as *non-DSP* within this review.

Description of studies

Consolidation of phase two and three of our search yielded a total of 289 abstracts for review. Reference list and Google Scholar searches resulted in identification of an additional four articles. After removing duplicates, 151 articles were screened for inclusion. In order for a study to be definitively excluded, the title and/or abstract had to undoubtedly fail to meet one of the predetermined inclusion criteria. Full text reviews were conducted on 30 articles. A total of 10 studies (14 articles) examining 6 identified DSP treatments met inclusion criteria. See Figure 1 for the PRISMA flow diagram outlining our search and screening results.

Sample characteristics. A summary of participant characteristics for the included articles is presented in Table 2. The 10 studies reported on outcomes for 716 children diagnosed with ASD who ranged in age from 1:3 to 6:0 years with a mean of 37.8 months. Sex was reported for 546 of the children; of these, 443 of participants were male and 103 were female. Sample size

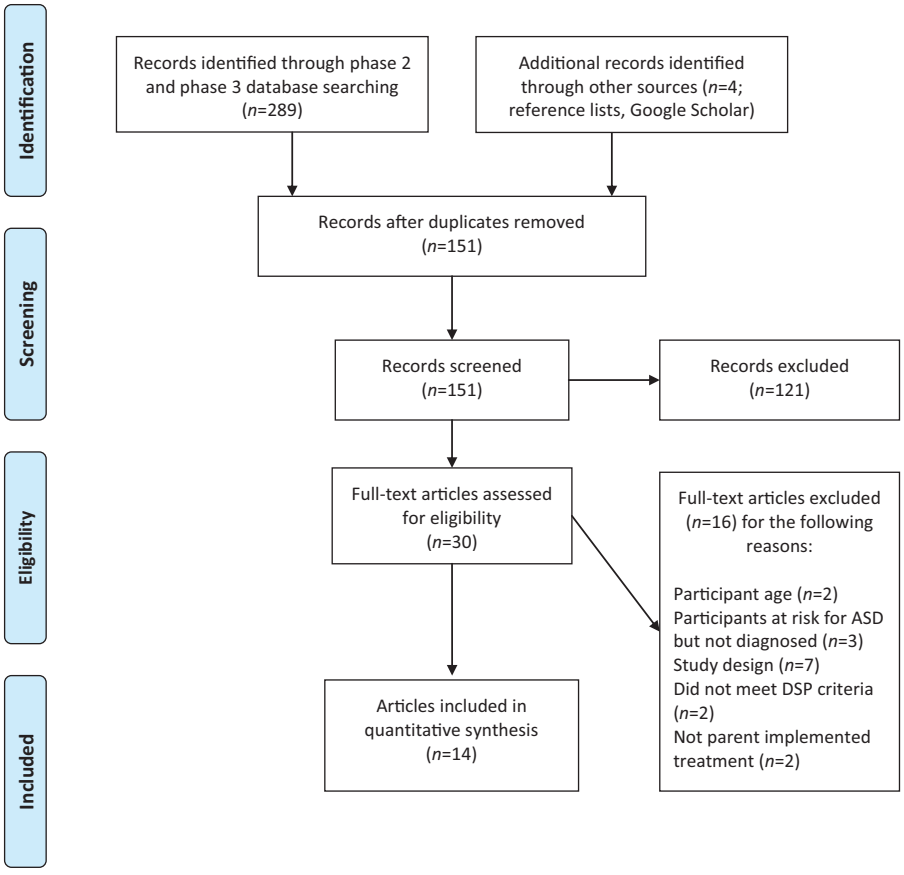

Figure 1. PRISMA flow diagram.

Table 2. Summary of included studies.

Articles	N (n females)	Age range[a] (mean age[b])	Treatment condition (control condition)	Intervention setting; frequency; duration	Practitioner; practitioner training
Aldred, Green and Adams (2004)	28 (3 f)	2:0–5:11 (48)	Child talk (routine care)	Clinic; 1 session/month for 6 months, then "less frequent" follow-ups for 6 months; 12 months	Unknown; unknown
Carter et al. (2011)	62 (11 f)	1:3–2:1 (20)	More than words (no treatment)	Clinic and home; 8 parent only sessions, 3 in home sessions; 3.5 months	SLP; Hanen certified
Casenhiser et al. (2013, 2015)	51	2:11–4:11 (44)	MEHRIT, DIR based (community treatment)	Clinic; 2 hour/week; 12 months	SLP, OT; DIR certification
Green et al. (2010), Pickles et al. (2016)	152 (28 f)	2:0–4:11	PACT (treatment as usual)	Clinic and home; biweekly sessions for 6 months, monthly follow-ups, 18 sessions total; 12 months	SLP; "Specially trained," supervised by senior SLP with clinical autism experience
Pajareya and Nopmaneejumruslers (2011)	32 (9 f)	2:0–6:0 (54)	DIR (community standard care)	Home; 1.5 hours first session, no specified time for remainder of sessions; 3 months	Rehabilitation Therapist; Reading books, viewing training videos
Schertz et al. (2013)	23	(26)	Joint attention mediated learning (community treatment)	Home; at least 15 sessions; 4–12 months with a mean treatment time of 7 months	Early Childhood Educators, Counselor; "Prior training"
Schertz, Odom, Baggett, and Sideris (2018)	144 (29 f)	1:4–2:6 (24)	Joint attention mediated learning (community treatment)	Home; 1 hour/week; 32 weeks	Unknown; unknown
Solomon, Van Egeren, Mahoney, Huber, and Zimmerman (2014)	128 (23 f)	2:8–5:11 (50)	Play project—DIR based (community standard care)	Home; 1, 3 hour session/month; 12 months	OT, SLP, Special Educator; 4-day Play Project Training, 12–18 months of supervision
Venker, McDuffie, Weisemer, and Abbeduto (2012)	14	2:4–5:8 (41)	Adapted more than words (delayed treatment group)	Clinic; 5, 2 hour parent education sessions, 2, 45 minute individual sessions, twice weekly 60 minute group sessions; 7 weeks	SLP, Graduate student SLP; Hanen certified
Wetherby et al. (2014)	82	1:4–1:8 (20)	SCERTS individual treatment (SCERTS group treatment)	Clinic and home; 3 sessions/week for 6 months, then 2 sessions/week for 3 months; 9 months	Unknown; unknown

DIR: developmental, individual difference, relationship based intervention; f: female; MEHRIT: Milton and Ethel Harris research initiative treatment; OT: occupational therapist; PACT: preschool autism communication treatment; RCT: randomized control trial; SCERTS: social communication, emotional regulation, transactional support intervention; SLP: speech-language pathologist.

[a]Years:months.

[b]Months.

across all studies ranged from 23 to 152 participants. Studies were conducted across four countries, and thus included participants from a variety of socioeconomic and cultural backgrounds.

Research design and rigor. All of the RCTs included at least one natural parent–child observation measure that evaluated generalization of skills learned in intervention during play interactions and all but one study (Schertz et al., 2013) reported adequate measures of inter-rater reliability for the observational scales they used.Nine studies included a social validity measure (Carter et al., 2011; Pajareya & Nopmaneejumruslers, 2011; Schertz et al., 2013, 2018; Venker, McDuffie, Ellis Weismer, & Abbeduto, 2012; Wetherby et al., 2014), which included parent satisfaction questionnaires, a parent stress index, and a clinician experience questionnaire. Implementation of some form of fidelity measure was included in six studies. Most of these studies evaluated clinician implementation of the intervention (Carter et al., 2011; Green et al., 2010; Schertz et al., 2013, 2018; Solomon et al., 2014; Venker et al., 2012; Wetherby et al., 2014), while only a few examined parent implementation of strategies (Casenhiser et al., 2013; Schertz et al., 2013, 2018).

Evidence was assessed to be compelling for four of the studies, suggestive for one and equivocal for five (see Table 3). Notably, one of the studies rated as equivocal was conducted in Thailand, a country where access to intervention services and resources is limited (Pajareya & Nopmaneejumruslers, 2011). Factors identified as recurring challenges in study design included small sample size (under powered), participant attrition, variable blinding of assessors (i.e. use of parent report outcome measures when parents were not blind to group allocation), lack of clarity in the identification of the active ingredients used with caregivers and children within the treatment, and lack of comprehensive fidelity measurement.

Description of intervention

Setting and intensity. Characteristics of the interventions are presented in Table 2. It was most common for therapy sessions to be provided within the child's home setting at least some of the time ($n = 7$). Only three studies conducted sessions solely in a clinic setting. The range of treatment intensity was extensive, from an unspecified amount of treatment over 3 months, to a hybrid of individual and group sessions over 7 weeks, to 2 hours weekly over 12 months.

Service delivery. The trainers implementing the DSP interventions varied across studies. SLPs were the most frequently noted professionals ($n = 5$). Other professional backgrounds included occupational therapists, a social worker, a psychologist, rehabilitation therapists, recreation therapists, and educators, and three studies did not report the professional background of the clinicians. The level of training of the therapists was diverse and ranged from therapists who had undergone four years of training (e.g. Casenhiser et al., 2013), to students reading a book and watching videos on the intervention (e.g. Pajareya & Nopmaneejumruslers, 2011), to having no mention of specific training (e.g. Schertz et al., 2018).

Intervention impact

Foundational social communication skills. All of the RCTs examined the impact of DSP intervention on social communication outcomes (see Table 3). The most common social communication capacities targeted were overall social interaction or communication ($n = 4$), attention ($n = 3$), joint attention ($n = 4$), and initiation ($n = 3$). Studies also examined children's focusing on faces ($n = 1$), involvement ($n = 1$), engagement ($n = 1$), reciprocal interactions ($n = 1$), gesture use ($n = 1$), nonverbal communication ($n = 1$), and intentional communication ($n = 1$).

Social interaction or social communication. 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 & Nopmaneejumruslers, 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.

Attention, interest, engagement, and involvement. Children's overall attention was considered in three studies. Results were mixed. Positive results were reported in two studies (Casenhiser et al., 2013; Solomon et al., 2014). The other study reported no significant changes in children's attention posttreatment (Aldred et al., 2004), but found small to moderate effects, possibly related to small sample size (i.e. $N = 28$). A more specific form of attention, *focusing on faces*, was also positively impacted for children who had received DSP intervention (Schertz et al., 2013, 2018). Joint attention (including initiating and responding to bids for joint attention) was examined in four studies. Large positive effects postintervention were reported in studies rated suggestive and compelling (Casenhiser et al., 2013; Schertz et al., 2013, 2018) and no effects were reported in one study that was underpowered (Carter et al., 2011). Children's involvement in interactions with caregivers and overall engagement were also found to be positively impacted postintervention with large to moderate effects (Casenhiser et al., 2013).

Table 3. Summary of included studies outcomes and certainty of evidence.

Citation	Outcome measures used	Social communication variable, p-value (effect size)	Language variable, p-value (effect size)	Parent outcome variable, p-value (effect size)	CASP certainty of evidence
Aldred et al. (2004)	ADOS social interaction domain; parent–child video analysis; VABS communication domain; MCDI	Social interaction, $p = .004$ ($d = .85$) Child communication acts, $p = .041$ ($d = .73$) Child shared attention, $p = .204$ ($d = .57$) Communication, $p > .05$ (unable to calculate effect size due to insufficient data)	Expressive language, $p < .001$ ($d = .01$) Language comprehension, $p = .10$ ($d = .00$) Communication, $p = .121$ ($d = .43$)	Increase in parent synchrony, $p = 0.16$ ($d = .93$) Decrease in parent asynchrony, $p = .009$ ($d = 1.07$) Parent shared attention, $p = .176$ ($d = .37$) Parent communication acts, $p = .293$ ($d = .54$)	Equivocal
Carter et al. (2011)	ESCS; PCFP; nonverbal communication of PIA-NV	Initiating joint attention, $p > .05$ ($d = .00$) Initiating behavior requests, $p > .05$ ($d = .00$) Frequency of intentional communication, $p > .05$ ($d = .00$)	–	Parent responsivity, $p = .08$ ($d = .71$)	Equivocal
Casenhiser et al. (2015) and Casenhiser, Shanker and Stieben (2013)	CBRS; PLS and CASL; language sample analysis; parent fidelity to treatment	Initiation of joint attention, $p < .001$ ($d = 1.02$) Enjoyment, $p < .05$ ($d = .63$) Attention, $p < .05$ ($d = .69$) Involvement, $p < .01$ ($d = .87$)	Total language, $p = .214$ ($d = .63$) Number of utterances, $p = .002$ ($\eta^{2p} = .191$) MLUm, $p = .015$ ($\eta^{2p} = .123$) Number of different communication acts, $p < .001$ ($\eta^{2p} = .208$) Contingent responses, $p = 0.28$ ($\eta^{2p} = .138$) Commenting, $p = .012$,($\eta^{2p} = .239$) Labeling, $p = .021$, ($\eta^{2p} = .104$) Responding, $p = .147$, ($\eta^{2p} = .161$) Directing, $p = .132$, ($\eta^{2p} = .001$) Sharing, $p = .005$ ($\eta^{2p} = .234$) Obtaining information, $p = .005$ ($\eta^{2p} = .151$) Rejecting/protesting, $p = .015$ ($\eta^{2p} = .160$) Social conventions, $p = .57$ ($\eta^{2p} = .024$) Spontaneous social expressions, $p = .05$ ($\eta^{2p} = .075$)	Fidelity parent coregulation, $p < 0.001$ ($d = .996$) Fidelity parent joining, $p < 0.01$ ($d = .92$) Fidelity supporting reciprocity, $p < 0.01$ ($d = .86$) Fidelity use of affect (facial expressions, gestures, intonation changes, etc.), $p < 0.001$ ($d = .96$)	Suggestive
Green et al. (2010)	Parent–child video analysis; CSBS-DP social composite; ADOS social communication modified algorithm total; PLS; MCDI; VABS communication domain	Child initiations, $p = .009$ ($d = .44$) Social composite, n.s., no p-value reported (log-odds = 2.49) Social communication, n.s., no p-value reported (log-odds = −0.64)	PLS receptive language, n.s., no p-value reported ($d = 1.09$) PLS expressive language, n.s., no p-value reported ($d = .00$) MCDI receptive, n.s., no p-value reported (log-odds = 2.49) MCDI expressive, n.s., no p-value reported (log-odds = 1.63) Vineland communication, n.s., no p-value reported ($d = .17$)	Parental synchrony, $p > .00$, ($d = 1.09$) Shared attention, n.s., no p-value reported ($d = .38$)	Compelling

(continued)

Table 3. (continued)

Citation	Outcome measures used	Social communication variable, p-value (effect size)	Language variable, p-value (effect size)	Parent outcome variable, p-value (effect size)	CASP certainty of evidence
Pajareya and Nopmaneejumruslers (2011)	FEAS; FEDQ	Functional emotional capacities, $p = .031$ ($d = .82$) Emotional development, $p = .006$ ($d = 1.18$)	–	–	Equivocal
Schertz et al. (2013)	PJAM; VABS communication domain; MSEL	Focusing on faces $p < .01$ ($d = 1.24$) Responding to joint attention $p < .001$ ($d = 1.39$) Turn taking $p > .05$ ($d = .55$) Initiated joint attention $p > .05$ ($d = .70$)	Receptive language, $p < .05$ ($d = .34$) Expressive language, $p > .05$ ($d = .45$) Communication, $p < .05$ ($d = .59$)	–	Equivocal
Schertz et al. (2018)	PJAM	Focusing on faces, $p < .001$ ($d = 1.20$) Responding to joint attention, $p < .001$ ($d = 2.80$) Turn taking, $p < .001$ ($d = 0.85$) Initiated joint attention, $p = .003$ ($d = .90$)	–	–	Compelling
Solomon et al. (2014)	CBRS; SCQ; MBRS; MSEL; MCDI-words gestures; MCDI-words sentences	Attention, $p < .01$, $n^2 = .07$ Initiation, $p < .001$, $n^2 = .14$ Social communication, $p > .05$, $n^2 = .01$ Gestures, $p > .05$, $n^2 = .00$ Functional emotional capacities, $p < .05$ ($n^2 = .05$)	Vocabulary understood, $p > .05$ ($n^2 = .00$) Phrases understood, $p > .05$ ($n^2 = .00$) Vocabulary produced (words and gestures), $p > .05$ ($n^2 = .01$) Vocabulary produced (words and sentences), $p > .05$ ($n^2 = .02$) Complexity, $p > .05$ ($n^2 = .00$) Receptive, $p > .05$ ($n^2 = .00$) Expressive language, $p > .05$ ($n^2 = .01$)	Maternal behavior, $p < .01$ ($n^2 = .30$) Maternal responsiveness, $p < .001$ ($n^2 = .15$) Maternal affect, $p < .001$ ($n^2 = .20$) Maternal achievement orientation, $p < .001$ ($n^2 = .10$) Maternal directiveness, $p < .001$ ($n^2 = .08$)	Compelling
Venker et al. (2012)	Parent–child video transcription	Spontaneous nonverbal communication acts, $p = .320$ ($d = .09$)	Prompted communication acts, $p = .007$ ($d = .74$) Spontaneous communication acts, $p = .196$ ($d = .54$)	Follow in comments, $p = .029$ ($d = .06$) Linguistic mapping, $p = .025$ ($d = 1.12$) Prompting, $p = .002$ ($d = 1.39$) Redirects, $p = .004$ ($d = .89$)	Equivocal
Wetherby et al. (2014)	CSBS; VABS communication and Socialization domains; MSEL	Social, $p = .04$ ($g = .48$) Socialization, $p = .04$ ($g = .66$)	Receptive language, $p = .008$ ($g = .58$) Expressive language, $p = .61$ ($g = .18$) Speech, $p = .81$ ($g = .05$) Symbolic, $p = .72$ ($g = .13$) Communication, $p = .004$ ($g = .69$)	–	Compelling

ADOS: Autism Diagnostic Observation Schedule (Lord et al., 2001); CASL: Comprehensive Assessment of Spoken Language (Carrow-Woolfolk, 1999); CBRS: Child Behavior Rating Scale (Bronson et al., 1990); CSBS-DP: Communication and Symbolic Behavior Scales Developmental Profile (Wetherby & Prizant, 2002); ESCS: Early Social Communication Scale (Mundy et al., 2013); FEAS: Functional Emotional Assessment Scale (Greenspan, et al., 2001); FEDQ: Functional Emotional Development Questionnaire (Greenspan et al., 2003); MBRS: Maternal Behavioral Rating Scale (Mahoney & Powell, 1986); MCDI: MacArthur Communicative Developmental Inventory (Fenson et al., 2007); MSEL: Mullen Scales of Early Learning (Mullen, 1995); PCFP: The Parent–Child Free Play Procedure; PIA-CV: Parent Interview for Autism–Clinical Version (Stone et al., 2003); PJAM: Precursors of Joint Attention Measure (Leaf & McEachin, 1999); PLS: Preschool Language Scale (Zimmerman et al. 2006); SCQ: Social Communication Questionnaire (Rutter, Bailey & Lord, 2003); VABS: Vineland Adaptive Behavior Scale (Sparrow et al., 2005).

Initiations. Moderate to large positive effects for children's initiation were found in two studies (Green et al., 2010; Solomon et al., 2014). However, Carter et al. (2011) found no significant improvements in *initiations of behavior requests*.

Reciprocity. Only one study examined children's reciprocity skills. Schertz et al. (2018) found large positive effects on children's turn taking post-DSP treatment.

Gestures, nonverbal, and intentional communication. No effects were found for children's use of gestures (Solomon et al., 2014), spontaneous use of nonverbal communication (Venker et al., 2012), or frequency of intentional communication (Carter et al., 2011).

Language capacities. Children's posttreatment language skills were considered within seven studies (see Table 3). Outcome measures used to assess language varied across studies. 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. However, parent ratings showed large positive effects on both children's expressive and receptive language. Casenhiser et al. (2013) and Aldred et al. (2004) found no significant differences for children's receptive, expressive, or total language scores using standardized language tests; however, moderate to large positive effects on children's language use were found when language skills were analyzed during naturalistic videotaped interactions (Casenhiser et al., 2015). Venker et al. (2012) also used naturalistic observation tools to evaluate language. They found mixed results, with no changes observed in children's use of spontaneous communication acts, but large positive effects on children's use of prompted communication acts, following DSP intervention.

Short-term follow-up. Four studies reported on outcomes from follow-up assessments that were conducted between 1–2 months and 1 year postintervention (Carter et al., 2011; Pajareya & Nopmaneejumruslers, 2011; Schertz et al., 2013, 2018). One study did not find significant treatment effects posttreatment or at follow-up (Carter et al., 2011). However, Schertz et al. (2013) found significant improvements in their DSP intervention group relative to a community intervention group that were maintained 4–8 weeks' postintervention for following faces of communication partners ($d = .84$) and responding to joint attention ($d = 1.18$). Schertz et al. (2018) reported similar maintenance of skill improvements in the DSP group six-month postintervention ($p = .007$, $d = .77$), in addition to improvements in reciprocal turn taking ($p < .001$, $d = .78$). However, improvements in initiating joint attention were not maintained ($p = .082$, $d = .69$). Another study found children's overall socioemotional skills (e.g. attention, reciprocity, use of affect) continued to significantly improve one-year postintervention relative to a community treatment group ($p < .001$; Pajareya & Nopmaneejumruslers, 2012).

Long-term follow-up. A 5.75-year follow-up of children who received PACT intervention revealed a smaller group difference for child initiations at follow-up ($d = .29$, 95% CI: −0.02 to 0.57) than directly postintervention (Pickles et al., 2015). However, the mean treatment effect from baseline to follow-up was stronger ($d = 0.33$, 95% CI: 0.1–0.6, $p = 0.004$). Similarly, parent synchrony did not maintain treatment effects at follow-up ($d = .02$, 95% CI: −0.30 to 0.36) but when the overall study duration was taken into account, the effects of the intervention were significant ($d = .61$, 95% CI: 0.38–0.86, $p < 0.0001$). Postintervention differences between groups in language were no longer present at follow-up ($d = .15$, 95% CI: –0.23 to 0.53).

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.

Responsiveness. 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 ($n = 28$).

Parental control/directiveness. 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).

Synchrony/joining and shared attention. Parent's synchrony with their children showed significant positive improvements in two studies (Aldred et al., 2004; Green et al., 2010). Similarly, Casenhiser et al. (2013) reported large positive effects postintervention for parents joining their children's ideas. Parents' use of comments that followed the children's interests also improved with moderate effects (Venker et al., 2012). Green et al. (2010) found positive changes in parent–child shared

attention post-DSP intervention but Aldred et al. (2004) did not.

Affect and coregulation. Both studies evaluating parents' use of affect to engage their children found large positive effects with DSP intervention (Casenhiser et al., 2013; Solomon et al., 2014). Parents' coregulatory strategies also had large positive changes (Casenhiser et al., 2013).

Parent communication acts, linguistic mapping, and indirect prompting. Aldred et al. (2004) reported no changes in the frequency of parent communication acts post-DSP intervention; however, moderate effects were noted. Large positive changes in parents' use of linguistic mapping and indirect prompting to encourage communication were also observed post-DSP treatment (Venker et al., 2012).

Factors influencing DSP intervention effects

Four studies examined child or intervention features that may have influenced children's response to DSP treatment (Carter et al., 2011; Casenhiser et al., 2013; Pajareya & Nopmaneejumruslers, 2012; Schertz et al., 2018). Formal mediation analysis examining the relationship between treatment elements and children's response to treatment was only conduced for two studies (Mahoney & Solomon, 2016; Pickles et al., 2015). The following themes emerged.

Child's pretreatment object interest. Carter et al. (2011) reported that children's object interest prior to treatment influenced the treatment effect on the residualized gain for several communication variables. Children who played with fewer than three toys during the pretreatment assessment demonstrated greater gains in initiating joint attention and initiating requests if they were assigned to the DSP intervention. However, children who played with five or more toys during the initial assessment showed fewer gains in initiating joint attention, initiating requests, and the weighted frequency of intentional communication if they were assigned to the DSP treatment group. This suggests that children's level of object interest at the time they entered the study had an impact on how they responded to the DSP intervention.

Autism severity and overall development. 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.

Expression of enjoyment of the child, joining, support of reciprocity, and support of independent thinking. Casenhiser et al. (2013) found that parent fidelity to treatment predicted both language and social communication outcomes in children following DSP intervention. Specifically, positive child outcomes were predicted by parent fidelity on expression of enjoyment during interactions with the child, joining, support of reciprocity, and support of independent thinking. However, caregiver behaviors before treatment were not significantly associated with any of the changes in child outcomes.

Amount of treatment. Pajareya and Nopmaneejumruslers (2014) found that the more hours per week of intervention, the better the gain in functional emotional capacities. However, fidelity to treatment was not considered, so it is unknown whether therapists or parents were implementing DIR therapy as it was intended. Therefore, it is unclear whether gains were related to time in the intervention per se or time spent interacting with a parent.

Caregiver responsiveness and use of affect. Mahoney and Solomon (2016) conducted a secondary analysis of data from Solomon et al. (2014) to examine potential mediators of their DSP treatment. Intervention effects on children's social engagement were mediated by increases in parental responsiveness. Similarly, intervention effects on children's social affect were mediated by increases in parental responsiveness and use of social affect. A large portion of the gains in children's social engagement and functional emotional capacities following DSP intervention was explained by change in caregiver responsiveness and use of social affect.

Caregiver synchronous behavior. A follow-up study examining the treatment mechanisms of PACT intervention found that children's improvements in communication initiations were mediated by an increase in caregivers' synchronous behaviors. Repeated measures reliability models and a two-mediator reliability mode indicated that approximately 70–90% of the changes in the children's improvement in communication were attributed to improvements in parent synchronous behavior (Pickles et al., 2015).

Discussion

This systematic review examined the impact of six different DSP interventions on children's or caregivers' social communication across 10 studies. Consolidation of results from the studies identified as being compelling reveal consistent empirical support for the effectiveness of DSP interventions for enhancing foundational social communication capacities, namely

positive changes in children's attention, focusing on faces, responding to bids for joint attention, use of affect, engaging in reciprocal interactions, and initiating communication. It is critical to identify interventions that support the development of these foundational communication skills given that they can have a tremendous positive impact on children's social interactions and language development, yet these skills can be particularly challenging for children with ASD (Watt, Wetherby, & Shumway, 2006).Within the few ($n = 4$) studies that included maintenance measures, positive gains in social communication remained, further supporting the effectiveness of DSP.

The effect of DSP interventions on children's language is less clear. Positive findings in some studies are tempered by null findings in others. Notably, of the studies rated compelling, none revealed lasting, large effects on children's language posttreatment. In light of these findings, we should consider factors that may have impacted children's response to treatment. First, given the young age at which some of the children began treatment, and the marked improvements in children's social communication but not language, we might consider the possibility that some of the children included in the studies were not developmentally ready to use symbolic language. Therefore, it would have been developmentally appropriate to solidify these foundational communication skills prior to targeting specific language goals, and this might be reflected within the results. Future studies should consider examining the impact of children's pretreatment language level on their response to DSP interventions.

Additionally, the heterogeneity in both the language capacities assessed and the tools used to measure change may have played a role in the inconsistent language results across studies. Children's social communication and functional language use are particularly difficult to evaluate using standardized or parent report measures (Tager-Flusberg et al., 2009) and yet standardized language testing was the most frequent tool used to evaluate children's language outcomes. In alignment with social pragmatic theory, DSP interventions focus on developing children's communicative intent and communication functions, rather than language form. Natural play interactions create an environment to more effectively evaluate these skills.Only two studies included in this review evaluated language within natural contexts and found positive results (Casenhiser et al., 2015; Venker et al., 2012). The inclusion of such natural outcome measures aligns with previous recommendations and underscores the importance of including tools that examine language within natural contexts as outcome measures to ensure that the data gathered have the highest degree of validity possible (Tager-Flusberg et al., 2009).

Variability in the professional background and experience of the treating clinicians, combined with the limited use of fidelity measures within the studies included in this review also raises questions about the effective implementation of treatment designed to support children's language. A comprehensive evaluation of treatment fidelity may help to resolve these issues. DSP interventions are considered triadic treatment models where there is (a) a therapist providing treatment to a child and coaching caregivers, (b) caregivers receiving training and then implementing strategies learned during interactions with their child, and (c) a child receiving intervention directly from both the therapist and the caregiver. When working within a triadic treatment model, researchers would be wise to measure fidelity of treatment implementation at each level of the intervention (e.g. therapist's fidelity to delivering treatment, fidelity of parent training, and fidelity of parent use of DSP strategies; Roberts & Kaiser, 2011). Within our review, although many studies reported use of fidelity measures, only one (Schertz et al., 2018) looked at fidelity at more than one level of implementation (i.e. clinician and caregiver).

Despite the importance DSP places on including caregivers in the treatment process and previous research outlining the relationship between parent interaction and communication styles and children's communication outcomes (Siller & Sigman, 2002, 2008), only three studies included outcome measures evaluating caregiver communication. Access to both parent and child data will bolster further exploration of the mediating effects of specific parent interaction styles on children's communication and language and vice versa.

Of the studies that included caregiver outcomes, increases in parent synchrony, responsiveness, and use of affect were observed post-DSP intervention, as was a decrease in the amount of directiveness. Uptake of these strategies aligns with a number of the core features of DSP interventions, namely: (a) allowing children to initiate activities and select materials, that is joining in with their ideas rather than directing the interactions and (b) adult responsiveness. However, these changes were not universal across all studies or all parent behaviors. To better understand why some studies found changes in caregiver behavior and others did not, future research should examine not only parent behaviors, but also the mechanics and techniques used in parent coaching. This information would also allow for study replication and analysis of the relations between coaching/training strategies and parents' effective use of DSP techniques.

Two specific mediating effects of DSP treatments were revealed in our review: caregiver responsiveness and caregiver synchronous behavior. Both positively

predicted children's communication development and response to DSP interventions (Mahoney & Solomon, 2016; Pickles et al., 2015). These findings align with previous research demonstrating that parental responsiveness supports children's cognitive, communication, and socioemotional development (e.g. Kochanska, Forman, & Coy, 1999; Mahoney & Perales, 2003, 2005; Tamis-LeMonda, Bornstein, Baumwell, & Melstein Damast, 1996; Wolff & Ijzendoorn, 1997). Both responsiveness and synchronous behavior (joining in with ideas children have initiated) are specifically targeted within DSP interventions and were included within the framework we used for identifying DSP-based interventions. Caregiver responsiveness in particular is one of the critical differences in how DSP and some NDBI interventions are implemented (with responsiveness not being a core defining feature of NDBI treatment models; Ingersoll, 2010). It is possible that this feature influences interventions' effectiveness for social communication and language development (Ingersoll, 2010). Given the movement toward integrating developmental principles within behavioral intervention models (Lord et al., 2005; Schreibman et al., 2015), it will be important to understand which features of DSP interventions best predict positive treatment response. Including analysis of potential treatment mediators in future research should be a priority. This could help clinicians better tailor interventions to each child's individual profile and enhance the decision-making process about which treatment characteristics to integrate when combining the two treatment models.

Limitations and future research

Within the studies that met inclusion criteria, there was sizable heterogeneity specifically with respect to (a) study design; (b) methodological quality; (c) duration, intensity, and implementation of treatment programs; (d) professional background of professionals delivering the treatment; (e) fidelity to treatment; (f) level of training of therapists; and (g) outcome measures used. Consequently, a meta-analysis was not conduced (Sterne, Egger, & Moher, 2011). There is need for additional RCTs that are adequately powered and that employ greater consistency in the frequency, duration, and delivery of the intervention provided to both the treatment and control groups. Consensus on outcome measures used across studies will also help researchers draw more definitive conclusions about DSP interventions. Although treatment effects were significant in many cases, wide confidence intervals demonstrating the variability of outcomes were also common across studies. Within future research, it might be advantageous to look at how DSP interventions impact more homogeneous groups of children with ASD (e.g. smaller age range, similar pretreatment language level).

Inclusion of measures of generalization and maintenance when evaluating treatment effectiveness is important (Dollaghan, 2007) and was scarce within the studies included in this review. The necessity of these kinds of measures is underscored when assessing interventions that include a parent training component. One goal of including parents in intervention is to increase the child's treatment dosage through having parents generalize the strategies learned during intervention to their interactions with their child outside of intervention. Without generalization measures, it is difficult to determine what might be driving change within the intervention. For parent coaching interventions, different levels of generalization that researchers should include: (a) whether the caregiver and child, as a dyad, are able to generalize skills learned in treatment to natural interactions that are outside of the treatment setting, and (b) whether the child is able to maintain communication and language gains when interacting with someone who has not received the intervention, and who therefore may not be providing scaffolds to enhance the child's communication or language. Examining generalization at these two levels can help researchers to answer the question: Did the child's language change because the caregiver learned to effectively scaffold the child's language, or was it specifically the child's language that changed, thus enabling the child to maintain changes across different partners? In future research, it is imperative that measures of generalization are included and that consideration is given to the tools used to evaluate generalization. Kazdin (2008) explored opportunities to bridge clinical research and practice, reporting that "even changes on well-established rating scales are often difficult to translate into everyday life" (p. 148). None of the studies included in this review assessed generalization or maintenance of social communication or language gains by removing the familiar caregiver during interactions. However, all studies employed at least one outcome measure that evaluated children with caregivers or therapists in natural play contexts. Including more extensive measures at multiple levels of generalization in future research would support evaluation of real-world generalization.

Finally, including detailed information about service delivery factors (e.g. intervention duration and frequency, clinician training) and how specific capacities are targeted during intervention would be a valuable addition to this body of research. Including this information would allow for analysis of how service delivery factors or use of specific treatment strategies might relate to children's response to treatment and inform

service delivery. Within the studies we reviewed, specific capacities targeted during intervention were often described vaguely, and many of the DSP programs were not manualized. This may be due to the concern that manuals do not always allow for enough flexibility and customization of intervention to meet the diverse needs for the children and families (Smith, 2012). However, a manual that provides guidance on how to consider implementation of the intervention in a way that allows for flexibility and individualized adaptation would help to make DSP intervention studies more replicable.

Conclusions

As far as we are aware, this is the first systematic review to identify a group of interventions that met clearly defined DSP intervention criteria. Our review examined the effectiveness of DSP treatments on the social communication and language of young children with ASD. It also investigated how parents' interaction and communication styles were impacted by these interventions. Our review suggests that DSP treatments positively impact children's foundational social communication capacities such as attention, focusing on faces, joint attention, initiation, and reciprocity, but do not consistently improve children's language skills. These interventions have the capacity to enhance the interaction styles of caregivers, optimizing them for supporting children's communication development. The two studies that examined mediating factors impacting children's response to DSP interventions suggest that caregiver responsiveness and synchronous behavior positively predict response to treatment, and thus inclusion of these intervention features should be strongly considered when working with preschool children with ASD. Future research efforts should aim to isolate and test potential active ingredients unique to DSP interventions to enhance understanding of how to most effectively combine evidenced, effective treatment mechanisms and personalize and adapt them to children's unique profiles and communication needs.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was assisted by the Ontario Mental Health Foundation, with funding from the Ontario Ministry of Health and Long-Term Care, and the Canadian Institutes for Health and Research and Sinneave Family Foundation's Autism Research Training Program.

Supplemental Material

Supplemental material for this article is available online.

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