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Interventions for Toddlers With Autism Spectrum Disorders

An Evaluation of Research Evidence

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Recently emerging intervention studies for toddlers with autism spectrum disorders (ASD) were reviewed through a systematic assessment of intervention outcomes, research rigor, and intervention features. The review includes published peer-reviewed experimental studies of toddlers with high risk for or diagnosis of ASD in which the majority of interventions occurred before age 36 months. Of 20 identified research studies, 6 were group comparison studies, all of which showed small to large magnitudes of effect when a uniform metric was applied. Fourteen were single-case design (SCD) studies, all of which reported effects on a variety of outcomes. When grouped by area of intervention focus (communication, general development, family well-being, imitation, joint attention, and play), commonly identified needs within focus areas were for replication, common measures, and authentic practices. A majority of studies in most focus areas showed strong to acceptable levels of research rigor, though this is an area of ongoing need.

Keywords: *autism spectrum disorders, disabilities and development delays, Part C services, components of practice, infants and toddlers, young children, instruction*

Research on intervention for toddlers with autism spectrum disorders (ASD) began appearing in the literature over the past decade in response to considerable interest in the potential for earlier intervention to enhance outcomes. These early investigations were furthered by improved general awareness of ASD and early identification initiatives that included toddler screening protocols (e.g., Robins, Fein, Barton, & Green, 2001), recommendation by the American Academy of Pediatrics for universal 18-month ASD screening

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at toddler well-child checks (Johnson & Myers, 2007), and a toddler version of the Autism Diagnostic Observation Schedule (Luyster et al., 2008). Recently, toddler research in ASD received a boost as private and public funding prioritized early intervention research (Autism Speaks, 2011; Interagency Autism Coordinating Committee, 2005). The emergent stage of toddler intervention research in ASD presents an opportunity to inform early intervention practice and future research at an important juncture.

Our assessment of the need for review of toddler intervention studies first considered reviews of interventions for young children with ASD already conducted, all of which were found to have included all or a majority of children older than age 36 months. These reviews addressed parent-implemented early intervention (Brookman-Frazee, Vismara, Drahota, Stahmer, & Openden, 2009; McConachie & Diggle, 2007), comprehensive intervention programs (Eikeseth, 2009; Eldevik et al., 2009; Howlin, Magiati, & Charman, 2009; Reichow & Wolery, 2009; Rogers & Vismara, 2008; Virués-Ortega, 2010), and interventions to facilitate social interaction (Reichow & Volkmar, 2010). Six of the 10 reviews focused on early intensive behavioral intervention studies, the most studied comprehensive intervention approach for preschoolers with autism, and all reported evidence of effects but noted limitations related to methodological concerns (Eikeseth, 2009; Eldevik et al., 2009; Howlin et al., 2009; Reichow, 2012; Reichow & Wolery, 2009; Virués-Ortega, 2010).

Intervention for preschoolers (ages 3 through 5) typically targets more developmentally advanced outcomes than those for toddlers (ages 1 to 3), is more oriented to group settings, and is guided by policy less integrally centered on families. For these reasons, and because toddlers and families were not prominently featured in the earlier reviews of preschool interventions, findings on preschool interventions can be difficult to generalize to toddlers and their families.

Although the need is clear for toddler intervention research to be reviewed separately, the relatively small collection of studies and their diversity of research designs, intervention purposes, and outcome measures are limiting factors. The reviews of interventions for older children, listed above, grouped similarly focused studies (i.e., peer-mediated, comprehensive, and socially oriented interventions). Because the body of toddler research is smaller, such groupings are unlikely to yield definitive conclusions on intervention effects, but could clarify future research needs on such dimensions as strength of outcomes, research rigor, and replication. A multidimensional review could also begin to explore the intersection between intervention outcomes and practical issues of implementation by reviewing feasibility concerns.

In conducting a systematic review, many decisions must be made (for descriptions of systematic review methods see Cooper, 2010; Higgins & Green, 2008; Petticrew & Roberts, 2006). One of the first decisions is how to group (or analyze) across studies, which has been shown to have a significant impact on the conclusions that can be drawn from a review (Hattie, 2009). Most reviews set out to describe the effects of an intervention on specific outcomes. Therefore, it is important to operationalize clearly the outcome variables that will be used in the review. Some reviews group studies by intervention method and attempt to analyze the overall effects of a given intervention. This method is sufficient when a similar intervention is being used to impact similar outcomes, and we have many methods for carrying out such analyses (e.g., Lipsey & Wilson, 2001; Odom et al., 2005). When multiple interventions are used to address multiple outcomes, the “apples and

oranges" problem is encountered, and the reviewers must make decisions on how to organize the review and analyze the findings to make meaningful recommendations for practice. When encountering the apples and oranges problem, organizing results by methods across outcomes can provide valuable information related to what works, for whom, and under what conditions.

A valid assessment of outcomes also depends on the rigor by which those outcomes were measured in the reviewed studies. There are many methods of evaluating research rigor in the primary studies included in a systematic review (e.g., Higgins & Green, 2008; Jadad et al., 1996). All methods have advantages and disadvantages depending on the audience and purpose, and there remains no single standard method for evaluating research rigor (Polanin, 2012). For quite some time, social scientists have debated how to assess research rigor and how to use the results of such ratings for systematic reviews. One method is to include all studies regardless of rigor, with the assumption that if combined statistically, the stronger studies will provide more weight than the weaker studies, thus providing balance. Others, most notably Slavin (1986), have proposed eliminating poor quality studies from reviews, arguing that the results of studies with poor methodological rigor are more likely to yield results in which we have low confidence. The evidence on the effects of including or excluding low-quality studies is inconclusive with some analyses showing little correlation between study quality and treatment effect (e.g., Juni, Witschi, Bloch, & Egger, 1999) and others suggesting that low-quality studies tend to overestimate true effects (e.g., Moher et al., 1998). Thus, when conducting a systematic review, it is important to operationalize the approach to assessing rigor and to provide transparency that allows consumers to interpret the findings.

Another element of a multidimensional review is assessment of intervention features with respect to practical issues of implementation. Reporting on the focus of intervention (i.e., intervention content) and elements of intervention delivery (intervention process) could give readers an overview of the extent to which interventions reported to be effective through rigorous research are also appropriate for toddlers and families, and feasible for implementation. A review of intervention focus could describe the extent to which intervention content addresses core concerns for toddlers with ASD, and a review of intervention processes could describe the use of intervention agents and settings that relate to expectations in the field for authentic intervention venues and family roles.

Regarding intervention content, some models used with older children (e.g., professionally implemented interventions focusing on verbal language) may not be developmentally appropriate for toddlers, whose early communicative learning is socially situated within transactional caregiver–child relationships and whose social communication development evolves from preverbal foundations, notably joint attention (Adamson, McArthur, Markov, Dunbar, & Bakeman, 2001; Tronick, 2007). In one example of the importance of joint attention focused relationship-situated learning for toddlers with ASD, Siller and Sigman's (2008) longitudinal research found that, independent of initial IQ or language abilities for toddlers with ASD, two factors predicted rates of later language growth: toddlers' early facility with responding to others' bids for joint attention and parents' responsiveness to their children. Research findings on the importance of joint attention (Bates, Snyder, Bretherten, & Volterra, 1979; Mundy, Sigman, & Kasari, 1990; Tomasello & Farrar, 1986) and parent responsiveness (Feldman, Greenbaum, & Yirmiya, 1999; Landry, Smith, &

Swank, 2006; Mahoney, Kim, & Lin, 2007) on language outcomes for toddlers with ASD are well replicated in the literature. This evidence has implications for how toddlers' learning goals are focused and for how parent–child interaction is featured in the intervention design, with its importance extending beyond immediate effects of the intervention.

Beyond addressing toddler-appropriate outcomes, full integration of intervention into toddlers' and families' everyday experiences and interactions is emphasized in policy and practice recommendations (Copple & Bredekamp, 2009; Individuals with Disabilities Education Act, 2004; Odom & Wolery, 2003; Sandall, Hemmeter, Smith, & McLean, 2005; Schertz, Baker, Hurwitz, & Benner, 2011). In addition to evidence from well-conducted empirical research, early intervention priorities generate from professional wisdom, experiential knowledge, and stakeholder values (Reichow & Volkmar, 2011; Snyder, 2006; Straus, Richardson, Glasziou, & Haynes, 2005). Values-based practices and those based on intervention efficacy may be complementary, as shown by the research showing superior effects for early intervention that is integrated within everyday settings and interactions (Dempsey & Keen, 2008; Dunst, Bruder, Trivette, & Hamby, 2006; Dunst, Trivette, & Hamby, 2007; Hebbeler & Gerlach-Downie, 2002; Mahoney, Boyce, Fewell, Spiker, & Wheeden, 1998; Trivette, Dunst, & Hamby, 2010).

Another feasibility concern is cost-effectiveness. Studying the impact of varying levels of intervention density requires comparing intervention effects with other variables held constant; however, showing the variance in intervention density even on a small scale, such as in a review of emerging research, could focus questions for future study.

In sum, a broad-based descriptive review of research on intervention for toddlers with ASD and their families is timely for early intervention researchers, practitioners, and families who have a stake in early intervention success. A description of outcomes measured and the extent to which they were achieved, research rigor, intervention focus, and feasibility-related variables could position the field to assess the early status of this research and clarify future research priorities.

The purpose of this review was, thus, to examine research on intervention for toddlers with ASD and their families through an analysis of intervention outcomes, research methods, and intervention features, organized by intervention purpose. Specifically, within intervention focus areas, we aimed to describe and evaluate the nature and strength of intervention outcomes, the rigor of research methods, and the feasibility of reported practices for the field.

Method

Selection criteria. Research studies were included if they met the following criteria: First, the majority of reported intervention time occurred before 36 months of age. In the case of single-case design (SCD) studies with mixed participant ages (i.e., participants with ages both above and below 36 months), we limited our review to the children who were less than 36 months (Table 1 notates included participants by study). The age restriction was to assure that the majority of intervention time was spent during the toddler period and that the intervention was designed for toddlers rather than for older children. Second, participants were identified as having or being at high risk for a diagnosis of ASD as

Table 1
Participant and Intervention Descriptions

	Participants			Intervention features		
Study	*n*	M/F	*M* age (months)	Setting	Agent	Density and duration
Group designs (intervention/control)						
Carter et al. (2011)	32/30	51/11	20	Home (child); clinic and home (parent)	Parent for child; SLP for parent	8 parent sessions, 3 parent–child sessions; 15 weeks
Dawson et al. (2010)	24/24	3.5:1 ratio	23.1/23.9	Home	Therapist, parent	20 hr per week individual, twice monthly parent training; 104 weeks
Drew et al. (2002)	12/12	11/1; 8/4	21.4/23.6	Home	Parent	3 hr every 6 weeks (professional); 3.5 to 7 hr per week (parent); 52 weeks
Landa, Holman, O'Neill, and Stuart (2011)	24/24	20/4; 20/4	28.6/28.8	Noninclusive classroom	Professional with parent carryover	10 hr per week classroom, 1.5 hr per month home parent training, parent classes; 26 weeks
Wetherby and Woods (2006)	17/17	15/2; 13/4	<24	Home, parent–child playgroups	Parent	2 home visits weekly + parent groups; duration varied
Zachor, Ben Itzchak, Rabinovich, and Lahat (2007)	19/20	18/1; 19/1	18.8/27.7	Noninclusive classroom; partial for some	Professional	35 hr per week; 52 weeks
Single-case designs[a]						
Brookman-Frazee and Koegel (2004)	3	3/0	34, 32, 29	Home, clinic playroom	Parent	12 sessions; length of session and total duration not specified
Cardon and Wilcox (2011) (4 of 6: E, J, L, A)	4	4/0	33, 28, 32, 33	Clinic	Researcher (SLP)	Three 30-min sessions per week, 5 weeks
Esch, Carr, and Grow (2009) (2 of 3: J, M)	2	1/1	28, 32	School (separate room)	Researcher	3-5 days/week, 5- to 15-min sessions, 10-20 weeks
Hine and Wolery (2006) (1 of 2: C)	1	0/1	30	Therapy room	Researcher	Five 15-min sessions per week, 10 weeks
Ingersoll, Dvortcsak, Whalen, and Sikora (2005) (2 of 3: D, P)	2	2/0	30, 32	Clinic	Therapist	2 hr/week, 10 weeks

(continued)

Table 1 (continued)

Study	Participants			Intervention features		
	n	M/F	*M* age (months)	Setting	Agent	Density and duration
Ingersoll and Gergans (2007) (1 of 3: C)	1	1/0	31	Clinic	Parent trainer, parent	Two 30- to 40-min sessions per week, 10 weeks
Jones, Carr, and Feeley (2006) (4 of 5: P, E, A, D)	4	4/0	25, 26, 34, 26	Study 1: noninclusive classroom, Study 2: home and community	ABA teacher	Study 1: 1-4 sessions/day (time not specified), 2-20 weeks Study 2: Five sessions/week (time not specified), 5-30 weeks
Leew, Stein, and Gibbard (2010)	4	4/0	32, 30, 33, 27	Home	Parent	Two to nine 20-min sessions, 2 weeks
Park, Alber-Morgan, and Cannella-Malone (2011)	3	3/0	29, 31, 29	Home	Parent	Three 40- to 60-min sessions
Rocha, Schreibman, and Stahmer (2007) (2 of 3: J, A)	2	2/0	27, 26	Clinic	Parent	Three 20-min sessions per week (51 total), 6 weeks
Schertz and Odom (2007)	3	3/0	24, 33, 22	Home	Parent	1 hr per week; 5 hr per week (parent–child); 9-26 weeks
VanDerHeyden, Snyder, DiCarlo, Stricklin, and Vigianos (2002) (1 of 2: G)	1	1/0	29	Semi-inclusive classroom	Professional	Not applicable (manipulated environment)
Vismara and Lyons (2007) (2 of 3: child 1, 2)	2	2/0	34, 26	Clinic or home	Parent	Two 150-min sessions (5 hr) per week + parent carryover at home, 12 weeks
Vismara and Rogers (2008)	1	1/0	9	Clinic	Parent	One 90-min session per week with parent + parent carryover, 12 weeks

Note: SLP = speech/language pathologist; ABA = applied behavior analysis.
[a]Includes age-eligible participants only, specified by first initial.

determined by one or more of the following: Autism Diagnostic Observational Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 1999), the Autism Diagnostic Interview–Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994), Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1988), *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; *DSM-IV-TR*; American Psychiatric Association, 2000), a reliable toddler autism screening instrument such as the Modified Checklist for Autism in Toddlers (M-CHAT; Robins et al., 2001), and clinical expertise (see Lord et al., 2006). We included studies of participants designated to be at high risk for an ASD because diagnostic evaluations of toddler-aged children were not widely available for earlier studies (Zwaigenbaum et al., 2007). Third, the content of the intervention and how it was delivered was clearly described. Fourth, the reported research used one of the following research designs: randomized controlled trial, quasiexperimental multiple-group comparison, or an SCD (multiple-baseline, withdrawal, or alternating treatments). Finally, the study was published in English in a peer-reviewed journal.

Search methods. The first two authors independently searched the online databases Academic Search Premier and PsycINFO using the search criteria (autis* or pdd or pervasive developmental disorder) *and* intervention *and* (toddler or young child* or preschool or pre-school) in December 2011. In addition, we surveyed pertinent reviews whose inclusion criteria intersected with those of this review (Brookman-Frazee et al., 2009; Eikeseth, 2009; Eldevik et al., 2009; Howlin et al., 2009; McConachie & Diggle, 2007; Reichow, 2012; Reichow & Volkmar, 2010; Reichow & Wolery, 2009; Rogers & Vismara, 2008; Virués-Ortega, 2010). Finally, we searched the "Online First" postings of articles accepted for publication but not yet published for the journals *Autism, Focus on Autism and Other Developmental Disabilities, Journal of Autism and Developmental Disorders, Journal of Early Intervention, Research in Autism Spectrum Disorders*, and *Topics in Early Childhood Special Education.*

We initially located 679 manuscripts after deleting duplicates in the database search, and no additional studies were identified through reference lists or "online first" searches. Forty manuscripts remained after the first and second authors independently screened each article's title and abstract, and excluded those that did not describe intervention research or did not include toddler-aged children. We then independently assessed the full papers of the 40 manuscripts, with 20 meeting all inclusion criteria. Of the 20 excluded studies, 7 were excluded due to research design limitations (e.g., no comparison condition for group studies), 2 for insufficient description of the intervention, and 11 because the participants did not fully meet our age criterion. Disagreements were resolved by consensus after comparing evidence.

Coding. We first classified each study as using either group comparison or SCD research, and summarized descriptive features of the participants and intervention characteristics as reported in Table 1. Three participant characteristics were coded from the studies' participant descriptions. The *number* quantifies the toddler participants in each study. The *age* of the participants is presented as a mean for group research design studies and as specific ages for the SCD studies. Finally, we recorded the *gender breakdown* of the participants.

We coded three intervention characteristics. The intervention *setting* was classified by type (home, clinic, or classroom) to determine whether it was the child and family's natural environment and, for group settings, the extent to which it included natural proportions of toddlers with and without disabilities. The second intervention feature was *agent*, or who delivered the intervention to the child. The third, *density and duration*, was based on the conceptual framework proposed by Guralnick (1998). Density is defined as the number of hours per week, and duration is defined as the total number of weeks that intervention was provided.

In a second coding scheme, studies were grouped by the *primary intervention focus*, determined by a review of the studies' purpose statements and reported outcome measures, as shown in Table 2. Five areas of intervention focus were identified: general development, communication, family well-being, joint attention, and play. Within these groupings, we determined for each study the reported child-focused intervention strategies and outcomes. We also estimated intervention success, research rigor, and ecological validity.

In addition to the five intervention focus areas, we created a separate (duplicated) grouping of fully parent-implemented interventions. For each, we listed parent-focused intervention strategies. Child- and parent-focused intervention *strategies* were derived from the intervention descriptions in each article. They described specific techniques reportedly used with children and families to achieve targeted outcomes.

Three variables were coded related to research methods and outcomes. First, we recorded up to three primary *outcome measures* (e.g., dependent variables) for each study, choosing the three most relevant outcomes related to global functioning regardless of magnitude of effect if more than three were reported and regardless of whether they were reported as primary or secondary measures.

Second, we adapted the *success estimate* proposed by Reichow and Volkmar (2010) to indicate strength or replicability of effects for group and SCDs, respectively. For group research designs, rather than using effect sizes that may have been reported in the studies, we computed the success estimate as an effect size by comparing posttreatment scores between treatment and comparison groups using Hedges's *g* (Hedges & Olkin, 1985). For SCD studies, we calculated the success estimate using visual analysis to determine whether the intervention was effective for each participant and reported it as a ratio of successful implementations of the independent variable to the total number of implementations attempted. For studies with multiple outcome measures, we calculated a separate success estimate for each outcome.

For *research rigor*, we used the rating rubrics from the Evaluative Method for Determining Evidence-Based Practices in Autism developed by Reichow and colleagues (e.g., Reichow, 2011; Reichow, Volkmar, & Cicchetti, 2008). The evaluative method contains two rating rubrics (one for group design studies and one for SCD studies) that provide a method for rating multiple variables reflecting strong or adequate research design principles (the rubrics are available from the second author). The variable ratings can then be summed within a research report to provide a level of research report strength rating for each study according to the criteria of Reichow et al., 2008. The method has been used to evaluate social skills interventions (Reichow & Volkmar, 2010), psychotropic medications (Siegel & Beaulieu, 2012), and sight word instruction (Spector, 2011), and initial analyses of the method showed good reliability and validity (Cicchetti, 2011). We made one modification of the SCD criteria to adapt for the exclusion of participants older than 36 months;

Table 2
Assessment of Outcomes, Common Strategies, Research Rigor, Ecological Validity, and Limitations by Primary Intervention Focus

Intervention focus	Strategies, with duplicate strategies highlighted[a]	Outcome measures	Success estimates[b]	Rigor ratings	Ecological validity[c]	Limitations, future research needs
Communication	Carter et al. (2011) Predictable routines and environment, video modeling, visual support	MSEL-C VABS-C VABS-S	$g = -.06$ $g = -.02$ $g = .10$	2	Full	Authentic settings and interaction partners Common measures
	Esch, Carr, and Grow (2009) Reinforcement: edible and other, stimulus-stimulus pairing	Vocalizations	4 of 4	2	None	Density and duration: Comparative effects on outcomes Comparison of preverbal vs. verbal approaches on language outcomes
	Ingersoll, Dvortcsak, Whalen, and Sikora (2005) Child actions treated as purposeful communication, follow child's lead, language stimulation	Expressive language	2 of 2	2	None	Replication within and across studies
	Park, Alber-Morgan, and Cannella-Malone (2011) Picture Exchange Communication System	Picture exchange	3 of 3	2	Full	
General development	Dawson et al. (2010) Adult *responsivity* and sensitivity to child cues, chaining, enhance child affect and shared engagement, *didactic parent training* in specific curriculum-based strategies, operant conditioning, *shaping, therapy* (speech/language, occupational)	MSEL-C VABS	$g = .59$ $g = .73$	1	Full	Authentic settings and interaction partners Common measures Density and duration: Comparative effects Joint attention vs. general developmental approaches: Comparative effects on social communication outcomes Replication within and across intervention approaches Research rigor
	Vismara and Rogers (2008) Antecedent-behavior-consequence, fading, *follow child's lead, functional assessment*, pivotal response training, prompting, reinforcement, *shaping*, systematic teaching	Vocalizations Imitation Social initiation	2 of 2 2 of 2 2 0f 2	3	Partial	
	Wetherby and Woods (2006) *Follow child's lead, functional assessment*, parent–child interaction, positive behavioral support, predictable routines, routines-based intervention	CSBS: social interaction, joint attention, communication	$g = .98$ $g = .88$ $g = .83$	3	Full	

(continued)

Table 2 (continued)

Intervention focus	Strategies, with duplicate strategies highlighted[a]	Outcome measures	Success estimates[b]	Rigor ratings	Ecological validity[c]	Limitations, future research needs
	Zachor, Ben Itzchak, Rabinovich, and Lahat (2007) Group activities, *therapy* (speech/language, occupational)	ADOS-LC ADOS-RSI	g = .70 g = .38	2	None	
Family well-being (and child engagement)	Brookman-Frazee and Koegel (2004) Follow child's lead, pivotal response training, reinforcement	Child affect Parent stress	3 of 3 3 of 3	2	Full/partial	Replication of this and other approaches with common measures
Imitation	Cardon and Wilcox (2011) *Reciprocal imitation training* (actions with toys), video modeling	Imitation	4 of 4	1	None	Authentic settings and interaction partners Replication within and across intervention approaches
	Ingersoll and Gergans (2007) *Reciprocal imitation training* (object & gesture imitation), corrective feedback for parents, modeling for parents	Imitation	1 of 1	2	Partial	
Joint attention/ social synchrony	Drew et al. (2002) Interrupt unwanted behaviors, *reinforcement*, visual support	NVIQ MCDI-U MCDI-S	g = .71 g = .71 g = .56	2	Full	Authentic settings and interaction partners Common measures
	Jones, Carr, and Feeley (2006) *Discrete trial training/reinforcement, natural consequences, prompting*, edible *reinforcement*	Responding to and initiating joint attention	4 of 4 4 of 4	2	None/partial	Density and duration: Comparative effects Joint attention vs. communication-focused intervention: Comparative effects on language outcomes
	Landa, Holman, O'Neill, and Stuart (2011) *Discrete trial training, follow child's lead*, interpersonal synchrony promotion, linguistic mapping, *natural consequences*, pivotal response training, *routines-based intervention*, visual support	MSEL-EL MSEL-VR Initiating joint attention	g = .15 g = .32 g = .31	2	Partial	Joint attention vs. general development approaches: Comparative effects on social communication outcomes Replication within and across approaches Research rigor
	Leew, Stein, and Gibbard (2010) Weighted vest	Competing behaviors Joint attention	1 of 4 0 of 4	3	Full	

(continued)

Table 2 (continued)

Intervention focus	Strategies, with duplicate strategies highlighted[a]	Outcome measures	Success estimates[b]	Rigor ratings	Ecological validity[c]	Limitations, future research needs
	Rocha, Schreibman, and Stahmer (2007) *Discrete trial training/reinforcement*, naturalistic behavioral techniques, *pivotal response training, prompting*	Responding to joint attention	2 of 2	3	Partial	
	Schertz and Odom (2007) Child actions treated as purposeful communication, *follow child's lead*, parent–child interaction, routines-based intervention	Joint attention Turn taking Regarding faces	2 of 3 3 of 3 2 of 3	2	Full	
	Vismara and Lyons (2007) *Follow child's lead*, pivotal response training, *reinforcement*	Initiating joint attention	4 of 4	1	Partial/full	
Play	Hine and Wolery (2006) Video modeling (toy play actions)	Imitation in play	2 of 2	2	None	Authentic settings and interaction partners Common measures
	VanDerHeyden, Snyder, DiCarlo, Stricklin, and Vigianos (2002) Within stimulus prompting (to expand contact with toys)	Play	2 of 2	2	None	Link to core social concern in ASD

Note: MSEL-C = Mullen Scales of Early Learning–Composite; VABS-C = Vineland Adaptive Behavior Scales–Communication; VABS-S = Vineland Adaptive Behavior Scales–Socialization; VABS = composite; NVIQ = nonverbal IQ; MCDI-U = MacArthur Communicative Development Index– (words understood); MCDI-S = MacArthur Communicative Development Index–Words said; MSEL-EL = Mullen Scales of Early Learning–Expressive Language; MSEL-VR = Mullen Scales of Early Learning–Visual Reception; CSBS = Communication and Symbolic Behavior Scales Developmental Profile; ADOS-LC = Autism Diagnostic Observation Schedule–Language and Communication; ADOS-RSI = Autism Diagnostic Observation Schedule–Reciprocal Social Interaction; PECS = Picture Exchange Communication System.

aDuplicates within focus areas are indicated in italics.

bFor group studies, large effects: ($g \geq .80$); medium effects ($g = .40$-79); small effects ($g = .20$-$.39$). 1 = *strong*, 2 = *acceptable*, 3 = *insufficient strength*.

cFull = conducted in (a) the natural environment and (b) with family involvement; partial = only one reported; none = neither reported.

for this, we evaluated experimental control across all participants reported in the study, not just the ones included in this review, when studies included participants who did and did not meet our inclusion criteria.

An estimate of *ecological validity* was determined by a "none," "partial," or "full" rating based on a simple assessment of each study's reporting of intervention setting and agent. For a rating of "full," intervention was assessed as being delivered in the child's natural environment with the parent having a role in the intervention. For a "none" rating, neither delivery in the child's natural environment nor parent involvement in the intervention was reported. For a "partial" rating, only one the conditions for setting or agent was met.

Finally, a listing of research needs was generated for each intervention focus area from an assessment of limitations uncovered through the review of coded elements. This assessment considered (a) the extent to which common measures were used within the focus area, (b) whether research was replicated for specific approaches and across intervention approaches within each area, (c) estimates of research rigor, (d) whether the interventions used authentic settings and involved parents, (e) variations in intervention density and duration, (f) the relevance of intervention goals to core concerns in ASD, and (g) comparative effects on outcomes across areas of intervention focus (e.g., preverbal and verbal approaches to promoting social communication and general vs. social-communication-specific intervention).

Each variable in Tables 1 and 2 was double coded independently by two of our authors. The extracted data were then compared, and any discrepancy was resolved through mediation and, if necessary, a third opinion. Although we are not reporting interrater agreement data, this is a common coding method used in systematic reviews and meets the standards of the most rigorous systematic review methods (e.g., Cochrane Collaboration; Cooper, 2010; Higgins & Green, 2008).

Results

Results from the study of toddler intervention research are presented in the three tables. From the 6 group comparison studies and 14 SCD studies, a total of 161 toddler participants received the experimental interventions across the reported studies. Of these, 139 were boys (86%; male:female = 6:1), and the mean participant age at entry was 26.6 months.

Study Features and Findings by Research Design

Outcome measures. Findings from the reported research were based on a range of intervention outcomes. All of the six group comparison studies used standardized measures, with one study reporting on a nonstandardized joint attention measure as well (Landa, Holman, O'Neill, & Stuart, 2011). Three of these studies (Carter et al., 2011; Drew et al., 2002; Landa et al., 2011) used the Mullen Scales of Early Learning (MSEL; Mullen, 1995), and two (Carter et al., 2011; Dawson et al., 2010) used the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984; Sparrow, Cicchetti, & Balla, 2005). Beyond these outcome measures, others were idiosyncratic to individual studies, with one study

(Zachor, Ben Itzchak, Rabinovich, & Lahat, 2007) using a diagnostic instrument (e.g., Autism Diagnostic Observation Schedule; Lord et al., 1994) and two (Drew et al., 2002; Wetherby & Woods, 2006) relying on different standardized language measures. The SCD studies used a range of mostly nonstandardized measures that tracked closely with the studies' intervention foci. Among the SCD studies, the most common focus for outcome measures was joint attention in responding or initiating forms with 5 of 14 studies including this outcome (Jones, Carr, & Feeley, 2006; Leew, Stein, & Gibbard, 2010; Rocha, Schreibman, & Stahmer, 2007; Schertz & Odom, 2007; Vismara & Lyons, 2007). Four studies (Cardon & Wilcox, 2011; Hine & Wolery, 2006; Ingersoll & Gergans, 2007; Vismara & Rogers, 2008) reported on child changes in imitation, and three used measures of verbal communication (Esch, Carr, & Grow, 2009; Ingersoll, Dvortcsak, Whalen, & Sikora, 2005; Vismara & Rogers, 2008). Other measures included child affect, parent stress, competing behaviors, picture exchange, social initiations, and play.

Success estimates and research rigor. For the group comparison studies, the range of effect sizes was −0.06 to 0.98. Using Cohen's (1988) guidelines to interpret these effect sizes for the 16 outcome measures across the six group comparison studies, we calculated the following: no effects (<.20) on 4 measures, a small effect (g = .20−.39) on 3 measures, a medium effect (g = .40−.79) on 6 measures, and a large effect ($g \geq .80$) on 3 measures. For the SCD studies, all studies had positive success estimates with most participants demonstrating the desired effect with the exception of the study by Leew and colleagues (2010), which showed no changes in competing behaviors or joint attention for a majority of their participants. Finally, of the 20 studies, 3 were rated as methodologically "strong," 13 as "acceptable," and 4 as having insufficient strength.

Setting. As reported in Table 1, among the described interventions, 5 were fully conducted in home or fully inclusive early childhood settings, and 10 were delivered in clinics or classroom settings that were not fully inclusive (i.e., did not include typical proportions of children with and without disabilities). The remaining 5 interventions were delivered in some combination of home and clinic or specialized classroom/playgroup settings.

Intervention agent. In the 10 studies that did not use parents in a primary intervention role, therapists, teachers, or other professionals implemented the intervention. For 3 of these studies, parents participated in a supporting role (e.g., to embed professionally modeled strategies into daily activities). Parent-implemented studies were fairly evenly dispersed among the five areas of intervention focus except for play, which did not use parent-implemented intervention.

Density and duration. The number of hours per week devoted to professionally delivered intervention ranged from a restricted number of sessions focusing on a specific skill to more sustained and broadly focused intervention. Of the latter group, the most professionally time-intensive interventions ranged from 10 (Landa et al., 2011) to 35 (Zachor et al., 2007) hours per week. Importantly, however, the time parents spent in intervention-related activities in the home was typically not reported.

Table 3
Parent-Focused Strategies for Fully Parent-Implemented Interventions

Study	Strategies to support parent learning[a]
Brookman-Frazee and Koegel (2004)	*Prompt/prompt fading*
Carter et al. (2011)	*Parent conceptual support, didactic parent training, promote parent responsiveness*
Drew et al. (2002)	*Parent conceptual support, didactic parent training*
Leew, Stein, and Gibbard (2010)	*Parent selects activities*
Park, Alber-Morgan, and Cannella-Malone (2011)	Corrective feedback for parents, *didactic parent training*
Rocha, Schreibman, and Stahmer (2007)	*Didactic parent training, prompt*/prompt fading, modeling
Schertz and Odom (2007)	*Parent conceptual support, parent selects activities*
Vismara and Lyons (2007)	*Didactic parent training*
Vismara and Rogers (2008)	*Didactic parent training*
Wetherby and Woods (2006)	*Parent conceptual support, parent selects activities, promote parent responsiveness*

[a]Duplicated strategies are indicated in italics.

Intervention strategies. We identified a total of 39 child-focused intervention strategies from the descriptions of toddler interventions and an additional 7 strategies from descriptions of fully parent-implemented interventions. Overall, the group comparison studies, most of which were developed as comprehensive interventions, reported a broader range of intervention strategies than did the SCD studies, many of which had a narrower intervention scope and some of which were designed to promote a specific skill, such as imitation. The most commonly reported child-focused intervention strategies were following the child's lead and reinforcement-based strategies. Parent-focused strategies were largely divided between those that provided didactic training on specific intervention components and those that provided broad-based conceptual support with parent discretion on activity choices. Child-focused intervention strategies found in more than one study within an intervention focus subgroup are italicized in Table 2, and the same can be found for parent-focused strategies listed in Table 3.

Study Features and Findings by Intervention Focus

Communication interventions. Outcomes measures used for the four communication-focused interventions showed no overlap among them. The one group comparison study in this group (Carter et al., 2011) reported no general effects on standardized measures from the intervention. The three SCD studies all reported positive change on observational measures from baseline to intervention conditions for the two or three participants in their studies, and adequate research rigor was assessed for all four studies. Generalized effects cannot be ascertained from this group because of variance in intervention methods, goals (vocalizations, requesting through picture symbols, and expressive language), and outcome measures.

Two of the studies were conducted in family homes and were fully parent-implemented (Carter et al., 2011; Park, Alber-Morgan, & Cannella-Malone, 2011), one was conducted in a clinic (Ingersoll et al., 2005), and one was conducted in a separate classroom (Esch et al., 2009). All were implemented for 10 to 15 weeks or less. No overlap in reported specific intervention strategies was evident.

General development interventions. The four studies that focused on general child development (i.e., with intervention targeting multiple developmental domains) had no common measures among them and are therefore not comparable on common criteria. However, all showed moderate to high success estimates on their own measures. Two studies, one a SCD (Vismara & Rogers, 2008) and one a group comparison design (Wetherby & Woods, 2006) reported research design features or procedures with insufficient strength to support reported outcomes with confidence, although they laid out models that can be tested in future studies. Another (Zachor et al., 2007) used a diagnostic instrument to assess outcomes, limiting conclusions that can be drawn from their findings. Dawson and colleagues (2010) reported moderate effects from their 2-year as-yet-unreplicated intervention, the Early Start Denver Model, with evidence supported by strong research rigor.

The studies in this group spanned a full range of intervention settings, including home (Wetherby & Woods, 2006), clinic (Vismara & Rogers, 2008), combined home and clinic (Dawson et al., 2010), and special class with partial inclusion for some toddlers (Zachor et al., 2007). Parents served as primary intervention implementers in one of these studies (Wetherby & Woods, 2006). The most professionally time-intensive interventions appeared in this focus area, with all except one implemented over 25 hr per week for at least a full year. The exception (Vismara & Rogers, 2008) was implemented for 90 min per week for 12 weeks. Strategies shared by two studies each included following the child's lead, functional assessment, skills shaping, and specialized therapies.

Family well-being interventions. One study found change on observational and rating scale measures of parent stress and child affect using an SCD for three participant pairs. The research design and methods were assessed as having adequate rigor. Replication of this and other studies is needed before effects can be assessed for this area. The intervention, conducted over 12 sessions, was implemented by parents in combined home and clinic playroom settings (Brookman-Frazee & Koegel, 2004) and used strategies of pivotal response training, reinforcement, and following the child's lead.

Imitation interventions. Two SCD studies assessed effects of imitation training on observational measures of imitation outcomes, both with findings of observable change from baseline to intervention conditions. Research rigor was assessed as strong (Cardon & Wilcox, 2011) and adequate (Ingersoll & Gergans, 2007). Although the two studies used similar methods and assessed similar outcomes, replication is needed.

Both interventions were conducted in clinical settings (Cardon & Wilcox, 2011; Ingersoll & Gergans, 2007), and the latter one was partially parent-implemented. Both were of low density and short duration and used reciprocal imitation training supplemented by other strategies.

Joint attention interventions. The largest group of studies focused on joint attention. Two group comparison studies (Drew et al., 2002; Landa et al., 2011) used standardized measures, with the Landa et al. (2011) study also using an observational measure. No measures were shared between the two. The other five studies used observational measures of joint attention (Jones et al., 2006; Leew et al., 2010; Rocha et al., 2007, Schertz & Odom, 2007; Vismara & Lyons, 2007) with two using supplemental observational measures (Leew et al., 2010; Schertz & Odom, 2007). Effects on the standardized measures were assessed as small (Landa et al., 2011) and medium (Drew et al., 2002), and with adequate research rigor. Most SCD studies in this group documented observable change following intervention for all participants (Jones et al., 2006; Rocha et al., 2007; Vismara & Lyons, 2007), with two studies finding partial effects (Leew et al., 2010; Schertz & Odom, 2007).

Reports of effects in five rigorously conducted joint attention studies showed considerable overlap in intervention strategies and similar measures among the studies, indicating that joint attention outcomes are likely attainable for toddlers with ASD. As with the other intervention focus areas, however, recommendations for replication (Gersten et al., 2005; Horner et al., 2005) were not entirely met, intervention procedures varied, and, although similar, the joint attention measures did not use common criteria.

The joint attention focused interventions were delivered in home (Drew et al., 2002; Leew et al., 2010; Schertz & Odom, 2007), clinic (Rocha et al., 2007), special classroom (Landa et al., 2011), combined classroom and home (Jones et al., 2006), and combined clinic and home (Vismara & Lyons, 2007) settings. Five of the seven were fully parent-implemented (Drew et al., 2002; Leew et al., 2010; Rocha et al., 2007; Schertz & Odom, 2007; Vismara & Lyons, 2007), one was professionally implemented (Jones et al., 2006), and the classroom-based intervention was professionally implemented with parent carryover at home (Landa et al., 2011). Intervention density ranged from 1.5 hr to 10 hr per week with an approximately even distribution between lower and higher density interventions. The duration of intervention ranged from 2 weeks to 1 year with the majority lasting more than 3 months. Shared strategies included discrete trial training and other reinforcement-based strategies (four studies), following the child's lead (three), pivotal response training (three), visual support (two), prompting (two), and routines-based intervention (two).

Play interventions. Two SCD studies assessed effects of play-focused intervention on play (VanDerHeyden, Snyder, DiCarlo, Stricklin, & Vigianos, 2002) and play imitation (Hine & Wolery, 2006). Both were assessed as showing adequate research rigor, and both reported intervention effects for the single participant in each of their studies. Generalized findings cannot be ascertained for this area because the studies' outcomes are not comparable and neither was replicated.

The interventions were professionally implemented in a separate therapy room (Hine & Wolery, 2006) and in a special class setting (VanDerHeyden et al., 2002). Each intervention was provided between 1 and 2 hr per week for 10 to 12 weeks using video modeling (Hine & Wolery, 2006) and within-stimulus prompting (VanDerHeyden et al., 2002).

Discussion

The prominence of joint attention as an intervention focus was striking in this review of 20 studies of intervention for toddlers with ASD. This choice of focus reflects researchers' understanding of the centrality of the toddlers' difficulty with joint attention, a preverbal social communication milestone that emerges by 12 months of age in typical development, and its close association with later language development. Joint attention difficulties are unique to young children with ASD when compared with groups with other disabilities and typical development (McArthur, 1996; Paparella & Kasari, 2004; Sigman & Ruskin, 1999).

The joint attention focused studies, by virtue of their greater number, collectively showed the most replicated evidence of intervention effects compared with other intervention focus areas although, as with the other areas, additional study of joint attention intervention is needed both within and across specific intervention approaches. More shared strategies were evident in the joint attention than in the other focus areas. Also, there was more convergence around outcome measures since most studies used a measure of joint attention to assess intervention effects, though measurement protocols varied. In the other focus areas, joint attention was mentioned as one of several intervention components in each of the four listed general development interventions, was associated with imitation as a justification for an imitation-focused intervention (Ingersoll & Gergans, 2007), and was an expected outcome in a communication-focused intervention (Carter et al., 2011).

Researchers' recognition of preverbal social communication's importance and the joint attention outcomes their interventions achieved are informative for practitioners, who must determine a meaningful intervention focus for toddlers with ASD. However, although correlational research findings show that the presence of joint attention is a strong predictor of language (e.g., Mundy et al., 1990; Tomasello & Farrar, 1986), the actual effects of joint attention *intervention* on language and social outcomes has not been adequately tested; for this, measures that capture broader outcomes are needed.

In the other focus areas, all of which included fewer studies than the joint attention focus area, outcome measures, intervention strategies, levels of research rigor, strength of outcomes, and feasibility indicators varied among the similarly focused studies, limiting the confidence with which conclusions on intervention effects and feasibility could be generated. Furthermore, only two imitation-focused studies and one family well-being-focused study were reported, further restricting analysis for those areas. Taken as a whole, therefore, this review may have greater value as a formative analysis to guide future research rather than as a summative evaluation of efficacy.

The range of outcome measures may reflect a natural process of experimentation in an emerging subfield. Among the standardized measures used in the six group comparison studies listed in Table 1, common measures were shared by only three, and only in part and with variance in choice of subtests (Carter et al., 2011; Dawson et al., 2010; Landa et al., 2011). Most of the SCD studies used measures tailored to their intervention goals and, while some measured similar constructs, their lack of shared measurement protocols limits comparison of results. This diversity in outcome measures illustrates the need for common measures, but perhaps more importantly, the need for convergence around what constitutes meaningful outcomes for toddlers with ASD. Measures focusing on social aspects of communication (as distinct from instrumental aspects such as requesting or following directions) are important, since it is the social rather than instrumental communication function that is

the central challenge in ASD (Mundy & Stella, 2000). This need is not well captured in general assessments of child development and may require use of joint attention measures such as were used in some of the SCD studies. Some consensus has emerged around measurement of spoken communication for young children with ASD (Tager-Flusberg et al., 2009), and this could provide a common benchmark for assessing effects of both joint attention focused and verbally focused interventions on verbal competency.

The overall research rigor of the reviewed studies, while showing some gaps, appears to be stronger than that found in a previous review of interventions for young children with ASD published between 2001 and 2005 (Reichow, Barton, Volkmar, & Cicchetti, 2007). In the earlier review, a smaller proportion of studies received the highest rating, and a larger proportion received the lowest rating. While rigor in the current review was rated using one instrument by individuals who either developed or were trained by the developer of the rating system, the evaluative method has been shown to have strong validity when compared with similar tools (Cicchetti, 2011) and should provide a fair assessment of the current status of research methods being used in early intervention for toddlers with ASDs. This finding is encouraging, and researchers should continue the trend toward stronger internal and external validity. Journal editors should also ensure that only studies meeting high methodological standards are published and disseminated.

Unless research settings and processes reflect conditions under which early interventionists operate, field-based replication of researched intervention models may not be feasible (Coakley, 2010). The limited use of authentic settings and interaction partners, with more than half of the studies carried out in clinical or nonintegrated settings, was a general concern. More encouraging was that the majority of studies provided some level of parent involvement in promoting their children's learning, another aspect of authentic early intervention practice, though a large minority did not.

Replication is a pressing need in the identified focus areas, both within and across specific intervention approaches. A standard of credibility for special education research is for replication in at least two independent methodologically strong randomized controlled trials (Gersten et al., 2005; Lewis-Snyder, Stoiber, & Kratochwill, 2002; Silverman & Hinshaw, 2008) or at least five rigorously designed SCD studies by at least three different researchers with at least 20 participants (Horner et al., 2005; Shernoff, Kratochwill, & Stoiber, 2002). Not surprisingly for emerging research, none of the intervention approaches met this standard.

Limitations of the Review

Several limitations from the review process itself are pertinent. First, we located a relatively small number of studies. Although this is likely due to the fact that intervention for toddlers with ASDs is a new and emerging area, the limited number of studies constricts the conclusions that we can draw, especially in light of the lack of replicated studies within focus areas. Related to this, although we attempted to locate all relevant studies, the conclusions drawn from all systematic reviews are limited by the possibility of publication bias (e.g., Rothstein, Sutton, & Borenstein, 2005), especially the possibility that negative or small effects remain unpublished and therefore more difficult to locate. Although it was beyond the scope of our review, future reviews might consider systematically searching gray literature to find unpublished theses, dissertations, and conference proceedings.

Finally, although we divided the studies for analysis according to their intervention purpose, there are other dimensions on which the studies could have been analyzed if the number of studies had been sufficient (e.g., outcome measures, intervention approaches). As acknowledged in the introduction, this decision can have ramifications for the findings of a review, and our review should be considered in light of this limitation.

Recommendations for Researchers

Future research needs are summarized in the last column of Table 2 for each intervention focus area, with substantial duplication across the groups. The most commonly identified needs, described above, concern the use of authentic intervention settings and interaction partners, use of common outcome measures, replication within and across settings, and enhanced research rigor.

An additional need, evident from the variance in intervention density and duration shown in Table 1, is for controlled studies that compare effects for interventions of varying density (e.g., hours per week of professional time) and duration. Howlin and her colleagues (2009) cite randomized controlled trials in which nonintensive but well-focused interventions have produced positive effects for young children with ASD. The oft-cited recommendation by the National Research Council (NRC; 2001) for intensive service levels (i.e., 25 hr per week) should be evaluated systematically with toddler-aged children, for whom intervention research had not been conducted at the time of the NRC's recommendation and for whom developmental considerations may suggest different approaches than for older children. For toddlers with ASD and their families, this research should sort out how intervention density impacts outcomes, cost-effectiveness, and family and child well-being. The issue of intervention density is confounded with the role of parents in intervention delivery, which should be analyzed as well. Study of intervention duration could assess whether intervention that did not show effects in a short-term implementation (e.g., Carter et al., 2011) does so when implemented over a longer period.

Two other areas for comparative research are suggested from this review. First, because of the previously discussed association of joint attention development with subsequent communication outcomes, an important question is how joint attention focused interventions compare with communication-focused ones on verbal communication outcomes, assessed longitudinally. This question has implications for whether targeting preverbal social communication outcomes (i.e., working closer to toddlers' competency level) is more efficient and effective than directly targeting verbal communication outcomes from the outset. A related question is how joint attention focused interventions compare with general development focused ones on standardized assessments. Findings could filter out whether it is social communication (the core area of difficulty) or all developmental domains that are important to target in early intervention for toddlers with ASD.

Recommendations for Practitioners

Early interventionists do not have the luxury of waiting for definitive research to make intervention decisions in the field. While recognizing the limited conclusions that can be drawn from this early research, a few important points are instructive for early interventionists. The foremost trend across the reviewed studies is toward promoting

social communication at the preverbal level. Practitioners can draw from specific strategies featured in the reviewed joint attention studies, with special attention to those that were shared among studies conducted by different researchers. Intervention strategies that were featured in other intervention focus areas are also of potential value to address particular intervention needs. Practitioners should recognize that, although research is not yet sufficient to support any particular intervention approach or level of intervention intensity for toddlers with ASD, intervention models that demonstrate both positive outcomes and congruence with principles of authentic early intervention practice provide useful guides for their intervention choices.

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