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EVIDENCE BASE UPDATE

Evidence Base Update for Autism Spectrum Disorder

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This evidence base update examines the level of empirical support for interventions for children with autism spectrum disorder (ASD) younger than 5 years old. It focuses on research published since a previous review in this journal (Rogers & Vismara, 2008). We identified psychological or behavioral interventions that had been manualized and evaluated in either (a) experimental or quasi-experimental group studies or (b) systematic reviews of single-subject studies. We extracted data from all studies that met these criteria and were published after the previous review. Interventions were categorized across two dimensions. First, *primary theoretical principles* included applied behavior analysis (ABA), developmental social-pragmatic (DSP), or both. Second, *practice elements* included scope (comprehensive or focused), modality (individual intervention with the child, parent training, or classrooms), and intervention targets (e.g., spoken language or alternative and augmentative communication). We classified two interventions as well-established (individual, comprehensive ABA and teacher-implemented, focused ABA + DSP), 3 as probably efficacious (individual, focused ABA for augmentative and alternative communication; individual, focused ABA + DSP; and focused DSP parent training), and 5 as possibly efficacious (individual, comprehensive ABA + DSP; comprehensive ABA classrooms; focused ABA for spoken communication; focused ABA parent training; and teacher-implemented, focused DSP). The evidence base for ASD interventions has grown substantially since 2008. An increasing number of interventions have some empirical support; others are emerging as potentially efficacious. Priorities for future research include improving outcome measures, developing interventions for understudied ASD symptoms (e.g., repetitive behaviors), pinpointing mechanisms of action in interventions, and adapting interventions for implementation with fidelity by community providers.

Autism spectrum disorder (ASD) is defined by difficulties with reciprocal social communication and stereotyped interests or behaviors (American Psychiatric Association [APA], 2013) that usually emerge in early childhood. About one third of children with ASD have delays in cognitive development and daily living skills (Autism and Developmental Disabilities Monitoring Network, 2014). Co-occurring behavior problems (tantrums, aggression, self-injury, impulsivity, anxiety, extreme food

selectivity, insomnia) and medical conditions (e.g., seizure disorder, gastrointestinal disturbance) are also common. Although ASD almost always persists across the lifespan, early intervention can alleviate symptoms (Rogers & Vismara, 2008).

ASD has a prenatal origin related to genetic risk and environmental events; however, the precise etiology has not been determined (Volkmar, Paul, Rogers, & Pelphrey, 2014). Although once considered rare, ASD is now estimated to occur in approximately 1 in 68 individuals (Autism and Developmental Disabilities Monitoring Network, 2014). It remains unknown whether the greater detection of ASD solely reflects changes in practice (broadened diagnostic criteria, heightened awareness,

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and improved screening), or whether there is also an actual rise in ASD. The lifetime cost of caring for an individual with ASD often exceeds \$2 million (Buescher, Cidav, Knapp, & Mandell, 2014). However, because this cost does not account for collateral effects of the disorder, such as stress on caregivers and families, it may underestimate the broader public health impact of ASD.

The previous review in this journal (Rogers & Vismara, 2008) portrayed findings on ASD interventions as promising but preliminary. Studies indicated that some interventions have the potential to mitigate core and associated features of ASD and possibly even enable some children with ASD to catch up to their peers. However, few of these studies incorporated methodologically rigorous designs. This situation was (and continues to be) a source of tension between families of children with ASD, who often are eager to enroll their children into what appear to be promising interventions, and funders, who often decline payment for interventions they deem as having insufficient empirical support (Rogers & Vismara, 2008). The tension may be exacerbated by the expense of ASD interventions, some of which involve many hours of highly specialized, individualized services that last 2 or more years.

The confluence of rising prevalence estimates, increasingly precise calculations of financial and social costs associated with ASD, and controversies about empirical support for interventions inspired federal and local legislation that transformed ASD intervention research. Notably, the Combating Autism Act (2006 Initiative, reauthorized in 2011 and 2014), “considered by some to be the most comprehensive piece of single-disease legislation ever passed by the United States Congress” (Autism Speaks, 2011), funded more than \$1 billion for research on ASD. Much of this research has focused on intervention (Interagency Autism Coordinating Committee [IACC], 2014). As a result, the literature now includes many more well-controlled intervention studies than were available at the time of the prior review. Whereas Rogers (1998) did not identify any randomized clinical trials (RCTs) on psychological or behavioral interventions for ASD, and Rogers and Vismara (2008) located only five, approximately 50 additional RCTs have been published as of this writing (Weitlauf et al., 2014). Moreover, the pace of ASD intervention research continues to accelerate rapidly (IACC, 2014).

At the local level, 42 states in the United States have now passed legislation mandating insurance coverage of ASD interventions (Autism Speaks, 2015), and many publicly funded early intervention and preschool programs also offer such interventions (Simpson, Mundschenk, & Heflin, 2011). Similar initiatives have taken place in Canada (Perry et al., 2008), the United Kingdom (Kendall et al., 2013), and elsewhere. Growing demand for treatments has also led to an

increasing number of specialty providers, such as Board Certified Behavior Analysts. It remains to be seen how successfully these initiatives promote access to and availability of behaviorally based services. Greater public awareness about specialized treatments may also intensify demands for these treatments. Although insurance reimbursement is intended to improve service dissemination, the need for providers and variations in coverage by state may unintentionally raise expectations for access to services that are not immediately available or that differ from services provided in research settings (IACC, 2014). These complex public health and policy issues require scrutiny of the ASD intervention literature. Using diverse methodologies, systematic reviews have been conducted under the auspices of the Cochrane Collaboration (Reichow, Barton, Boyd, & Hume, 2012), RAND Corporation (Maglione et al., 2012), government agencies in the United States (Warren, Veenstra-VanderWeele et al., 2011; Weitlauf et al., 2014; What Works Clearinghouse, 2010) and United Kingdom (Kendall et al., 2013), and many other organizations and teams of investigators (Reichow, 2012). Given all the changes in the climate for research on ASD interventions, an update on the empirical status of such interventions, based on *Journal of Clinical Child & Adolescent Psychology's* (JCCAP's) methods criteria (developed specifically for evaluating studies of treatments for childhood behavior disorders), is timely.

FINDINGS FROM THE 2008 JCCAP REVIEW

Rogers and Vismara (2008) reviewed evidence on early intervention programs for toddlers and preschoolers with ASD. They classified one such intervention as well-established and three others as possibly efficacious. The well-established approach was O. Ivar Lovaas's (1987) model of early intensive behavioral intervention (EIBI). This EIBI model is highly intensive (up to 40 hr per week of one-to-one intervention for 2–3 years) and is based upon applied behavior analysis (ABA), which utilizes learning principles to teach socially significant behaviors in real-life settings (Smith, 2011). Learning readiness, communication, social, and academic skills are broken down into small steps and taught systematically. Over time, intervention strategies become less structured, supporting children's entry into community settings such as schools.

Rogers and Vismara (2008) classified Pivotal Response Treatment (PRT; Koegel & Koegel, 2006) as possibly efficacious. An ABA approach, PRT aims to teach “pivotal” responses that, when acquired, have the potential to improve performance across many other skill areas. It emphasizes incidental teaching, in which intervention occurs in the context of natural learning

opportunities that arise throughout an individual's day, unlike the more contrived, structured format associated with early stages of intervention in EIBI.

Rogers and Vismara (2008) identified three other possibly efficacious treatments. One was a 12-week training program for parents and day care providers (Jocelyn, Casiro, Beattie, Bow, & Kneisz, 1998). Because replications of this program have not been reported, the program is not considered further in the current review. The remaining two possibly efficacious interventions were both parent training programs to promote the child's social communication, (Aldred, Green, & Adams, 2004; Drew et al., 2002). In addition, Rogers and Vismara presented evidence that psychotropic medications showed promise for treating behavior problems associated with ASD in older children and youth with ASD but cautioned that the applicability of this evidence to young children with ASD was unclear. Further, they commented that many other interventions exist for children with ASD but have not been adequately evaluated. Finally, they documented that little information was available on mediators and moderators of response to any intervention for ASD.

METHOD FOR THE CURRENT REVIEW

Parameters

Population

In keeping with the previous review (Rogers & Vismara, 2008), we focus on interventions for young children with ASD, age 5 years or younger at entry into treatment. This focus is based on two considerations: First, more research is available on interventions for young children with ASD than for older individuals (Taylor et al., 2012). Such intervention is likely to have the largest impact because young children with ASD have not yet fallen as far behind and may be more amenable to change than older individuals (Myers & Johnson, 2007). Second, although interventions for younger and older individuals with ASD overlap somewhat in terms of treatment goals and approach, they tend to differ in key respects. Notably, interventions for young children usually occur at home or school and address broad developmental domains (e.g., increasing intellectual functioning or reducing ASD symptoms). In contrast, interventions for older individuals often take the form of outpatient psychotherapies (e.g., social skills groups) and target specific problems (e.g., cognitive-behavioral therapy for reducing anxiety). Although interventions for older individuals with ASD lie outside the scope of the current review, they are important and have attracted increasing research in recent years (Weitlauf et al., 2014). Thus, the literature on these interventions likely warrants a separate review in the near future.

Intervention

We examine psychological and behavioral interventions for children with ASD. The previous review (Rogers & Vismara, 2008) also included studies on psychopharmacological treatments for behavior problems associated with ASD. However, given the exponential growth in the volume of ASD intervention research, we have narrowed the scope of the current review. We refer readers to McPheeters et al. (2011), Dove et al. (2012), and Siegel and Beaulieu (2012) for systematic reviews of empirical reports on psychopharmacological treatments.

Study Design

Rogers and Vismara (2008) sought to summarize all group studies on interventions for children with ASD, including uncontrolled case series. In contrast, evidence tables in the current review present only studies that used random or quasi-experimental assignment to groups and that met all of the remaining *JCCAP* methods criteria (summarized in Table 1). The intensity of some ASD interventions impedes randomization (Lord et al., 2005); we therefore consider quasi-experimental studies along with experimental studies in order to present a complete picture of ASD intervention research.

Because children with ASD are an extremely heterogeneous population and frequently present with idiosyncratic problems, there is a long, rich tradition of single-subject studies in the ASD literature, resulting in the publication of many hundreds of such studies. We cite systematic reviews of such studies in the text. Based on *JCCAP*'s methods criteria (Table 1), single-subject studies can form the basis for classifying an intervention as "possibly efficacious" because they can meet Evidence Criterion 3.3 ("Two or more clinical studies showing the treatment to be efficacious, with two or more meeting the last four [of five] *Methods Criteria*, but none being randomized controlled trials"). However, group studies are required to designate an intervention as "probably efficacious" or "well-established."

Outcomes

We include studies that contain validated measures of associated or defining features of ASD. Associated features that are often targeted in intervention include (a) cognitive delays, evaluated with scores on standardized intelligence tests (i.e., IQ); (b) adaptive behavior (a child's ability to use his or her skills functionally to cope with daily life), measured by standardized observational or parent-report scales; and (c) disruptive behavior, measured by observational or parent-report scales. Evaluation of defining features of ASD may involve

TABLE 1

Journal of Clinical Child & Adolescent Psychology Evidence Base Updates Evaluation Criteria

Methods Criteria	
M.1. Group design:	Study involved a randomized controlled design
M.2. Independent variable defined:	Treatment manuals or logical equivalent were used for the treatment
M.3. Population clarified:	Conducted with a population, treated for specified problems, for whom inclusion criteria have been clearly delineated
M.4. Outcomes assessed:	Reliable and valid outcome assessment measures gauging the problems targeted (at a minimum) were used
M.5. Analysis adequacy:	Appropriate data analyses were used and sample size was sufficient to detect expected effects
Level 1: Well-Established Treatments	
Evidence Criteria	
1.1. Efficacy demonstrated for the treatment by showing the treatment to be either:	
1.1.a. Statistically significantly superior to pill or psychological placebo or to another active treatment	OR
1.1.b. Equivalent (or not significantly different) to an already well-established treatment in experiments	AND
1.1.c. In at least two (2) independent research settings and by two (2) independent investigatory teams demonstrating efficacy	AND
1.2. All five (5) of the Methods Criteria	
Level 2: Probably Efficacious Treatments	
Evidence Criteria	
2.1. There must be at least two good experiments showing the treatment is superior (statistically significantly so) to a wait-list control group	OR
2.2. One (or more) experiments meeting the Well-Established Treatment level except for criterion 1.1c (i.e., Level 2 treatments will not involve independent investigatory teams)	AND
2.3 All five (5) of the Methods Criteria	
Level 3: Possibly Efficacious Treatments	
Evidence Criteria	
3.1. At least one good randomized controlled trial showing the treatment to be superior to a wait list or no-treatment control group	AND
3.2. All five (5) of the Methods Criteria	OR
3.3. Two or more clinical studies showing the treatment to be efficacious, with two or more meeting the last four (of five) Methods Criteria, but none being randomized controlled trials.	
Level 4: Experimental Treatments	
Evidence Criteria	
4.1. Not yet tested in a randomized controlled trial	OR
4.2. Tested in 1 or more clinical studies but not sufficient to meet level 3 criteria.	
Level 5: Treatments of Questionable Efficacy	
5.1. Tested in good group-design experiments and found to be inferior to other treatment group and/or wait-list control group; i.e., only evidence available from experimental studies suggests the treatment produces no beneficial effect.	

Note: Adapted from Silverman and Hinshaw (2008) and Division 12 Task Force on Psychological Interventions' reports (Chambless et al., 1998; Chambless et al., 1996), from Chambless and Hollon (1998), and from Chambless and Ollendick (2001). Chambless and Hollon (1998) described criteria for methodology.

either a global assessment of *all* ASD symptoms (i.e., social-communication and repetitive behavior), usually with a standardized rating scale or behavioral assessment, or a specific symptom such as joint attention, shared enjoyment, and social initiation that contribute to ASD but are not a sufficient proxy for ASD symptomatology on their own. Our approach is more inclusive than many previous reviews, some of which have focused mainly on associated features rather than core features (e.g., Eldevik et al., 2009) or vice versa (e.g., Kendall et al., 2013), or have required that studies contain at least one global or standardized measure (e.g., Rogers & Vismara, 2008). As the variability among reviews suggests, a consensus does not yet exist on which outcome measures are most clinically meaningful and psychometrically sound. Thus, we review studies with a broad range of measures, and in each section we highlight the targeted intervention outcomes.

Other Considerations

Two of *JCCAP's* methods criteria are controversial in the ASD literature: giving more weight to group studies than single-subject studies and requiring that interventions be standardized in a manual. Other reviews of the ASD intervention literature emphasize single-subject studies more or less than do *JCCAP's* methods criteria. At one extreme, single-subject and group studies are regarded as equally useful sources of evidence (e.g., Wong et al., 2013); at the other, single-subject studies are excluded from reviews, and only findings from group studies are considered (e.g., Weitlauf et al., 2014). The intermediate position of single-subject studies in *JCCAP's* criteria is most consistent with consensus guidelines for designing studies of psychological and behavioral interventions for ASD (Smith et al., 2007). According to these guidelines, studies with single-subject designs are especially useful for initial development of a new intervention. Advantages of single-subject studies include (a) individualized, continuous monitoring of intervention effects, providing opportunities to refine treatment techniques and (b) small sample sizes, making it possible for independent practitioners and small teams to have a central role in testing novel therapeutic strategies (Hayes, Barlow, & Nelson-Gray, 1999). However, group studies are needed to evaluate the efficacy of an intervention with a large, representative sample of children with ASD, multiple clinicians, and a range of outcome measures (Smith et al., 2007). For these reasons, we regard *JCCAP's* methods criteria as suitable for evaluating the strength of evidence for an ASD intervention from single-subject and group studies.

Manuals are controversial in ASD intervention research because of concerns that they do not allow

enough flexibility to customize intervention to meet the diverse individual needs of children with ASD (Smith, 2012). However, a manual that provides step-by-step guidance on implementing an intervention, accompanied by measures of adherence to the manual, is currently the only methodology available to make a multifaceted intervention replicable by independent investigators and clinicians (McHugh & Barlow, 2012). In addition, there are now many resources that describe how to incorporate flexibility into a manual (Smith et al., 2007). Thus, the current review examines only interventions that have manuals.

Summary

As shown in the PICO (Population-Intervention-Comparator-Outcome) chart in Table 2, the current review concentrates on psychological and behavioral interventions for children with ASD who are 5 years old or younger. It examines evidence from (a) group studies that used random or quasi-experimental designs and that met *JCCAP* methods criteria M.2–M.5 (see Table 1) and (b) systematic reviews of single-subject studies that met *JCCAP* methods criteria M.2–M.5 (Table 1). It uses *JCCAP* criteria for classifying the level of evidence for an intervention as “well-established,” “probably efficacious,” “possibly efficacious,” “experimental,” or “questionable” (Table 1).

Procedures

We searched for relevant studies on PsycINFO and Medline using the terms *autism* and *early intervention* or the treatment name from 2007 to the time of this writing (February 2014). In addition, we hand-searched the three most detailed reviews of the literature (Kendall et al., 2013; Warren et al., 2011; Weitlauf et al., 2014). We included all studies that fell within the scope of our review (described in the preceding section and Table 2). We relied on cross-checking and consensus between the authors for complete identification of studies and accurate extraction of data. We did not include

“gray literature” (e.g., unpublished dissertations or non-peer-reviewed manuscripts such as online reports), conduct a systematic evaluation of publication bias, or generate a quantitative meta-analysis of study findings. However, we report information from such evaluations when available from prior reviews. We focused on child outcome measures at the end of treatment. When possible, we present results in terms of effect size (Cohen’s *d*) and 95% confidence intervals, as reported by the investigators or derived from Wilson’s (n.d.) effect size calculator, which uses formulas presented by Lipsey and Wilson (2001). Findings from follow-up evaluations, analyses of mediators and moderators, and assessments of family impact are described in the text when available.

Classification of Interventions

Interventions for children with ASD are many and varied. In keeping with guidelines for *JCCAP*’s evidence-based updates (Southam-Gerow & Prinstein, 2014), we categorized interventions into “treatment families” that share theoretical principles and practice elements, instead of concentrating on individual, “brand name” treatments. This approach has the advantage of emphasizing potential mechanisms of action for efficacious treatments, as opposed to specific intervention programs.

Theoretical Principles

The two predominant sets of theoretical principles in ASD intervention research are ABA (Smith, 2011) and *developmental social-pragmatic (DSP) models* (also called *developmental, interactive, transactional, or interpersonal*; Ingersoll, Dvortcsak, Whalen, & Sikora, 2005). ABA interventions are based on the view that ASD is a learning difficulty that can be addressed with operant conditioning strategies such as systematically reinforcing target behaviors and teaching children to distinguish between different cues (Smith, 2011). Strategies range from highly structured, adult-led didactic instruction (e.g., DTT) to child-led interactions that may occur in the context of play activities or the child’s everyday routine. Target behaviors include a range of defining and associated features of ASD, with the goal of improving a child’s overall functioning in everyday settings and increasing access to inclusive environments such as general education classrooms (Smith, 2010, 2011). In contrast, DSP interventions are based on the view that a core feature of ASD is an impaired ability to engage in activities jointly with another person and that this impairment leads to a cascade of other problems with social communication and interaction (Mundy & Crowson, 1997). DSP intervention strategies are derived from findings in developmental psychology that show a strong association between caregivers’

TABLE 2
Focus of the Review

Population	Children With ASD Younger Than 5 Years
Intervention	Psychological or behavioral intervention
Comparison	No treatment or alternative treatment (group designs); baseline performance on outcome measures (single-subject designs)
Outcomes	Associated or defining features of ASD (e.g., symptom reduction, IQ, adaptive behavior, challenging behavior, social-communication skills, and social engagement).

Note: Adaptive behavior = Flexible use of skills to meet the demands of everyday situations. ASD = autism spectrum disorder.

responsivity to their young children and the children’s subsequent acquisition of skills for communicating and interacting with others (Prizant & Wetherby, 2005). Relying on strategies similar to ones used in interventions to help caregivers be more sensitive to their young, typically developing children (Siller, Morgan et al., 2014; Wallace & Rogers, 2010), DSP interventionists aim to promote social communication and interaction by being responsive to the child in ways such as imitating, expanding on, or joining into play activities that the child initiates (Ingersoll et al., 2005).

ABA and DSP interventions overlap in some respects. Notably, ABA interventions, like DSP interventions, are intended to be appropriate to the child’s developmental level and to address deficits in social interaction and communication (Smith, 2011). DSP interventions, like ABA interventions, emphasize helping children with ASD learn new skills (Ingersoll et al., 2005). However, there are also differences. As previously noted, ABA interventions target a range of defining and associated features, whereas defining deficits in social communication and interaction tend to be the highest priority in DSP interventions. Also, ABA interventions involve discrete teaching trials or separate learning units with a clear beginning and end. In contrast, DSP interventions aim for a continuous flow of back-and-forth social communication (Prizant & Wetherby, 2005). DSP interventions also seek to reinforce this communication by imitating the child’s actions and verbalizations and by prompting or modelling ways to build on the interaction (Rogers & Dawson, 2009), rather

than delivering a reinforcer selected on the basis of the child’s individual preferences (e.g., praise or a preferred toy), as is characteristic of ABA strategies. Thus, both DSP and ABA involve reinforcement, but the reinforcement strategies tend to differ.

Some interventions explicitly combine ABA and DSP strategies. For example, they may begin a session with structured ABA intervention strategies and then proceed to play-based, DSP interventions (Kasari, Freeman, & Paparella, 2006). Alternatively, they may incorporate ABA strategies into DSP play sessions (Rogers & Dawson, 2009). We refer to these interventions as ABA + DSP interventions. Another term is “naturalistic developmental behavioral interventions” (Schreibman et al., 2015).

Practice Elements

Some ASD interventions are *comprehensive*, aiming to address all areas of need (e.g., EIBI), whereas others are *focused*, having a more circumscribed set of goals (e.g., parent training to promote children’s social communication; Odom, Boyd, Hall, & Hume, 2010). Comprehensive interventions entail many hundreds of hours of direct intervention with the child with ASD (usually more than 1,000 hr). Focused interventions involve fewer than 50 hr of intervention.

ASD intervention strategies diverge along several dimensions, including the recipient of the intervention, techniques, and provider of the treatment. Intervention can involve working individually with the child with ASD, engaging a teacher and peers (e.g., classroom-wide

TABLE 3
Intervention Categories

Scope	Recipient	Theoretical Principles		
		ABA	DSP	ABA + DSP
Comprehensive	Child	Adult-led 1:1 instruction	—	DSP play sessions for social engagement + ABA (e.g., priming or instruction on specific skills)
	Teacher/peers	Classroom-wide intervention to promote interactions among children with and without ASD	—	Structured teaching and environmental manipulation ^a
	Parent	—	—	—
Focused	Child	Spoken communication; AAC	Play sessions for increasing social engagement	Adult-led ABA instruction + child-led DSP play session
	Teacher/peers	—	Teacher/peer training for social engagement	Teacher training for social engagement + instruction on specific skills
Parent	Parent training for reducing disruptive behavior or increasing communication	—	Parent training on strategies to increase social engagement + provide instruction on specific skills	—

Note: ABA = applied behavior analysis; DSP = developmental social-pragmatic; ASD = autism spectrum disorder; AAC = augmentative and alternative communication.

^aStructured teaching models also emphasize instructional strategies based on research on neuropsychology and learning style in ASD.

models), or guiding a parent to deliver intervention. It can emphasize oral communication or augmentative and alternative communication (AAC) systems such as the use of picture symbols or voice output devices to express wants, needs, and interests.

Table 3 displays the classification of interventions in the current review. The columns correspond to the primary theoretical principles (ABA, DSP, or ABA + DSP). The rows separate comprehensive from focused interventions and different recipients of service. Within each box (e.g., individual, comprehensive ABA), we identify treatment families. The remainder of this review examines treatment families presented in each row of Table 3 (individual,

comprehensive treatments for the child; then comprehensive, classroom-based treatments; etc.).

COMPREHENSIVE TREATMENTS

Individual, Comprehensive ABA

Individual, comprehensive ABA interventions are commonly referred to as EIBI in the ASD literature. These interventions consist of 20–40 hr per week of treatment for 2–3 years, beginning prior to age 5 years. They involve individualized, adult-led intervention based on a broad curriculum that addresses communication,

TABLE 4
Comprehensive Interventions for Young Children With ASD

Study (Design, N, Age)	Treatment	Outcomes
<i>Individual, Comprehensive ABA</i>		
Eikeseth et al. (2007) Quasi-Experiment N = 25, 4–7 Years	Lovaas model delivered in public school (n = 13, M = 28 hr per week in 1st year, tapering thereafter) vs. TAU (n = 12, M = 29 hr per week)	EIBI > TAU: Δ IQ (Bayley/WPPSI) d = 1.27, 95% CI [.32, 2.22] Δ VABS d = .96, 95% CI [.04, 1.87]
Eldevik et al. (2012) Quasi-Experiment N = 43, 2–5 Years	Lovaas model delivered in public preschool for 2 years (n = 31, M = 14 hr per week, 2 years) vs. TAU (n = 12, 5 + hr/week)	EIBI > TAU: IQ (Bayley/SB), d = 1.06, 95% CI [.34, 1.72] VABS, d = .75, 95% CI [.05, 1.36]
Eikeseth et al. (2012) Quasi-Experiment N = 59, 2–7 Years	Lovaas Model in public school (n = 35, M = 23 hr/week, 1 year) vs. TAU (n = 24, amount unspecified)	EIBI > TAU: VABS d = .93, 95% CI [.38, 1.48]
Peters-Scheffer et al. (2010) Quasi-Experiment N = 34, 4–7 Years	Both groups in TEACCH classes in public schools, with addition of Lovaas model (n = 12, M = 6.5 hr/week for 8 months) vs. no additional treatment (n = 22)	EIBI > No Tx, Δ IQ d = 1.86, 95% CI [1.03, 2.69] Δ VABS d = 1.42, 95% CI [.64, 2.20] Δ CBCL d = .23, 95% CI [−.48, .93] Δ PDD-MRS d = .09 [−.62, .79]
<i>Individual, Comprehensive ABA + DSP</i>		
Dawson et al. (2010) RCT N = 48 (45 Completers), 18–30 Months	ESDM (n = 24, 20 hr/week for 2 years + parent training twice monthly) vs. TAU (n = 24, outcome data n = 21, amount unspecified)	ESDM > TAU: MSEL d = .62, 95% CI [.02, 1.22] VABS d = .79, 95% CI [.18, 1.40] ESDM = TAU: ADOS d = .24, 95% CI [−.34, .83] RBS d = .18, 95% CI [−.41, .77]
<i>ABA Classrooms</i>		
Strain & Bovey (2011) RCT N = 294 in Preschool (M age = 50 Months)	LEAP (n = 177, 13.75–15 hr per week for 2 years) or TAU (n = 117), 13.75–15 hr/week for 2 years	LEAP > TAU: CARS d = .59, 95% CI [.38, .83] PLS-4 d = .92, 95% CI [.67, 1.17] MSEL d = .89, 95% CI [.65, 1.13] SSRS – Positive d = 1.22 [.97, 1.47] SSRS – Negative d = .62, 95% CI [.38, .86]
<i>ABA + DSP Classrooms</i>		
Boyd et al. (2014) Quasi-Experiment N = 198 (185 Completers), M age = 48 Months	LEAP (n = 54, half-day of school for 2 years), TEACCH (n = 85, five classrooms half-day and 20 classrooms full-day for 2 years), TAU (n = 59, 21 classrooms half-day and seven full-day for 1 year)	LEAP = TEACCH = TAU: ASD symptoms, communication, repetitive behaviors, social interaction, fine motor skills

Note: ASD = autism spectrum disorder; ABA = applied behavior analysis; TAU = treatment as usual; Δ = change from pre- to postintervention; EIBI = early intensive behavioral intervention; Bayley = Bayley Scales of Infant Development, 3rd edition, Mental Development Index (Bayley, 2005); WPPSI = Wechsler Preschool and Primary Scales of Intelligence, 3rd Edition, Full Scale IQ (Wechsler, 2002); d = Cohen's *d*; VABS = Vineland Vineland Adaptive Behavior Scales, Survey Edition–Composite Standard Score (Sparrow, Cicchetti, & Balla, 2005); CI = confidence interval; TEACCH = Treatment and Education of Autistic and related Communication Handicapped Children; Tx = Treatment; CBCL = Child Behavior Checklist–Total Score (Achenbach & Rescorla, 2000); PDD-MRS = Pervasive Developmental Disorder Mental Retardation Scale (Kraijer, 1999); RCT = randomized clinical trial; ESDM = Early Start Denver model; MSEL = Mullen Scales of Early Learning (Mullen, 1995); ADOS = Autism Diagnostic Observation Schedule; RBS = Repetitive Behavior Scale (Bodfish, Symons, & Lewis, 1998) LEAP = Learning Experiences: An Alternative Program for Preschoolers and Parents; CARS = Childhood Autism Rating Scale (Schopler, Reichler, & Renner, 1988); PLS-4 = Preschool Language Scale, 4th Edition (Zimmerman, Steiner, & Pond, 2001); SSRS = Social Skills Rating Scale; SB = Stanford-Binet Intelligence Test, 5th Edition, Full-Scale IQ (Roid, 2003).

social skills, self-management, cognition and preacademic skills such as imitation, matching, letter, and number concepts (Smith, 2011). Many structured EIBI models exist (Handleman & Harris, 2001), of which the best known was developed by Lovaas and colleagues at UCLA (Smith, 2010). As already mentioned, Rogers and Vismara (2008) classified the Lovaas model as a well-established treatment. Four subsequent quasi-experimental studies on this model met our criteria for inclusion in Table 4 (Eikeseth, Klintwall, Jahr, & Karlsson, 2012; Eikeseth, Smith, Jahr, & Eldevik, 2007; Eldevik, Hastings, Jahr, & Hughes, 2012; Peters-Scheffer, Didden, Mulders, & Korzilius, 2010). One study (Eikeseth et al., 2007) was a follow-up of a report reviewed by Rogers and Vismara (Eikeseth, Smith, Jahr, & Eldevik, 2002). All studies indicated that the Lovaas model has large effects on IQ, adaptive behavior, or both (Table 4). Encouragingly, these favorable effects were obtained in school settings, rather than in the home (where Lovaas recommended that intervention take place), and with 6–28 hr per week, instead of 40 (as Lovaas advised). Thus, there may be a variety of efficacious ways to implement this model. Of concern, however, the only study that examined changes in ASD symptoms and problem behavior (Peters-Scheffer et al., 2010) found that EIBI had little effect on functioning in these domains. In addition, all of the findings from recent studies must be viewed with caution because they were obtained in quasi-experimental rather than experimental studies.

The extent to which findings on the Lovaas model extend to the rest of the treatment family (i.e., other individual, comprehensive ABA approaches) is difficult to determine. Studies of such approaches have not met our criteria for inclusion in Table 4 and have yielded mixed results. Two quasi-experimental studies reported favorable results (Flanagan, Perry, & Freeman, 2012; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005, summarized by Rogers & Vismara, 2008); one found gains at the end of treatment (Remington et al., 2007) but not at a follow-up 2 years later (Kovshoff, Hastings, & Remington, 2011); and two reported no statistically significant differences between EIBI and treatment as usual (TAU; Magiati, Charman, & Howlin, 2007, with a follow-up by Magiati, Moss, Charman, & Howlin, 2011; Zachor & Itzhak, 2010). Thus, while most findings indicate that various individual, comprehensive ABA programs result in at least temporary developmental gains for children with ASD, the evidence is limited and inconsistent.

Given that results have been predominately favorable, we retain Rogers and Vismara's (2008) classification of the Lovaas model as *well-established* and extend this classification to the treatment family of individual, comprehensive ABA interventions, with the qualification that the evidence is currently more compelling for the Lovaas model than for other models. As is apparent

from the preceding discussion and Table 4, evidence from EIBI has come from numerous teams in a wide range of community settings.

Our conclusion accords with nearly all of the many other systematic reviews and meta-analyses that have been performed on studies of individual, comprehensive ABA (Reichow, 2012). Available reviews generally yield moderate to large effect sizes for IQ, ranging from 0.69 (Reichow & Wolery, 2009) to 1.10 (Eldevik et al., 2009) and moderate effect sizes for adaptive behavior (0.66; Eldevik et al., 2009). About 30% of children in EIBI make reliable gains (beyond what could be attributed to random fluctuations in performance) in IQ, and about 20% make reliable gains in adaptive behavior, compared to 7% and 6%, respectively, of children in TAU groups (Eldevik et al., 2010).

Nevertheless, reviews revealed that, despite meeting some or all of *JCCAP*'s methods criteria, studies on individual, comprehensive ABA have substantial shortcomings. Notably, both RCTs of this approach (Sallows & Graupner, 2005; Smith, Groen, & Wynn, 2000) enrolled small numbers of participants ($N = 24$ and 28, respectively). Moreover, the control group in one of these RCTs (Sallows & Graupner, 2005) received nearly the same intervention as the Lovaas model group, and the intervention and control groups achieved similar outcomes. As such, the study did not allow for comparison of the Lovaas model against alternative approaches. Also, reviewers have questioned whether intervention fidelity has been documented adequately (Kasari, 2002). Further, the precise amount of services often is not reported (Howlin, Magiati, & Charman, 2009). In addition, although most studies have used developmental tests such as IQ as outcome measures, little attention has been devoted to other potentially important outcomes, including reductions in the social communication difficulties that characterize ASD and the impact of intervention on the family (Howlin et al., 2009).

Individual, Comprehensive ABA + DSP

One prominent comprehensive treatment, Early Start Denver model (ESDM), blends ABA strategies, especially PRT (an incidental teaching approach described earlier), with DSP approaches. The DSP component consists of child-led activities, imitation of child behavior, matching of child affect, and sensory regulation. ESDM was evaluated in a well-designed RCT with 48 toddlers with ASD, age 18–30 months at entry into treatment (Dawson et al., 2010). Children in the ESDM group received 20 hr per week of intervention for 2 years. The RCT indicated that ESDM had medium to large beneficial effects, relative to TAU, on measures of developmental quotient and adaptive behavior, but only small, nonsignificant effects on ASD symptoms

(Table 4). Follow-up evaluations suggested that ESDM may normalize children's attention to faces (Dawson et al., 2012). Although independent replications and well-controlled studies of comprehensive ABA + DSP interventions are currently unavailable, the strengths of the Dawson et al. study, notably its exceptionally broad assessment of outcomes and follow-up evaluation, gives individual, comprehensive ABA + DSP a classification of *possibly efficacious* (support from "at least one good randomized controlled trial"; Table 1, Criterion 3.1).

Comprehensive ABA Classrooms

Learning Experiences: An Alternative Program for Preschoolers and Parents (LEAP) integrates children with ASD with typically developing peers in early childhood education settings and emphasizes ABA strategies to improve peer interactions. Impressively, a well-controlled, cluster RCT of 294 children with ASD in 56 preschool classes over 2 years found that, compared to TAU, LEAP had moderate, beneficial effects on ASD symptoms and large, positive effects on developmental quotient, language, and social interaction (Strain & Bovey, 2011; Table 4). However, a subsequent quasi-experimental study of 198 children with ASD in 75 classrooms found no statistically significant differences among LEAP, another classroom model called Project Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH; Mesibov, Shea, & Schopler, 2004), or TAU for 1 year. (TEACCH does not fit entirely within the ABA or DSP classifications; rather it is a structured teaching intervention that integrates research on cognitive styles characteristic of individuals with ASD, along with antecedent-based ABA strategies such as environmental manipulations and visual supports; Mesibov et al., 2004.) Pending further research to resolve the conflicting findings, we follow Chambless and Hollon's (1998) recommendation to be conservative and classify classroom ABA interventions as *possibly efficacious*.

Comprehensive ABA + DSP Classrooms

As noted in the preceding section, ABA + DSP classrooms usually incorporate not only ABA and DSP strategies, but also strategies based on other sources such as research on cognitive style in ASD. Some studies suggest that these classrooms are as effective as ABA classrooms (Boyd et al., 2014; Magiati et al., 2007, 2011; Zachor & Itschak, 2010), whereas other studies suggest they are less effective (Eikeseth et al., 2007, 2012; Eldevik et al., 2012; Howard et al., 2005; Peters-Scheffer et al., 2010). (See "Individual, Comprehensive ABA" and "Comprehensive ABA Classrooms" for a description of these studies.) As the available research on specialized classrooms is mixed and does not include evaluation of manualized intervention, we designate this approach as *experimental*.

FOCUSED TREATMENTS

Individual, Focused Interventions

Individual, Focused ABA for Spoken Communication

As mentioned previously, Rogers and Vismara (2008) classified one incidental teaching approach, PRT, as a comprehensive intervention. In the single-subject literature, PRT has been successful for teaching a variety of skills and particularly for reducing social deficits (Koegel, Koegel, Shoshan, & McNeerney, 1999; Kuhn, Bodkin, Devlin, & Doggett, 2008). Although PRT has broad applications (Koegel et al., 1999; Koegel & Koegel, 2006; Kuhn et al., 2008), group studies and systematic reviews are available only for spoken communication. Thus, the current review classifies PRT as a focused intervention. Rogers and Vismara documented support for PRT from numerous single-subject studies of children with ASD. A recent review located 21 such studies, including nine on preschoolers, all of which reported substantial improvements in spoken communication or play (Sham & Smith, 2014). The review uncovered evidence of publication bias, as published articles yielded larger effect sizes than unpublished dissertations with similar methodologies. However, even including unpublished reports, PRT appeared efficacious, and the quality of the research was high. PRT is also one of the primary components of ESDM, which, as noted previously, has shown promise in an initial RCT. However, one study that compared PRT to another established approach for increasing social communication (i.e., Picture Exchange Communication System [PECS]) did not yield any group differences (Schreibman & Stahmer, 2014; Table 5). Other incidental teaching approaches have support from single-subject studies (Wong et al., 2013), although most do not have manuals. Because group studies have not confirmed these findings, our application of the *JCCAP* methods criteria leads us to classify incidental teaching approaches such as individual, focused ABA for spoken communication as *possibly efficacious*. However, given the large amount of evidence from single-subject studies and the inclusion of PRT in an intervention that has support from an RCT (ESDM), larger scale investigations of interventions in this treatment family are warranted.

Individual, Focused ABA for AAC

AAC systems such as sign language, gestures, or pictures are used to increase communication in minimally verbal children with ASD. The PECS is a popular ABA-based approach that aims to teach children with ASD to select picture symbols and hand them to another

TABLE 5
 Focused Treatments for Young Children With Autism Spectrum Disorder

<i>Study (Design, N, Age)</i>	<i>Design and Treatment</i>	<i>Outcomes</i>
<i>Individual, focused ABA for AAC</i>		
Yoder and Stone (2006a, 2006b) RCT $N = 36$, (21–54 Months)	PECS ($n = 18$) and parent training for social communication ($n = 18$), 20-min sessions 3×/week for 6 months	Parent training > PECS Object exchange turns $d = .82$, 95% CI [.14, 1.50] PECS > parent training Spoken acts $d = .63$, 95% CI [−.04, 1.29] Spoken words $d = .50$, 95% CI [−.16, 1.16]
<i>Individual, Focused ABA for Spoken Communication</i>		
Schreibman and Stahmer (2014) RCT $N = 39$ (20–45 Months)	PRT ($n = 20$, $M = 247$ hr) vs. PECS ($n = 19$, $M = 247$ hr)	PRT = PECS MSEL Expressive Language $d = .41$, 95% CI [−.22, 1.05] MacArthur number of raw words $d = .06$, 95% CI [−.57, .68] VABS Communication $d = .59$, 95% CI [−.05, 1.24]
<i>Individual, Focused ABA + DSP</i>		
Ingersoll (2010) RCT $N = 21$ (27–47 Months)	RIT ($n = 11$, 10 hr total) vs. No-Treatment Control ($n = 10$)	RIT > Control: Elicited imitation $d = .92$, 95% CI [.02, 1.82] Spontaneous imitation $d = 1.20$, 95% CI [.27, 2.13] Follow-Up Analyses (Ingersoll, 2012) RIT > Control: JA initiations $d = .97$, 95% CI [.06, 1.87] Bayley SES $d = 1.09$, 95% CI [.17, 2.01]
Kasari et al. (2006, 2008, 2012) RCT 12-Month Follow-Up to Kasari et al. (2006) $N = 53$ (3–4 Years)	JA ($n = 20$, 30 min per day for 5–6 weeks) vs. Symbolic Play ($n = 17$, 30 min per day for 5–6 weeks) vs. TAU ($n = 16$, amount unspecified)	JA > TAU: Expressive language $d = .59$, 95% CI [−.08, 1.26] JA initiation $d = 1.01$, 95% CI [.31, 1.71] Joint engagement $d = .83$, 95% CI [.15, 1.52] JA = TAU: JA responding $d = .18$, 95% CI [−.28, .83] Receptive language $d = .36$, 95% CI [−.30, 1.03]
<i>Teacher-Implemented, Focused DSP</i>		
Lawton & Kasari (2012) RCT $N = 16$ (3–5 Years)	JASPER ($n = 9$, 1-hr workshop +1 hr per week for 5 weeks) vs. Delayed Treatment ($n = 7$)	JASPER > Delayed Treatment: JA initiations $d = 1.85$, 95% CI [−.86, 2.59] Pointing $d = 2.02$, 95% CI [.72, 2.30] Showing $d = 1.85$, 95% CI [1.16, 1.85] Object engagement $d = 1.41$, 95% CI [.14, 2.27] JASPER = Delayed Treatment: Giving $d = 1.09$, 95% CI [.04, 2.15] ESCS IJA $d = .67$, 95% CI [−.35, 1.68] IJA during play $d = 2.70$, 95% CI [1.34, 4.06]
<i>Teacher-Implemented, Focused ABA + DSP</i>		
Goods et al. (2013) RCT $N = 15$ (3–5 Years)	JASPER ($n = 7$, 30-min sessions, twice per week for 12 weeks) vs. TAU ($n = 8$, $M = 30$ hr per week in regular school program)	JASPER > TAU: Academic Engagement $d = -1.63$, 95% CI [−2.96, −.24] Spontaneous Play $d = .77$, 95% CI [−.46, 2.00] Requesting $d = 1.60$, 95% CI [.24, 2.97] JASPER = TAU: ESCS Behavior Requests $d = .37$, 95% CI [−.82, 1.56] ESCS Joint Attention $d = -.42$, 95% CI [−1.62, .78]
Kaale et al. (2012) RCT $N = 61$ (29–60 Months)	JA Intervention ($n = 34$, 80 20-min sessions across 8 weeks) vs. TAU ($n = 27$, amount unspecified)	JA Intervention > TAU: Frequency of JA with teacher $d = .55$, 95% CI [.04, 1.07] Joint Engagement with mother $d = .64$, 95% CI [.13, 1.16] JA Intervention = TAU: ESCS JA $d = .00$, 95% CI [−.51, .50] Frequency of JA with mother $d = .44$, 95% CI [−.06, .96] Joint engagement with teacher $d = .16$, 95% CI [−.34, .67] 12-month follow-up (Kaale et al., 2014) JA Intervention > TAU: JA Initiation with teacher Joint engagement with mother JA = TAU: Language (RDLS) Social-Communication skills (SCQ)
Landa et al. (2011) RCT $N = 50$ (21–33 Months)	Developmental Intervention plus Interpersonal Synchrony Condition ($n = 25$, 2.5 hr per day for 6 months) vs. Developmental Intervention alone ($n = 25$, 2.5 hr per day for 6 months)	DI plus IS > DI Alone: Socially Engaged Imitation $d = .29$ DI plus IS = DI Alone: IJA $d = .31$ SPA $d = .21$ MSEL Expressive Language $d = .15$ MSEL Visual Reception $d = .31$
<i>ABA Parent Training</i>		
Hardan et al. (2014) RCT $N = 53$ (24–83 Months)	Parent-mediated PRT ($n = 27$, 1 session per week in groups of 4–6 parents for 12 weeks) vs. Parent psychoeducation ($n = 26$, 1 session per week for 12 weeks)	PRT > Psychoeducation: Total utterances $d = .42$, 95% CI [−.16, 1.0] VABS Communication $d = .34$, 95% CI [−.23, .91] CGI Severity $d = -.47$, 95% CI [−1.05, .11] PRT = Psychoeducation MCDI $d = .50$, 95% CI [−.08, 1.08]
Strauss et al. (2012) RCT $N = 44$ (26–81 Months)	Parent-mediated EIBI ($n = 24$, $M = 14$ hr per week) vs. Eclectic ($n = 20$, $M = 12$ hr per week)	EIBI > Eclectic: ADOS Total $d = .08$, 95% CI [−.67, .51] GMDS-ER $d = -.31$, 95% CI [−.91, .28] MCDI Production $d = .48$, 95% CI [−.11, 1.08] EIBI = Eclectic: VABS Composite $d = .31$, 95% CI [−.28, .91]

(Continued)

TABLE 5
Continued

<i>Study (Design, N, Age)</i>	<i>Design and Treatment</i>	<i>Outcomes</i>
Tonge et al. (2012) Quasi-Experiment $N = 105$ (2–5 Years)	Skills training ($n = 35$, 10 sessions) vs. Parent education ($n = 35$, Ten 6-min sessions and ten 90-min groups) vs. TAU ($n = 35$, amount unspecified)	Skills > Education: VABS Daily Living $d = -.52$, 95% CI [-1.01, -.04] VABS Motor Skills $d = -.59$, 95% CI [-.93, .03] Skills > TAU: DBC-ASA $d = -.69$, 95% CI [-1.17, -.21] VABS Communication* Skills and Education > TAU: VABS Socialization* Skills = Education = TAU: PEP-R DQ, RDLS III Comprehension/Expressive Language, CARS *Moderated by lower pre-treatment scores
<i>DSP Parent Training</i> Carter et al. (2011) RCT $N = 62$ (15–24 Months)	HMTW ($n = 32$, 8group sessions +3 in-home coaching sessions) vs. TAU ($n = 30$, amount unspecified)	HMTW = No Treatment*: ESCS IJA $d = .12$, 95% CI [-.67, .43] ESCS Behavior Request $d = .19$, 95% CI [-.37, .74] PCFP Comm. $d = .20$, 95% CI [-.80, .40] PIA-CV Nonverbal Comm. $d = .09$, 95% CI [-.67, .48] *Gains for HMTW moderated by object interest
Casenhiser et al. (2011) RCT $N = 51$ (2–5 Years)	MEHRIT center-based training and ongoing consultation ($n = 25$, 3 weeks initial +2 hr per week) vs. TAU ($n = 26$, $M = 3.9$ hr per week)	MEHRIT > TAU: Enjoyment in Interaction $d = .63$, 95% CI [.06, 1.18] Involvement $d = .77$, 95% CI [.21, 1.34] Imitation of Joint Attention $d = 1.02$, 95% CI [.52, 1.70] mCBRS: Attention to activity $d = .69$, 95% CI [.11, 1.24] MEHRIT = TAU: Language Assessment (CASL/PSL-4): $d = .35$, 95% CI [-.20, .91]
Green et al. (2010) RCT $N = 152$ (2–5 Years)	PACT ($n = 77$, 2 hr every 2 weeks for 6 months + monthly boosters for 6 months) vs. TAU ($n = 75$, $M = 9.8$ hr per week)	PACT > TAU: Child initiations $d = .48$, 95% CI [-.07, 1.02] Shared attention $d = .32$, 95% CI [-.22, .87] PACT = TAU: ADOS-G $d = .14$, 95% CI [-.46, .18] PLS Receptive $d = .09$, 95% CI [-.22, .41] PLS Expressive $d = .00$, 95% CI [-.32, .32] Teacher VABS $d = .17$, 95% CI [-.49, .15]
Kasari et al. (2010) RCT $N = 38$ (21–36 Months)	Joint Engagement Intervention ($n = 19$, 24 sessions across 8 weeks) vs. Waitlist ($n = 19$, $M = 22.1$ hr, excluding school hours)	Joint Engagement > Waitlist: Frequency of JA Responses $d = 3.22$, 95% CI [2.25, 4.18] Functional Play Acts $d = .86$, 95% CI [.19, 1.52] Joint Engagement $d = .87$, 95% CI [.20, 1.53] Object Engagement $d = -1.09$, 95% CI [-1.77, -.41] Joint Engagement = Waitlist: Engagement $d = .87$, 95% CI [.20, 1.53] Frequency of JA Initiations $d = .18$, 95% CI [-.82, .45] Symbolic Play $d = .24$, 95% CI [-.88, .40]
Keen et al. (2010) RCT $N = 39$ (2–4 Years)	Professionally Supported Intervention ($n = 17$, 2-day workshop + 10 home-based consults) vs. Self-Directed Video Based Intervention ($n = 22$, amount unspecified)	Supported > Self-Directed: CSBS – Caregiver $d = .38$, 95% CI [-.25, 1.02] Supported = Self-Directed: CSBS – Behavior $d = .05$, 95% CI [-.58, .68] SIB-R $d = .51$, 95% CI [-.13, 1.15]
Pajareyea & Nopmaneejumruslers (2011) RCT $N = 32$ (2–6 Years)	Floortime™ ($n = 15$, $M = 15.2$ hr per week) vs. TAU ($n = 16$, M estimate = 21 hr per week)	Floortime > TAU: CARS $d = .50$, 95% CI [-.21, 1.21] FEAS $d = .77$, 95% CI [.04, 1.51] FEDQ $d = .90$, 95% CI [.16, 1.64]
Roberts et al. (2011) RCT $N = 84$ (2–5 Years)	Center-based (CB; $n = 29$, 2hours per week for 40 weeks) vs. Home-based (HB; $n = 27$, 2 hr every other week for 40 weeks) vs. Waitlist (WL; $n = 28$, no treatment hours)	HB > WL: VABS Socialization $d = -.71$, 95% CI [-1.25, -.16] CB = WL: DBC $d = .58$, 95% CI [.05, 1.11] Reynell Comprehension $d = .32$, 95% CI [-.20, .84] Reynell Expression $d = .21$, 95% CI [-.31, .73] VABS Communication $d = .12$, 95% CI [-.40, .63] VABS Socialization $d = .04$, 95% CI [-.56, .47]
Siller et al. (2013) RCT $N = 70$ (3–7 Years)	Focused Playtime Intervention ($n = 36$, $M = 90$ min per week across 12 weeks) vs. Parent Advocacy Coaching ($n = 34$, $M = 90$ min per month)	FPI = PAC: MSEL Expressive Language $d = .73$, 95% CI [.24, 1.21] Baseline expressive language moderated treatment outcomes in favor of FPI Secondary analysis (Siller, Swanson et al., 2014) FPI > PAC Avoidant Behavior Scale $d = .50$, 95% CI [.03, .98] FPI = PAC MPCA $d = .55$, 95% CI [.08, 1.03] PCSB $d = .21$, 95% CI [-.26, .68]
Solomon et al. (2014) RCT $N = 112$ (32–71 Months)	PLAY ($n = 57$, 3-hr monthly consultation across 12 months +110 TAU hr) vs. TAU ($n = 55$, 102 hr)	PLAY > TAU FEAS $d = .48$, 95% CI [.11, .86] MBRS $d = .62$, 95% CI [.25, 1.0] CBRS $d = .54$, 95% CI [.17, .92] PLAY = TAU MSEL developmental quotient $d = .27$, 95% CI [-.10, .65] MacArthur $d = .13$, 95% CI [-.24, .50] SCQ $d = .01$, 95% CI [-.38, .36]

(Continued)

TABLE 5
Continued

Study (Design, N, Age)	Design and Treatment	Outcomes
Venker et al. (2012) RCT $N = 14$ (28–68 Months)	Verbal Responsiveness ($n = 7$, 8 parent education sessions and 3 home visits plus 24-hr small group) vs. Waitlist ($n = 7$, amount unspecified)	Verbal Responsiveness > Waitlist: Child prompted communication $d = .77$, 95% CI [-0.31, 1.86] Verbal Responsiveness = Waitlist: Child spontaneous communication $d = -.53$, 95% CI [-1.6, .53]
<i>ABA + DSP Parent Training</i>		
Rogers et al. (2012) Multisite RCT $N = 98$ (14–24 Months)	ESDM ($n = 49$, 12 hr total) vs. TAU ($n = 49$, $M = 11.06$ hr per week)	ESDM = TAU: ADOS Social Affect $d = .07$, 95% CI [-0.47, .32] MCDI Phrases Understood $d = .24$, 95% CI [-0.63, .16] MCDI Vocab Comprehension $d = .18$, 95% CI [-0.59, .21] MCDI Vocab Production $d = .05$, 95% CI [-0.34, .45] MCDI Gestures $d = .13$, 95% CI [-0.53, .26] MSEL Composite $d = .01$, 95% CI [-0.39, .40] VABS Composite $d = .27$, 95% CI [-0.67, .12]

Note: ABA = applied behavior analysis; AAC = alternative and augmentative communication; RCT = randomized clinical trial; PECS = Picture Exchange Communication System; d = Cohen's d ; CI = confidence interval; PRT = Pivotal Response Training; MSEL = Mullen Scales of Early Learning; VABS = Vineland Adaptive Behavior Scales; DSP = developmental social-pragmatic; RIT = Reciprocal Imitation Training; SES = Social-Emotional Scale; TAU = treatment as usual; JA = Joint Attention; JASPER = Joint Attention Symbolic Play Engagement and Regulation; ESCS = Early Social Communication Scales; IJA = Initiating Joint Attention; RDLS-III = Reynell Developmental Language Scales III; SCQ = Social Communication Questionnaire; SPA = Structured Play Assessment; CGI = Clinical Global Impressions; MCDI = MacArthur Communicative Development Inventory; EIBI = early intensive behavioral intervention; ADOS = Autism Diagnostic Observation Schedule; GMDS-ER = Griffiths Mental Development Scale—Extended Revision; DBC-ASA = Developmental Behavior Checklist—Autism Disorder Screening Algorithm; PEP-RDQ = Psychoeducational Profile—Revised Developmental Quotient; RDLS = Reynell Developmental Language Scales; CARS = Childhood Autism Rating Scale; HMTW = Hanen's More Than Words; PCFP = Parent-Child Free Play Procedure; PIA-CV = Parent Interview for Autism—Clinical Version; MEHRIT = Milton & Ethel Harris Research Initiative Treatment program; CBRS = Child Behavior Rating Scale; CASL = Comprehensive Assessment of Spoken Language; MBR = Maternal Behavior Rating Scale; ADOS-G = Autism Diagnostic Observation Schedule—Generic; PACT = Preschool Autism Communication Trial; PLS = Preschool Language Scale; CSBS = Communication and Symbolic Behavior Scales; SIB-R = Scales of Independent Behavior—Revised; FEAS = Functional Emotional Assessment Scale; FEDQ = Functional Emotional Developmental Questionnaire; MPCA = Maternal Perception of Child Attachment Questionnaire; PCSB = Proximity/Contact Seeking Behavior; PLAY = Play and Language for Autistic Youngsters; ESDM = Early Start Denver Model.

person in order to make requests or comments (Bondy & Frost, 2001). Other AAC systems rely on voice output communication aides, which incorporate technology to translate pictorial or textual icons into spoken words (Shane et al., 2012). As documented in multiple systematic reviews, many single-subject studies indicate that PECS can establish communication in minimally verbal children and older individuals with ASD (Flippin, Reszka, & Watson, 2010; Preston & Carter, 2009; Tien, 2008; Tincani & Devis, 2010). Similarly, a meta-analysis of 24 single-subject studies of 58 individuals with ASD, including 27 preschoolers, showed that voice output communication aides consistently have positive effects on communication (Ganz et al., 2012). However, the extent to which these improvements transfer to new settings and last over time is less clear. One RCT that compared PECS to parent training for social communication (Yoder & Stone, 2006a, 2006b; Table 5) indicated that PECS was moderately more effective than parent training in increasing the number and type of spoken words at posttreatment; parent training was much more effective than PECS in increasing turn-taking, and the groups did not differ in requesting. However, these differences were not maintained at a 6-month follow-up evaluation (Yoder & Stone, 2006a). Comparable findings were reported in an RCT of PECS in 84 school-age

children with ASD (Howlin, Gordon, Pasco, Wade, & Charman, 2007) and a quasi-experimental study of 3- to 7-year-old children with ASD (24 receiving PECS and 17 receiving TAU, of insufficient rigor to include in Table 5; Carr & Felce, 2007). Schreibman and Stahmer (2014) conducted a direct comparison of PRT and PECS to teach social communication, with both interventions including direct service and parent training. Although children in both groups gained language, no significant differences were found between the interventions. Furthermore, without a no-treatment control group it cannot be determined whether these treatment effects were uniquely related to the interventions. Nevertheless, because evidence for the efficacy of AAC comes from systematic reviews of single-subject studies, an RCT of preschool children, an RCT of children in early elementary school, and a quasi-experimental group study, ABA-focused AAC is classified as a *probably efficacious intervention*, with the caution that effects may be situation specific and time limited.

Individual, Focused ABA + DSP

Individual, focused ABA + DSP often targets joint attention (JA), which is an early social-communication

skill that involves sharing interest by directing the attention of others through acts such as pointing, making eye contact, or showing objects. JA skills are often underdeveloped in children with ASD, which is concerning because JA is a precursor to language, play, and imitation. Kasari et al. (2006) compared individual, focused ABA + DSP for JA to the same type of intervention for symbolic play, and a no-treatment control group. Results from the initial study and two follow-up evaluations (Kasari, Gulsrud, Freeman, Paparella, & Helleman, 2012; Kasari, Paparella, Freeman, & Jahromi, 2008) indicate that although the JA and play groups made comparable gains in skills, language, social engagement, and play, both groups made larger gains than the no-treatment group (see Table 5).

Reciprocal Imitation Training (RIT) is an approach that integrates incidental teaching and DSP to teach imitation within naturalistic social-communication contexts. Like other approaches that incorporate incidental teaching, the efficacy of RIT was initially explored in single-subject studies (Ingersoll & Lalonde, 2010; Ingersoll & Schreibman, 2006). Of late, research on RIT has included the use of a published manual and has extended to pilot RCTs. Preliminary findings indicate that children who receive RIT show benefit in social communication, including imitation (Ingersoll, 2010) and joint attention and social-emotional functioning (Ingersoll, 2012; secondary data analysis from the 2010 study; Table 5). One single-subject study independently reproduced these results (Cardon & Wilcox, 2011).

Overall, individual, focused ABA + DSP interventions have been shown to be superior to TAU in two independent RCTs and a series of single-subject studies, but definitive data on generalization and maintenance patterns are not yet available. As such, they are characterized as *probably efficacious* for specific social-communication outcomes, such as JA, imitation, and play. Additional research in this area may very well add to the evidence base of individual ABA + DSP interventions, as the efficacy of teacher- and parent-implemented ABA + DSP interventions is emerging (see the Teacher-Implemented, Focused ABA + DSP and the ABA + DSP Parent Training sections). Finally, despite the overall classification assigned here, it is important to note that social engagement interventions comprise several different approaches (e.g., JA treatments, RIT), and it is currently unknown whether there are important distinctions among them.

Teacher-Implemented, Focused DSP

As is the case with comprehensive treatments, focused interventions are often offered in classroom settings. These interventions differ from those classified as comprehensive in that they are delivered on a time-limited basis, usually for only part of the day and across a finite

number of weeks. At present, we have identified one classroom-based DSP intervention. Lawton and Kasari (2012) evaluated an intervention delivered by preschool teachers that emphasized child-directed play and social engagement opportunities. The results indicated that teachers were able to implement the intervention with high fidelity and that children showed significant improvements in JA and aspects of play (e.g., object engagement). Given that this one study meets all of the JCCAP methods criteria, teacher-implemented, focused DSP interventions are classified as *possibly efficacious*.

Teacher-Implemented, Focused ABA + DSP

Some teacher-delivered interventions also include a blend of ABA and DSP strategies and are often based upon individual, focused treatments. For example, the focused ABA + DSP intervention described in an earlier section (Kasari et al. 2006) was adapted for delivery by classroom teachers, resulting in significant gains over TAU in play diversity and academic engagement (Goods, Ishijima, Chang, & Kasari, 2013). Other interventions that target social-communication skills, such as joint attention and play, have resulted in improvements in these specific skill areas (Kaale, Fagerland, Martinsen, & Smith, 2014; Kaale, Smith, & Sponheim, 2012). To investigate mechanisms of change, one RCT (Landa, Holman, O'Neill, & Stuart, 2011) evaluated the contribution of a specific treatment “ingredient,” interpersonal synchrony (matching the child’s behavior and affect). As presented in Table 5, results indicated that a focus on interpersonal synchrony led to increases in one aspect of social-communication (socially engaged imitation) but not others (initiating joint attention or play). A few studies have included evaluations of skill generalization and maintenance. JA skills learned during treatment with an interventionist may extend to other people (Kaale et al., 2014; Kaale et al., 2012; Table 5) and hold up over time (Kasari et al., 2012; Kasari et al., 2008). Findings on whether these benefits lead to improvements on more global outcomes are mixed, with some studies documenting long-term change in language (Kasari et al., 2012) and others reporting few ancillary gains (Kaale et al., 2014). Similar to individual focused ABA + DSP interventions, teacher-implemented focused ABA + DSP interventions are consistent with a classification of *well-established* for discrete social-communication skills. However, the current evidence does not clearly indicate whether these benefits extend to more global outcomes.

Focused Parent Training

As mentioned earlier, Rogers and Vismara (2008) classified parent training programs as *possibly efficacious*.

Subsequently, many new RCTs have evaluated such programs, extending prior research indicating that parents can learn to implement a range of intervention strategies (Odom et al., 2003). Although parent training is often an adaptation of interventions that were originally intended to be delivered directly to the child by specialists, we believe there is value in separately evaluating parent training models. First, if interventions can be disseminated to and delivered by “nonprofessionals,” children with ASD will have much greater access to a trained “provider” who can implement cost-effective intervention. Thus, research on parent training could lead to major changes in service delivery. Second, parent involvement can facilitate generalization and maintenance of acquired skills (Crockett et al., 2007; Kaiser, Hancock, & Nietfeld, 2000) that surpass what specialized interventionists can provide.

ABA Parent Training

Finding effective coping strategies and addressing child challenging behavior are common sources of stress for parents. Many single-subject studies center on guiding parents to use ABA techniques to help their children learn new skills or reduce challenging behavior such as tantrums (Odom et al., 2003). Although these studies show benefits, the available data and methodology do not support more precise conclusions. Two RCTs have used ABA parent training to target challenging behavior. Strauss et al. (2012) found that joint staff- and parent-delivered EIBI resulted in positive child outcomes, such as skill acquisition and reduced challenging behaviors. However, because the treatment group involved both parents and staff interventionists, the unique contribution of parent involvement cannot be determined. Furthermore, parents in the comparison group, which received an eclectic intervention, achieved more positive outcomes than parents in the EIBI group. Tonge, Brereton, Kiomall, Mackinnon, and Rinehart (2014) compared a parent skills intervention to an educational intervention and TAU. We consider the design of this study quasi-experimental, as participants were randomly assigned to one of the two treatment groups but not to the TAU group, which was recruited separately. Children whose parents were involved in the skills group made larger gains than children whose parents were in the other two groups in daily living skills, motor skills, and ASD symptom severity; however, for many outcomes, these benefits were observed mainly in children with the largest delays at entry into treatment.

One RCT (Hardan et al., 2014) compared parent-implemented PRT to a group-based psychoeducation control. Results suggested that the parent training group was associated with improvements in spoken language on experimental and standardized measures, as

well as improvements in global social-communication functioning. Overall, evidence from single-subject studies and two group studies suggest that ABA parent training may reduce challenging behavior. Additional single-subject studies and one group study suggest that ABA parent training may improve spoken communication. However, due to design limitations and the variability of chosen outcomes among these studies, the overall empirical support for ABA parent training programs is consistent with a classification of *possibly efficacious*.

DSP Parent Training

Because social-communication deficits, a defining feature of ASD, are particularly stressful for parents (Davis & Carter, 2008), parent-implemented interventions to address these skills are increasingly well researched. Many different models of DSP parent-implemented interventions are now available. One popular example is Floortime™, which encourages parents to engage their children by matching their behavior, both physically (i.e., by “getting down on the floor” to play) and behaviorally (following child’s lead, imitating child behavior). Two initial RCTs indicated that Floortime parent training interventions (Casenhiser, Shanker, & Stieben, 2013; Pajareya & Nopmaneejumrulers, 2011) were associated with improvements in communication, decreases in symptom severity, and more responsive parent behaviors, as shown in Table 5. Further, responsive caregiver behavior correlated with positive child outcomes (Casenhiser et al., 2013). In another RCT of an intervention based on Floortime, Solomon et al. (2014) evaluated the Play and Language for Autistic Youngsters (PLAY) program, which included monthly home consultation with parents. Children in the PLAY group showed significant improvements in ASD classification, social-emotional skills, and quality of parent-child interactions but not ASD symptoms, communication skills, or development level.

RCTs of other DSP parent training programs have yielded mixed findings (Table 5). Two programs obtained similarly favorable results with targeted social-communication skills and more global outcomes (Kasari, Gulsrud, Wong, Kwon, & Locke, 2010; Siller, Hutman, & Sigman, 2013). A secondary analysis of Siller’s intervention indicated that this program was also associated with gains in some attachment-related behaviors (Siller, Swanson, Gerber, Hutman, & Sigman, 2014). Other RCTs have generally reported more favorable results for communication and social engagement outcomes than in global outcomes (e.g., ASD symptoms). For example, the Preschool Autism Communication Trial (Green et al., 2010) evaluated a parent training program that consisted of 2-hr sessions every other week for 6 months, followed by monthly booster

sessions for another 6 months. This study is the largest RCT included in the current review and had an exceptionally well-designed methodology and analysis plan. At the end of intervention, children in the parent training group initiated communication more often than children in TAU, but the groups did not differ significantly in ASD symptoms or language level. Hanen's More Than Words is a speech and language-based program that aims to improve reciprocal interactions through repetition, turn-taking, and a focus on child preference. In an RCT, Hanen's More Than Words did not reliably change child behaviors (Carter et al., 2011), although it was associated with improvements in parental synchrony with the child (i.e., matching the child's behavior and affect). An additional RCT showed changes solely in parent outcomes (Keen, Couzens, Muspratt, & Rodger, 2010); another found no changes in either parent or child outcomes (Oosterling et al., 2010). Overall, outcomes tend to be more positive for parent behavior than child behavior (Carter et al., 2011; Venker, McDuffie, Weismer, & Abbeduto, 2012).

Roberts et al. (2011) specifically set out to compare parent and child outcomes in DSP parent training and included two approaches to training (i.e., home based and center based) and a TAU condition. Consistent with other studies, the authors found variability in both parent and child outcomes. They observed improvements in receptive language and socialization skills in center-based treatment but no effects of this treatment on other outcomes (e.g., expressive language, developmental behavior). Parents whose children were in center-based treatment made gains in parenting skills and knowledge. However, parents in the home-based group reported greater access to specialized services and social support around special needs. Other measures such as parenting stress were unrelated to either treatment. At present, therefore, factors that may contribute to the inconsistent findings across studies remain unclear.

Overall, the literature on DSP parent training includes many methodologically strong studies such as the Preschool Autism Communication Trial. However, the positive findings in some studies are tempered by a large number of null findings in other studies. Further, the tendency of these types of interventions to focus on highly specific social-communication outcomes, which are inconsistently related to broader, clinically relevant outcomes, detracts somewhat from the strength of the evidence base (Weitlauf et al., 2014). Consistent with the Chambless and Hollon (1998) recommendation to be conservative, the mixed evidence in this area is most consistent with a classification of *probably efficacious*.

ABA + DSP Parent Training

Rogers et al. (2012) conducted an RCT of parent training in ESDM intervention strategies (described in

the Comprehensive ABA + DSP Classrooms section). Parent training was provided at low intensity (i.e., 1 hr per week, compared to 20 hr per week in the full ESDM program). Outcomes of children in the parent training program and children in TAU were indistinguishable (Table 5). Thus, despite promising findings from the initial RCT of the full ESDM program (Dawson et al., 2010; Table 5), parent training in ESDM approaches was not found to be efficacious. Yoder and Stone (2006a, 2006b), in a study described in the Individual, Focused ABA for Augmentative and Alternative Communication section, reported that ABA + DSP parent training was more efficacious than ABA for increasing turn-taking but not for other outcomes (Yoder & Stone, 2006a, 2006b). An additional multimethod intervention, integrating ABA and TEACCH (Wang, 2008), yielded positive effects relative to TAU for parental behaviors during parent-child interactions; however, child outcomes were not evaluated. Given the limited evidence that ABA + DSP parent training programs improve child outcomes, these programs are classified as *experimental*.

Summary

The increase in RCTs to evaluate parent training programs is encouraging, given the methodological concerns highlighted in previous reviews (Rogers & Vismara, 2008; Warren, McPheeters et al., 2011). However, additional research is needed to resolve the conflicting findings across studies and determine whether the parent training programs that have support from initial RCTs (e.g., Siller et al., 2013) can be independently replicated (Oono, Honey, & McConachie, 2013; Wetlauf et al., 2014).

PREDICTORS, MEDIATORS, AND MODERATORS

The extent to which analyses of predictors, mediators, and moderators has been conducted varies greatly by treatment approach, with the most detailed investigations done on comprehensive interventions. Although researchers have generally not performed formal mediator and moderator analyses, they have identified both child and intervention characteristics that may predict outcomes. Given the wide range of outcomes documented in this review, it is essential for future research to determine which child and treatment factors are most likely to derive maximal benefit from each intervention approach.

Comprehensive Interventions

Despite the overall positive findings on individual, comprehensive ABA, studies consistently show large

variations in outcomes across children. Learners may show reliable change in IQ and other measures (Sallows & Graupner, 2005), acquire many new skills but not catch up to their peers, or show little or no improvement with this therapy (Lovaas, 1987; Smith et al., 2000). Regarding child characteristics, the most consistent finding thus far is that higher pretreatment IQ predicts better outcome, although this prediction is far from perfect (Eldevik et al., 2009). Potential predictors that have not yet been tested via RCTs include younger age (e.g., Granpeesheh, Dixon, Tarbox, Kaplan, & Wilke, 2009; Smith, Klorman, & Mruzek, 2015) and social and object interest (Klintwall & Eikeseth, 2012; Smith et al., 2015). Other potentially important child and family characteristics (e.g., race, ethnicity, cultural background, socioeconomic status) have received little attention, although the few available findings have not shown an association with outcome (e.g., Smith et al., 2000).

In addition to child factors, particular components of individual, comprehensive ABA could be “active ingredients” that produce favorable outcomes (Kasari, 2002), although few of these have been directly tested. Potential important components include amount of supervision (e.g., Magiati et al., 2011), treatment “dose” (Eldevik et al., 2009; Granpeesheh et al., 2009; Sheinkopf & Siegel, 1998; Smith et al., 2015), and parental involvement (Smith, 2010). Finally, despite varying opinions about the method and content of individual, comprehensive ABA (e.g., the optimal mix of structured and child-led intervention strategies, the most useful skills to target in intervention), systematic comparisons are currently unavailable.

Focused Interventions

The limited available evidence on parent training suggests that favorable response to treatment is moderated by baseline participant characteristics including object interest (Carter et al., 2011) and more limited pretreatment communication skills (Siller, Swanson et al., 2014; Tonge et al., 2014). Other studies focused on predictors of outcome, such as the child’s joint attention, involvement, enjoyment (Casenhiser et al., 2013), and age (Rogers et al., 2012); parent’s intervention fidelity (Rogers et al., 2012) and quality of engagement (Kasari et al., 2010); and treatment “dose” (Rogers et al., 2012). Although no consistent mediators or moderators of focused, social engagement interventions have been identified, one study indicated that functional language, functional play, and intervention at a younger age predicted success at a 5-year follow-up (Kasari et al., 2012).

Focused interventions vary across several dimensions that may directly relate to outcomes (e.g., duration, intensity, coaching of parents or teachers on intervention strategies with or without children present).

However, research is currently unavailable on the effects of these variables.

DISCUSSION

The quantity and quality of research on interventions for young children with ASD have increased markedly since the previous *JCCAP* review (Rogers & Vismara, 2008), thereby boosting the number of interventions that have some empirical support. Whereas the previous review classified only one intervention as well-established, none as probably efficacious, and three as possibly efficacious, the current review identifies two interventions as well-established (individual, comprehensive ABA and teacher-implemented, focused ABA + DSP), three as probably efficacious (individual, focused ABA for AAC; individual, focused ABA + DSP; and focused DSP parent training), and five as possibly efficacious (individual, comprehensive ABA + DSP; comprehensive ABA classrooms; focused ABA for spoken communication; teacher-implemented focused DSP; and focused ABA parent training). These interventions, summarized in Table 6, are based on diverse theoretical frameworks and practice elements, indicating that a variety of approaches can be efficacious for young children with ASD.

However, even the research on well-established treatments continues to have important gaps, particularly limitations in outcome measures (discussed further in the Complications section). These limitations make it difficult to determine whether the interventions in Table 6 have similar or differing effects. For example, as shown in the table, outcome measures in studies on one well-established intervention (individual, comprehensive ABA) have usually focused on associated features of ASD such as cognitive and adaptive functioning; little is known about the effects of this intervention on defining features of ASD. In contrast, outcome measures in studies on the other well-established intervention (teacher-implemented, focused ABA + DSP) have usually focused on defining features of ASD such as joint engagement, and the effects of this intervention on associated features are unclear.

In addition, recent research has sometimes produced contradictory results, notably the mixed findings across studies on classroom ABA (Table 4) and DSP parent training (Table 5). Information on mediators and moderators of outcome also remains scant. Hence, little guidance is available on how investigators might enhance the potency of interventions or tailor intervention plans for an individual child with ASD.

Despite these caveats, advancements in ASD intervention research and the increase in treatments that have some empirical support are welcome developments

TABLE 6
 Summary of Levels of Evidence and Primary Outcomes Reported in Research on Psychological and Behavioral Interventions for Young Children With Autism Spectrum Disorder

<i>Intervention</i>	<i>Primary Outcomes Reported in Research</i>
<p><i>Level 1: Well-Established</i> Individual, Comprehensive ABA Teacher-Implemented, Focused ABA + DSP</p>	<p>IQ/DQ, Parent-rated adaptive functioning Joint engagement in play activities with caregivers and teachers</p>
<p><i>Level 2: Probably Efficacious</i> Individual, Focused ABA for Augmentative and Alternative Communication Individual, Focused ABA + DSP Focused DSP Parent Training</p>	<p>Use of picture symbols to make requests Initiation of joint attention, Joint engagement in play activities with caregivers and other adults, Imitation, Language and cognitive skills Joint engagement in play activities with caregivers and other adults, Communication with caregivers, Make-believe play</p>
<p><i>Level 3: Possibly Efficacious</i> Individual, Comprehensive ABA + DSP Comprehensive ABA Classrooms Focused ABA for Spoken Communication Teacher-Implemented, Focused DSP Focused, ABA Parent-Training</p>	<p>DQ, Parent-rated adaptive skills Examiner-rated ASD symptoms, Language, DQ, Teacher-rated social Skills Use of spoken words for joint engagement or requesting Initiation of joint attention with teachers, Engagement with objects during interactions with teachers Parent-reported adaptive behavior, Use of utterances or words to communicate</p>
<p><i>Level 4: Experimental</i> Comprehensive, ABA + DSP Classrooms^a Focused ABA + DSP Parent Training</p>	

Note: ABA = applied behavior analysis; DQ = developmental quotient; DSP = developmental social-pragmatic; Comprehensive = intended to address all areas of need; Focused = intended to target a specific outcome (e.g., an ASD symptom).

^aComprehensive, ABA + DSP classrooms also emphasize instructional strategies based on research on neuropsychology and learning style in ASD.

for the ASD community. Moreover, this progress is attributable not only to the rise in research funding afforded by initiatives such as the Combating Autism Act (2006) but also to investigators' adroitness in designing and carrying out rigorous group studies of interventions for children with ASD (Lord et al., 2005). As described in the Method for the Current Review section, investigators must overcome many logistical obstacles, including the length and intensity of many interventions, strong parent preferences, and availability of comparable interventions from publicly funded programs in some locations. Nevertheless, they have successfully carried out large, quasi-experimental studies of well-matched groups of participants who are either receiving individual, comprehensive ABA or TAU (Table 4). For comprehensive treatments that are less widely available, such as individual, comprehensive ABA + DSP and classroom ABA, investigators have conducted RCTs comparing these treatments to TAU (Table 4). Such comparisons provide some evidence for the relative efficacy of these treatments, even though the services encompassed in TAU are certainly not uniform.

Another productive strategy has been to study focused treatments that have more circumscribed (yet

important) goals. Although research on focused treatments was just emerging at the time of the previous review, many focused DSP interventions have quickly attracted more high-quality RCTs than any other behavioral treatments for children with ASD. The mixed findings on DSP parent training show that focused treatments may fall short for some outcomes. However, studies on individual, focused DSP and perhaps individual, focused ABA suggest that meaningful gains can occur even with a relatively small amount of intervention, often in the range of 10 to 50 hr of direct contact between the service provider and child or family (Table 5).

Practical Implications

Children with ASD, their families, and providers now have more viable treatment options than they did even a few years ago. Research indicates that, although not a cure, comprehensive treatments can accelerate development of cognitive and adaptive skills, and focused treatments can help establish and expand social communication. It is difficult to foresee how far this progress will go toward addressing the myriad public health issues associated with ASD, but research trends do

lay the groundwork for improvement. Useful resources already exist to guide families toward empirically supported treatments and help providers learn to implement them. Information for families includes lay summaries of research findings by the Agency for Healthcare Research and Quality (www.ahrq.gov), Association for Science in Autism Treatment (www.asatonline.org), and Interactive Autism Network (www.iancommunity.org); family-friendly books (*Topics in Autism* series [Woodbine House], Thompson, 2007); toolkits on the website of Autism Speaks (www.autismspeaks.org) consumer guidelines (www.bacb.com/downloadfiles/ABA_Guidelines_for_ASD.pdf); and resource directories (www.autismspeaks.org/family-services/resource-guide). Provider resources include published manuals (e.g., through www.aap.org), online videos illustrating intervention techniques (www.ocali.org), and training opportunities.

Well-established approaches, particularly individual, comprehensive ABA and teacher-implemented, focused DSP, can be considered first-line treatments. However, because of the wide individual variation in outcome and the dearth of information about mediators and moderators linked to these outcomes, an empirical trial with careful monitoring of progress is necessary to determine whether these treatments are helpful for each individual child with ASD. Such trials are especially important for comprehensive interventions, given the extensive commitment of time and resources that these interventions entail. The most intensive of these interventions is individual, comprehensive ABA. Working groups of investigators, providers, and family members have proposed benchmarks to help determine whether this intervention is progressing as intended (Blalock & Perry, 2010; Region 6 Autism Connection, 2006). In addition, investigators have outlined remedial strategies to consider when the intervention is not progressing (Ferraioli, Hughes, & Smith, 2005).

Probably or possibly efficacious interventions also merit consideration. Many of these interventions have techniques and goals that differ greatly from individual, comprehensive ABA and focused, teacher-implemented ABA + DSP. For example, they may rely more on child-led interactions than does individual, comprehensive ABA, and they may focus on associated features more than does focused, teacher-implemented ABA + DSP. As such, they may be beneficial even for children who struggle with well-established treatments, although additional research is needed to verify this supposition.

Besides differences, empirically supported treatments also have commonalities, which, in the view of many investigators, can be regarded as a set of best practices that should always be incorporated into services offered

to children with ASD (Iovannone, Dunlap, Huber, & Kincaid, 2003):

1. Individualized services and supports: making use of the particular interests and individual learning style of each child with ASD to increase engagement in activities through interventions such as reinforcement systems and incorporation of preferred activities into intervention sessions.
2. Systematic intervention planning: selecting goals and instructional procedures based on a data-based assessment of each child, monitoring progress, and troubleshooting as needed.
3. Comprehensible, structured environments such as using visual schedules to help children with ASD anticipate transitions between activities and organized work spaces to facilitate task completion.
4. Specific intervention content to address the impairments in social communication and restricted, repetitive behaviors that define ASD.
5. Functional approach to problem behavior: assessing the function or purpose of the behavior and selecting intervention strategies based on this assessment.
6. Family involvement to promote consistency between home and the intervention setting, take advantage of the family's knowledge of the child with ASD, and overcome difficulties that children with ASD are likely to have in conveying information from one setting to another.

Complications

Although investigators have made a concerted and largely successful effort to carry out controlled group studies, much uncertainty remains about outcome measurement and about criteria for appraising studies in systematic reviews. Regarding measurement, many studies have met *JCCAP*'s criteria of incorporating "reliable and valid outcome assessment measures gauging the problems targeted" (Table 1). However, as Tables 4 and 5 make clear, investigators use a broad range of measures to evaluate associated and defining features of ASD, ranging from discrete social-communication skills (e.g., joint attention, eye contact, play) to global, standardized outcome measures (e.g., IQ, adaptive behavior). Even within families of treatments that employ similar methods, investigators lack consensus on which measures to use. The variation in measures across studies makes it difficult to compare findings. Moreover, studies of individual, comprehensive ABA have given priority to changes in associated features of ASD (delays in cognitive and adaptive skills), rather than primary ASD symptoms. Studies on DSP treatments have emphasized changes in laboratory

observations of individual ASD symptoms (especially in the area of social communication), but these measures have uncertain relevance to everyday functioning. Across many treatment families, a few investigators have administered ASD diagnostic tools as outcome measures, but such tools were not intended to be used for this purpose and may not be sensitive to change. Unfortunately, a practical, ecologically valid measure of change in ASD symptoms does not yet exist. There are currently no published, observational measures designed to detect such change in preschool children, although some measures are currently under development (Lord, Carr, & Grzadzinski, 2013). One study incorporated a neurological measure of change (electroencephalogram recordings of children's responses to faces; Dawson et al., 2012), but no other studies have done so. Although brief symptom checklists have been created to monitor response to treatment in disorders such as attention-deficit/hyperactivity disorder, oppositional-defiant disorder, anxiety, and depression, no checklists of this kind are available for ASD. Longer rating scales have been devised (e.g., Cohen, Schmidt-Lackner, Romanczyk, & Sudhalter, 2003) but were not given in any of the studies listed in Tables 4 and 5. Thus, the need to identify appropriate outcome measures, particularly for ASD symptoms, is acute.

Regarding methods criteria, beyond taking divergent stances on the role of single-subject studies and manuals (described in the Method for the Current Review section), investigators have also applied varying criteria to evaluate group studies and combine evidence across studies. For example, although *JCCAP* requires randomized studies to classify a treatment as well-established, other systems go further and require a clear description of how randomization was accomplished and how the allocation sequence was concealed from the investigators (Warren et al., 2011). In addition, *JCCAP* requires that "sample size was sufficient to detect expected effects" (Table 1), but other systems rate the precision with which effect size can be determined (Maglione et al., 2012). In contrast to the focus in *JCCAP*'s criteria on the number of well-designed studies that support an intervention, other systems rate the consistency of evidence across studies (Warren et al., 2011). Depending on how stringently these criteria are applied, treatments that are classified as well-established in this review have been rated as having low to moderate levels of evidence in some other reviews (Maglione et al., 2012; Reichow et al., 2012; Weitlauf et al., 2014). Conversely, for several intervention approaches (e.g., parent training for problem behavior, incidental teaching), preliminary support in RCTs extends long-standing findings from single-subject research. Alternative review systems that allow single-subject research to support a "well-established" classification may depict the evidence base for some

of these intervention approaches as stronger than it appears here.

The limited information on randomization protocols in some studies reflects the absence of a standard in the ASD intervention literature for transparent reporting of study procedures, such as the Consolidated Standards of Reporting Trials (CONSORT) Statement for RCTs (Moher et al., 2010) and the Transparent Reporting of Evaluations with Nonrandomized Trials (TREND) Statement for quasi-experimental studies (Fuller, Pearson, Peters, & Anderson, 2012). At present, specialized journals for research on ASD or other intellectual disabilities do not instruct authors to follow such standards, nor do many other journals that commonly publish ASD intervention research. We do not believe that the extent to which reports adhered to these standards would have influenced the evidence ratings in the current review. However, "transparent reporting" should be considered in both funding and publication as well as in rating individual studies, and it may be advisable for ASD journals to consider requiring authors to follow standard reporting guidelines.

Appraisal of the precision of effect size estimates and consistency of findings across studies may facilitate moving beyond identifying treatments as well-established toward gauging their potential utility in practice. The magnitude and clinical relevance of effects also would be important to assess. Because of the small sample sizes in many studies and the wide range of outcome measures used, effect size estimates remain somewhat imprecise even for well-established treatments. Also, as previously discussed, limitations in the measures reduce the clinical relevance of findings. Inconsistent findings across studies are also a prominent issue, particularly in research on classroom ABA and DSP parent training. Some approaches to conducting systematic reviews allow for assigning separate ratings to the quality of evidence and the strength of clinical recommendations that can be derived from the evidence (e.g., Grading of Recommendations Assessment, Development and Evaluation; Guyatt et al., 2008). It may be beneficial to adapt such a system for use in reviewing ASD intervention studies, particularly as research in this area grows more sophisticated.

FUTURE DIRECTIONS

The development and validation of interventions is a process with a sequence of stages (initial tests for "proof of concept," standardization into a manual and pilot testing, efficacy trials, and effectiveness studies). From this perspective, much work remains to be done at all stages. At the initial stage, research has barely begun on specific interventions for one of the defining features

of ASD: restricted, repetitive behavior. Indeed, no studies on this symptom area met criteria for inclusion in the current review. Also, although research is available on establishing social communication, few studies have examined interventions for more advanced skills such as back-and-forth conversations and complex, sociodramatic play. Thus, proof-of-concept studies are needed to start addressing these key problems in ASD.

Many interventions have support from numerous single-subjects studies and are ready to progress to standardization into a manual. Examples include video modeling to demonstrate social skills (Bellini & Akullian, 2007), functional communication training to teach communication skills as a replacement for problem behavior (Hart & Banda, 2010), and differential reinforcement procedures to address difficulties with sleep (Durand, 2014) and feeding (Sharp, Jaquess, Morton, & Herzinger, 2010). A few interventions (e.g., incidental teaching approaches such as PRT) have been described in a manual (Koegel et al., 1989) but not yet tested in group studies.

At the stage of efficacy trials, most group studies have compared an active intervention against a waitlist control or TAU (Tables 3–5). With noteworthy exceptions (e.g., Boyd et al., 2014; Landa et al., 2011), investigators have not yet contrasted an active treatment with a well-defined control group (i.e., a control condition standardized in a manual; Lord et al., 2005) or another active treatment, conducted dismantling or constructive studies, designed adaptive trials, or employed other strategies that would help pinpoint the “active ingredients” of a treatment. Moreover, few studies have enrolled enough participants to support adequately powered analyses of mediators and moderators. The limited socioeconomic, cultural, and racial or ethnic diversity of study participants also make it difficult to determine whether these factors moderate outcomes. In the absence of such research, treatment families were defined in the present review based on clinical impression, rather than known mechanisms of action. More important, there is no established mechanism for improving upon existing interventions, and providers and families have little basis for selecting one empirically supported intervention over another. Thus, it will be crucial for investigators to go beyond simply comparing an active treatment against no treatment or TAU.

Community effectiveness studies have been reported on individual, comprehensive ABA, classroom ABA, and teacher-implemented, focused DSP. Studies in which providers have received ongoing supervision from experts in the intervention have generally reported favorable outcomes (e.g., Eikeseth et al., 2012; Strain & Bovey, 2011), but studies without such supervision have not (e.g., Boyd et al., 2014; Magiati et al., 2007). Although preliminary, these studies suggest that exporting empirically supported

interventions into community settings may prove difficult. Investigators might need to consider strategies such as engaging community partners early in the process of designing interventions or working with them to adapt interventions for use outside of a research context (Kasari & Smith, 2013).

Given that two ongoing developments are an increased focus on RCTs and legislation to increase access to ASD services, it may be possible to merge these two initiatives. New, publicly funded programs usually start small and gradually expand over time. As a result, when the programs begin, most families endure lengthy waits for services or have limited access to these services. Under these circumstances, it may make sense to conduct RCTs comparing outcomes in the new program to community TAU. This has been accomplished in publicly funded initiatives for other groups of children, such as charter schools and mandates to reduce class size (Murnane & Willett, 2010). In ASD research, one such example already exists, involving school-age children with ASD. The School District of Philadelphia decided to introduce ABA classrooms in its self-contained classrooms in early elementary education and agreed to an RCT comparing these classrooms with TAU, enhanced with extra training opportunities for teachers (Mandell et al., 2013). Adding to evidence from early intervention studies that community-based treatment is not always effective, this study revealed that teachers’ fidelity of implementation was uneven and that outcomes in classroom ABA did not significantly differ from outcomes with TAU (Mandell et al., 2013). Thus, despite disappointing outcomes, the study was informative and may serve as a model for working with publicly funded programs to conduct RCTs.

At the time of the previous review (Rogers & Vismara, 2008), most group studies centered on a single treatment, the UCLA/Lovaas model of individual, comprehensive ABA. This intervention continues to have stronger empirical support than other comprehensive treatments. However, several of these other treatments show promise and merit further study. Also, a variety of focused treatments have emerged, many of which can be considered possibly or probably efficacious or well-established. Eventually, empirically supported, focused treatments may become available to individual children in a modular format (i.e., treatment components selected based on data). This modular approach could serve as an alternative to comprehensive treatments (Kasari & Smith, 2013). Overall, our review surveys many different behavioral interventions for young children with ASD and highlights the recent evolution toward broader, more rigorous evaluations of such interventions. Well-designed studies that produce interpretable data on a range of treatment modalities will help communities provide appropriate, effective services for children with ASD.

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