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## Evidence-Based Comprehensive Treatments for Early Autism

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### Abstract

Early intervention for children with autism is currently a politically and scientifically complex topic. Randomized controlled trials have demonstrated positive effects in both short-term and longer term studies. The evidence suggests that early intervention programs are indeed beneficial for children with autism, often improving developmental functioning and decreasing maladaptive behaviors and symptom severity at the level of group analysis. Whether such changes lead to significant improvements in terms of greater independence and vocational and social functioning in adulthood is also unknown. Given the few randomized controlled treatment trials that have been carried out, the few models that have been tested, and the large differences in interventions that are being published, it is clear that the field is still very early in the process of determining (a) what kinds of interventions are most efficacious in early autism, (b) what variables moderate and mediate treatment gains and improved outcomes following intervention, and (c) the degree of both short-term and long-term improvements that can reasonably be expected. To examine these current research needs, the empirical studies of comprehensive treatments for young children with autism published since 1998 were reviewed. Lovaas's treatment meet Chambless and colleague's (Chambless et al., 1998; Chambless et al., 1996) criteria for “well-established” and no treatment meets the “probably efficacious” criteria, though three treatments meet criteria for “possibly efficacious” (Chambless & Hollon, 1998). Most studies were either Type 2 or 3 in terms of their methodological rigor based on Nathan and Gorman's (2002) criteria. Implications of these findings are also discussed in relation to practice guidelines as well as critical areas of research that have yet to be answered

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In 1987 and 1993, Lovaas and colleagues published articles describing the “recovery” of almost 50% of a group of very young children with autism, treated intensively with applied behavioral analysis for several years (Lovaas, 1987; McEachin, Smith, & Lovaas, 1993). These articles suggested an entirely new way of thinking about autism: as a disorder marked by considerable plasticity, for which there was the hope of recovery given appropriate intervention. The articles have had tremendous impact on public schools and other public service agencies that fund intervention for all children with disabilities, resulting in the development of specialized intervention programs for children with autism that differ markedly for those of children with other developmental disorders. The articles also had a tremendous effect on thousands of parents, who hope to achieve a similar recovery for their own children. Many parents have spent large amounts of their own money purchasing the interventions and hundreds to

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thousands of hours of their time mobilizing services and funding for their children's interventions, including many hearings and court cases (reviewed by Etscheidt, 2003).

Governmental agencies of several different nations, including the United States (National Research Council, 2001), have set up national review groups to review the literature and recommend or establish public policy on appropriate education and intervention for this group of children. As the 1998 review of early intervention in autism published in this journal suggested (Rogers, 1998), the existing literature suggested some plasticity in early development in response to several different kinds of interventions, but the question of "recovery" awaited stronger scientific designs and independent replications.

In this article, we return to the same question: What is the empirical evidence supporting efficacy of early intervention for young children with autism? To answer this question, we conducted a search of the literature for all published papers on early intervention in autism published between 1998 and 2006, excluding those reviewed in our previous review article. We required that the study involve comprehensive treatment approaches for children with autism, predominantly ages 5 or younger, using either controlled group designs or single-subject multiple baseline designs using three or more subjects with published data. We defined *comprehensive* as meaning treatments that addressed core deficits in *autism*, including language, social, cognition, and play. We initiated an Internet search in PsycINFO using keywords such as *autism*, *preschool*, *treatment*, and *intervention*. We followed up that search by searching the bibliographies of all reviewed articles for additional articles that met the search criteria. We then eliminated studies that did not report analyses of child progress using general measures of children's language or intellectual development as one aspect of the outcome measures. We eliminated studies that targeted only one domain, like play, social behavior, or unwanted behaviors. We also eliminated case reports and studies whose data were published only in chapters rather than in peer-reviewed journals.

Unlike the situation 5 years ago, we identified a number of articles that used comparative designs to address the question of treatment efficacy. We review these treatments based on the criteria for "well-established" or "probably efficacious" psychosocial interventions from Chambless et al. (1998) and Chambless et al. (1996) and the classification from Nathan and Gorman (2002).

The treatment classification criteria of Chambless et al. (1998) and Chambless et al. (1996) are as follows:

1. "Well-established" requires treatment manuals, and clearly specified participant groups, and either of these characteristics:
  - a. Two independent well-designed group studies showing the treatment to be better than placebo or alternative treatment or equivalent to an established effective treatment.
  - b. Nine or more single-subject design studies using strong designs and comparison to an alternative treatment.
2. "Probably efficacious" requires clearly specified participant groups (treatment manual preferable but not required), and either of three characteristics:
  - a. Two studies showing better outcomes than a no-treatment control group.
  - b. Two strong group studies by the same investigator showing the treatment to be better than placebo or alternative treatment or equivalent to an established treatment;

- c. Three or more single-subject design studies that have a strong design and compare the intervention to another intervention.

The Nathan and Gorman (2002) study criteria are as follows:

Type 1 studies: Randomized, prospectively designed clinical trials using randomly assigned comparison groups, blind assessments, clear inclusion/exclusion criteria, state-of-the-art diagnosis, adequate sample sizes to power the analyses, and clearly described statistical methods. We also expected treatment fidelity measures (i.e., measurement of the degree to which the treatment as delivered adheres to the treatment model) to be included in Type 1 studies.

Type 2 studies: Clinical trials using a comparison group to test an intervention. These have some significant flaws but not a critical design flaw that would prevent one from using the data to answer the study question. Type 2 studies provide useful information. We also included single-subject designs in this group.

Type 3 studies have significant methodological flaws. In this group we included uncontrolled studies using pre-post designs and studies using retrospective designs.

Types 4 and 5: Secondary analysis articles (not used in this review).

Type 6: Case reports (not used in this review).

The following review has been organized into several sections: (a) review of studies using random assignment to treatment and control conditions (randomized control trials [RCT]), (b) review of full or partial replications of Lovaas's treatment approach, (c) review of empirical studies of other intervention approaches, (d) research involving variables that mediate or moderate children's responses to intervention approaches, (e) psychopharmacological interventions, and (f) practitioner guidelines. Table 1 provides a summary of the main features of each study, including descriptions of the participants, outcome measures, treatment results, classification (including justifications) of study with respect to the aforementioned criteria. The article concludes by describing practice guidelines that can be drawn from the intervention research and current research needs.

## STUDIES USING RANDOMIZED CONTROLLED DESIGNS

When the 1998 version of this article was published (Rogers, 1998), it did not report a single RCT in early autism treatment. Five years later, the situation has changed, and we have five RCT studies to examine.

### Jocelyn, Casiro, Beattie, Bow, and Kneisz (1998)

**Design**—This Canadian study involved a 12-week treatment conducted in community day care centers in which most of the children had typical development. Each child in the experimental condition was assigned a special childcare worker, and both the worker and the parents received 15 hr of classes over the 12-week intervention period. The classes taught day care workers and parents to understand how children with autism behaved and learned; how to understand their behavior; and how to facilitate their communication, play, and social interaction. They were taught to carry out functional analysis of behavior and develop treatment strategies for changing behavior. Facilitating social and communicative development took precedence over “problem behavior” management. Concurrent on-site consultations were provided by autism specialists for 3 hr per week for 10 weeks for each day care center, helping the staff develop treatment goals and approaches. There was no further elaboration of treatment approaches or mention of a treatment manual or treatment fidelity measurement.

The comparison group received standard community care, consisting of attendance in the same kind of community day care center and a specially assigned childcare worker. The day care center received consultation from a child counselor and a family social worker concerning the child's special needs but no special training. After the 12-week study ended, these children were provided with the same care as the experimental group.

The sample included 35 children between ages 24 and 72 months who had not received services or childcare before, diagnosed by the criteria of the Diagnostic and Statistical Manual of Mental Disorders (4th ed.; *DSM-IV*; American Psychiatric Association, 1994), either with Autistic Disorder (AD) or Pervasive Developmental Disorder Not Otherwise Specified (PDDNOS) by a specific autism team. Children were excluded if they were outside the 24- to 72-month age range, lived too far away from the study site, currently attended a day care or school program, or had a severe physical disability. They were recruited from referrals to a specialized hospital-based autism service. Children were evaluated pre- and posttreatment by a psychologist blind to group assignment. Children were stratified into two groups based on severity scores of the Childhood Autism Rating Scale (Schopler, Reichler, & Renner, 1988) and assigned randomly to either experimental or control groups.

The pre- and post assessment battery included parent and childcare worker knowledge of autism test, child autism severity, a criterion-based developmental profile, a measure of family stress and arousal, family coping and performance, and a satisfaction questionnaire after the intervention. The two groups of children were well matched on demographics, severity of disorder, and amount of time in day care (mean of 20 hr a week for both groups).

**Findings**—Assessment after 12 weeks indicated a statistically significant increase in knowledge of autism by mothers and trained childcare workers. There was no change in professional rating of autism severity and no treatment effect on parent rating of autism severity. On developmental measures, both groups progressed, and the experimental group showed a significant gain compared to controls in only one area—language development (a mean change of 5.3 months in 12 weeks;  $p = .008$ , effect size [ES] = 0.87).

Although the level of intensity of the intervention is considerably less than most other treatment studies and the clinical significance of the gain is modest, the study demonstrated a statistically significant effect in a short time of a relatively low-cost intervention, delivered by community settings. For this community, the delivery system was feasible for a large number of children. A small effect in only one area of development may seem rather insignificant, but the time period was short—only 3 months—and the intervention was carried out by paraprofessionals who were naïve to autism at the start of the study, with a short period of initial training but with ongoing oversight. Given that the study included a large-enough sample size to offer adequate statistical power, clearly described statistical methods, a randomized design, and reasonable diagnostic methods, the study is classified as a Type 1 using Nathan and Gorman's (2002) criteria. Moreover, given that replication studies have not yet been published, this intervention does not meet the well-established or probably efficacious criteria. The treatment does meet the *possibly efficacious* criterion, however, because, in accordance with Chambless and Hollon (1998), there is evidence supporting the treatment's efficacy relative to a control condition in one “good” study.

#### **Drew et al. (2002)**

**Design**—The second RCT study in the literature tested the effects of a home-based, parent-delivered developmental intervention. The pilot study involved 24 toddlers with autism ( $M$  age = 23 months) who met full criteria for AD on multiple measures, randomized to an experimental parent training group and community services control group.

The parents were trained in two main areas: the pragmatics of social communication and behavior management. The behavior management intervention involved using operant reinforcement approaches, interruption of unwanted behavior, and reinforcing alternative behaviors for promoting compliance during joint action interactions. The pragmatics interventions involved development of joint action routines involving books, mirrors, and toys and other objects within which the parents carried out explicit teaching of joint attention, play, imitation, turn taking, use of visual supports for communication, and stimulation of nonverbal gestural communication in their interactions with their children.

Training occurred via home visits from a speech pathologist every 6 weeks for a 3-hr visit, reviewed child progress, taught the parents new facilitation skills, and set goals for the next 6 weeks. Parents were to use the techniques daily in their home routines and in joint play sessions with their children for 30 to 60 min daily in set-aside activities.

Comparison children received standard community care, which the experimental group also received, including weekly speech and occupational therapy and intensive behavioral interventions. Measures included detailed language development assessments, nonverbal IQ, symptom severity, and parental stress. No information was provided about blind assessors, treatment manuals, or fidelity measures.

**Findings**—After 12 months of treatment, significantly more of the treated group developed speech (8 of 12) than the comparison group (3 of 12), and the only children who acquired phrase speech during the year were in the treated group. There was also a trend toward significance for the treated group to understand more words. The vocabulary counts reveal that the treated group both used and understood almost twice as many words as the comparison group. Unfortunately, however, the treated group had a significantly higher nonverbal IQ than controls at the start of the study (88 vs. 66), which may have contributed to their greater language gain. The treated group lost 11 IQ points on the nonverbal measure over the course of the treatment, whereas the IQ scores of controls remained stable. Thus, the evidence presented in this study provides some support for the efficacy of this intervention in fostering language development over 12 months. Given that no replications have yet been published, the approach does not yet meet criteria for a well-established or probably efficacious intervention. This approach does meet the *possibly efficacious* criterion, however, because in accordance with Chambless and Hollon (1998), there is evidence supporting the treatment's efficacy relative to a comparison control condition in one “good” study. With respect to Nathan and Gorman (2002), because there is no mention of treatment manuals, fidelity measures, or blind assessors, this study is classified as Type 2.

#### **Aldred, Green, and Adams (2004)**

**Design**—In this British study, 28 children with autism ages 2 through 5 years who met full criteria for AD on widely accepted standardized measures were randomized into treatment and control groups stratified by age and severity of autism symptoms into four cells based on two dichotomous groups: younger versus older, and lower functioning versus higher functioning. Children in both groups received standard community care, including speech and language therapy and TEACCH<sup>1</sup> interventions and social skills training in educational settings.

In addition, the experimental group received a manualized parent-delivered pragmatic language intervention that targeted five broad skill sets: (a) *focusing* the child's attention on dyadic activities, (b) *sensitivity* and responsiveness to child cues, (c) *modeling* of desired

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<sup>1</sup>TEACCH (Mesibov, Schloper, & Hearsey, 1995) is an intervention approach that builds on autism-specific characteristics involving visual-spatial skills, need for predictable routines, environmental structure, and strengths in visual as opposed to verbal communication.

communicative behaviors, (d) *consolidation* in predictable routines in play and communicative interactions, and (e) *elaboration* to expand the child's skill repertoire. Parents were trained through six group workshops, six monthly treatment sessions with parent and child, and six additional maintenance sessions with a therapist. Parents were asked to deliver 30 min per day of direct delivery in addition to incorporation into daily routines.

The assessors were blind to child treatment status. Assessment battery was administered pretreatment and 12 months posttreatment. It included standard autism diagnostic instruments, adaptive behavior interviews, language questionnaires, and parent-child video analysis analyzed for child communications and parental use of the treatment. No IQ test was reported.

**Findings**—The treated group showed several areas of significantly improved functioning when compared to controls, including reduced autism severity scores, increased expressive vocabulary (but not receptive vocabulary), and increased child communication and higher levels of parental responsivity during the parent-child interactions. There were no significant differences in adaptive behavior domains or parental stress. Language gains were particularly marked in the experimental subgroup of younger, lower functioning children. Thus, similar to Drew et al. (2002), this study demonstrated positive effects of teaching parents pragmatically based communication interventions. Although the study lacks standardized measures of developmental performance, the finding of marked increases in child spoken language in the treated group is an important outcome, given the strong predictive relationships between expressive language abilities in the preschool years and better outcomes later (Lord & Schopler, 1989; Sigman & Ruskin, 1999). Without a replication, this intervention cannot yet be considered well-established or probably efficacious. The treatment does meet the *possibly efficacious* criterion, however, because, in accordance with Chambless and Hollon (1998), there is evidence supporting the treatment's efficacy relative to a comparison control condition in one “good” study. Given that this study included randomization with well-matched comparison groups, appropriate diagnostic methods, blind assessors, and clear statistical results, this study is viewed as a Type 1 using Nathan and Gorman (2002) criteria.

### **Smith, Groen, and Wynn (2000)**

Probably the most eagerly awaited RCT study involved a replication of Lovaas's intervention approach. Lovaas (1987, 1993) and colleagues compared a group of 19 children receiving intensive intervention 40 hr per week for 2 or more years, initially through one-to-one didactic behavioral teaching in the homes, later expanded into inclusive preschools as well. This treatment group was compared to a nonrandomly assigned comparison group who received the same treatment for a greatly reduced amount of time and to a second comparison group gathered via chart review. The studies reported that 9 of 19 (47%) of those children who received the experimental treatment were functioning in the average range by ages 7 to 8 years, whereas only 1 child (2%) across both comparison groups had that kind of outcome. These reports, made available to the public through a parent's autobiographical description of the recovery of both of her children after this treatment (Maurice, 1993), offered new hope to families.

This was the first empirical article to report attainment of typical functioning for a significant number of treated children with autism, and it involved a treatment with a strong empirical base established in single-subject studies spanning more than 20 years. As with any first report of a scientific finding, but especially a finding that was so unexpected, the field looked forward to an independent replication with tighter methodology (see Gresham & MacMillan, 1998, and Rogers, 1998, for reviews).

Smith, Groen, and Wynn (2000) provided this replication, with several methodological improvements over Lovaas's original study, including random group assignment, a uniform assessment battery delivered at uniform time points, careful diagnosis of autism and

differentiation among levels of severity, and objective accounting of the number of treatment hours. Two potentially important differences existed between the original study and the replication: amount of treatment and the nature of the groups. The biggest difference involved fewer treatment hours for the experimental group and more for the comparison group. The number of hours the experimental group received in the 1st year of treatment was 25, with fewer hours over the next 2 years.

The other main difference involved treatment for the comparison group. In the replication study, comparison parents were trained to deliver the experimental treatment and delivered it 5 hr per week, as well as 5 hr per week of individual training at home, for 3 to 9 months. Finally, comparison children also received 10 to 15 hr per week of special education from their public school systems throughout the study period.

**Design**—Participants were recruited from all referrals to Lovaas's clinic at UCLA in a 3-year time span. Twenty-eight children were enrolled (23 male), with an additional 9 excluded. There was a range of socioeconomic status among the families, from impoverished to upper middle class. Mean age was 36 months, and mean IQ was 51, lower than Lovaas's original group, which had a mean ratio IQ of 63. A uniform and detailed approach to differential diagnosis resulted in a group in which half met diagnostic criteria for PDDNOS rather than AD. This is a diagnostic distinction that did not exist during the period of the original study and raises an important methodological issue, as children diagnosed with PDDNOS generally have higher IQ and language abilities than those who meet full criteria for AD, as they did in this study.

**Findings**—Measures included (a) standardized IQ and language tests, (b) adaptive behavior scales, (c) a behavior checklist completed by both parents and teachers to assess social-emotional functioning, (d) a standardized measure of academic achievement, (e) assessment of the type of school placement at follow-up, and (f) a measure of parent satisfaction. Children were assessed within 3 months of beginning treatment and were seen for follow up between 7 and 8 years of age.

The findings replicated Lovaas's (1987) original report of significant IQ gains of the treated group in relation to the comparison group. The Smith, Groen, and Wynn (2000) treated group gained a mean of 15 IQ points (from 51 to 66,  $p < .05$  on a one-tailed test [ES = 0.77]) while the comparison group mean IQ score was stable over time (51 to 50). This compares favorably to Lovaas's original treatment group gain of 22 points (from 53 to 85; McEachin et al., 1993). However, posttreatment, Smith, Groen, and Wynn's treated group still functioned in the IQ range associated with mental retardation. Two of 15 children in the treated group and 1 in the comparison group achieved the “best outcome” status. Fourteen of 15 experimental children and 11 of 13 comparison children were verbal, and the difference in language performance between the groups was not significant (Smith, Groen, & Wynn, 2001). There were no posttreatment group differences in adaptive behavior or intensity of behavior problems. Thus, the experimental treatment resulted in much less improvement in the replication than in the original study.

A final point concerns the treatment gains made by the children diagnosed with PDDNOS compared to those diagnosed with AD. When one examines the pre-test and posttest scores in the published tables by child diagnosis, questions are raised about the effect of the treatment on children with the full syndrome of autism. The treated children with the full autism syndrome showed little developmental acceleration over the course of treatment. Their posttreatment scores were essentially the same as their pretreatment scores, and they showed a 10-point loss on a standard language measure. Moreover, their posttreatment scores in IQ, language, and adaptive behavior were highly similar to the comparison group of children with the full syndrome of autism. In contrast, the experimentally treated children diagnosed with PDDNOS

demonstrated large increases in IQ and language scores from pre- to posttreatment (including a 26-point IQ gain), though the differences were not statistically significant (perhaps because of power problems).

To conclude, they have replicated the positive effects of the experimental treatment on IQ functioning reported originally by Lovaas and colleagues. However, the reports of “recovery” were not replicated. The treated group demonstrated posttreatment IQs in the range of mental retardation, with language and adaptive behavior deficits of similar severity. Furthermore, and sobering, is the lack of evidence of positive treatment effects on the subgroup of children with the full syndrome of autism, especially because, in the authors’ experience, this type of treatment is considered by many clinicians to be the treatment of choice for children with autism with greater levels of impairment. Didactic massed trial teaching is often not considered by clinicians the treatment of choice for more mildly affected children in the autism spectrum. The Smith, Groen, and Wynn (2000) study, by virtue of its excellent methodological approach, raises as many questions as it answers. The replication by Smith and colleagues can be classified as a Type 1 study using Nathan and Gorman (2002) criteria because of its rigorous design methodology and clear analytic approach.

### **Sallows and Graupner (2005)**

A second independent partial replication of Lovaas's treatment by Sallows and Graupner (2005) examined outcomes and predictors of outcomes.

**Design**—Twenty-three children with autism were randomly assigned to the clinic-directed group ( $n = 13$ ), or to the parent-directed group ( $n = 10$ ), who received the experimental treatment approach but in a less intensive format. Children averaged 33 to 34 months of age at pretreatment and started treatment at 35 to 37 months. Parents in both groups were instructed to participate in weekly team meetings and encouraged to practice the techniques with their child throughout the course of the day.

Children in the clinic-directed group received an average of 39 hr per week of one-on-one treatment during Year 1 of treatment and 37 hr during Year 2, with hours continuing to decrease as children became school-age. Children in the parent-directed group received an average of 32 hr during Year 1 of treatment and 31 during Year 2. In addition, both groups received in-home supervision, though at a less intense rate for the parent-directed group (i.e., 6 hr per month vs. 6–10 hr per week for the clinic-directed group).

The treatment included the interventions described in Lovaas's (1981, 2002) treatment manual. However, various additional intervention methods were used from applied behavior analysis, including techniques from Pivotal Response Training (a treatment approach that focuses on motivation and initiative derived from applied behavior analysis that uses naturalistic interactions rather than adult-directed mass trial procedures to develop child motivation and initiative; L. K. Koegel, Koegel, Harrower, & Carter, 1999), augmentative language intervention using a picture system, considerable daily emphasis on social play with peers, use of favorite activities, enrollment in inclusive preschool classes, and frequent social play breaks. Given these differences in the curriculum, it is unclear to what extent the approach replicated Lovaas's procedures versus delivering a unique approach made up of a variety of application of Applied Behavioral Analysis.

Measures included a standard IQ test and language test, adaptive behavior scales, the children's rate of acquisition of skills during the first several months of treatment, a behavior checklist completed by both parents and teachers to assess social–emotional functioning, a standardized measure of academic achievement, and assessment of the type of school placement and therapeutic services at follow-up. Children were assessed within 3 months of beginning



treatment and were assessed yearly for 4 years, with the final assessment occurring between 7 to 8 years of age.

**Findings**—There were no statistically significant group differences on the measures at posttest. The authors then merged data from both groups, changing the design into a noncontrolled pre–post design. Across the course of treatment, children gained a mean 25-point increase in IQ, with the post IQ in the high 70 s. Language scores showed less gain, with posttreatment scores in the 55 to 65 range. Similarly, Vineland scores at post-treatment were in the 65 to 75 range (note that for all these measures,  $M = 100$ ,  $SD = 15$ ). Thus, the participant group as a whole was functioning 1 to 2 standard deviations below average in all areas after treatment.

However, this summary does not capture the bimodal distribution of the group. After 3 to 4 years of treatment, almost half the children (11 of 23 across both groups) had IQs higher than 85 and thus were in the range of normal functioning on IQ, language measures, Vineland, and Autism Diagnostic Interview scores. At follow-up, these children were reported to be succeeding in regular education classrooms, with fluent verbal skills and socially interacting with peers on a regular basis. The IQ gains for the group as a whole were because of the gains in IQ for these 11 children.

The other 13 children, analyzed separately, showed no significant increase in IQ from pretest to posttest. Their pre- and posttreatment standard scores ranged from the 30 s to the 50 s across various tests, and their autism symptoms continued to be greatly elevated. Thus, half of the children in this study demonstrated poor outcomes, with marked delays in all areas, little developmental acceleration, and little decrease in autism symptoms, even after 4 years of 30 to 40 hr a week of intensive daily treatment. Pretreatment measures associated with poor outcomes included initial low IQ (below 44) and lack of language (no words at 36 months). Imitation, language, daily living skills, and socialization were the strongest pretreatment predictors of outcome. Rapid acquisition of new skills and change in IQ after 1 year of treatment were strongly predictive of favorable outcomes.

To summarize, this study did not demonstrate beneficial effects of the expertly delivered treatment over the parent-delivered and organized treatment, perhaps because of the roughly equivalent amount of treatment received by both groups. One contribution of this study is the inclusion of pre–post test score data for each participant, documenting the range of trajectories seen. This is the second study to report recovery in almost half of a group of children with autism receiving intensive delivery for many hours per week of Lovaas's model or adaptations of it. The pre–post approach to analyses leads to a Type 3 study classification.

## OTHER STUDIES OF LOVAAS'S METHOD

Several other nonrandomized controlled studies based on Lovaas's treatment model have been published in the past 5 years.

### Eikeseth, Smith, Jahr, and Eldevik (2002)

Eikeseth et al. (2002) reported a study of older children, ages 4 to 7 years, receiving Lovaas's treatment in a school setting rather than home.

**Design**—This study is unique in that it involved a comparison treatment that controlled for intensity of the experimental treatment. The comparison treatment was eclectic, designed by the educational staff for each individual child consisting of aspects from various approaches, including applied behavior analysis, sensory approaches, general special education approaches,

the TEAACH approach involving structured visually based teaching focused on independent work (Mesibov, Schopler, & Hearsy, 1994), and other treatments.

Children in the Lovaas treatment group needed to have a parent attend their behavioral therapy with them at least 4 hr per week for 3 months for the parent to become trained. There was no such training for the comparison group parents. Treatment teams for both groups included a special education teacher and a classroom aide. The Lovaas treatment teams received 10 hr per week of supervision by experts in the method and a weekly 2-hr team meeting including child, parent, and team members to review and change the treatment and train staff. The comparison group's staff members received no ongoing supervision but did receive a weekly 2-hr consultation from the same behavioral supervisors. Thus, both parents and staff in the Lovaas group received considerably more training and supervision than the eclectic group. Children in both groups received equivalent amounts of one-on-one instruction in the prescribed treatment for almost 30 hr per week, and when they were not in one-on-one teaching, both groups were in a classroom for typically developing children with an individual therapist who supported them.

All children with autism referred to a Norwegian public habilitation team in a 3-year time span were evaluated on the three inclusion criteria: age between 4 and 7 years, a *DSM-IV* diagnosis of AD, and no other medical condition. Exclusion criteria involved IQ below 50. Thirteen were assigned to Lovaas's treatment group and 12 were assigned to the comparison treatment, based on therapist availability for the Lovaas treatment group. Posttreatment measures were carried out 1 year after treatment began, by qualified psychologists who were blind to treatment status. Measures included a standard IQ test, a standardized language test, measure of visual-spatial abilities, and a measure of adaptive behavior.

**Findings**—Posttest group comparisons showed no significant differences between groups, which may have partly been because the comparison group had much higher scores on both IQ and language measures pre-treatment, even though the difference did not reach statistical significance. However, the amount of change that occurred in the Lovaas group was much larger than comparisons, increasing their scores on every measure, and gaining statistically significantly more points than the comparison group on all measures. For example, the experimental group increased by a mean of 17 IQ points, the comparison group by 4 points ( $p < .01$ ,  $ES = 1.38$ ), with similar differential gain in language for the Lovaas group. The posttreatment IQ scores of the majority of children in the Lovaas treatment fell above 85 and the IQ of the group as a whole was no longer in the range of mental retardation ( $M IQ = 79$ ), although the mean language scores still fell in the impaired range (58–67). Given the IQ advantage of the comparison group at pretest, use of change scores appears well justified in these analyses.

A second study from these researchers, retrospective in design, reported on 26 children with autism with half receiving each of these same two treatments but delivered at much lesser intensity, an average of 12 hr of one-on-one teaching per week. Findings revealed a similar pattern of significantly greater gains for children receiving Lovaas's model than eclectic treatment (Eldevik, Eikeseth, Jahr, & Smith, 2006).

The study makes several novel contributions to the literature on Lovaas's approach. First, it demonstrates positive intervention effects with older children (4- to 7-year-olds). Second, it demonstrates significant effects after 1 year of treatment, a shorter period than other studies of this method. Third, the delivery was carried out in school settings, rather than in homes, as in the other studies. Fourth, significant gains were accomplished through many fewer hours of treatment than 40 hr per week. Finally, children receiving Lovaas's treatment with accompanying intensive parent and team training showed much more gain than children

receiving an intervention delivered at equivalent intensity, both in terms of ratios and hours. The rigor of the diagnostic procedures and requirement that all children had full-blown AD are additional strengths.

Finally, the article raises important cautions about eclectic treatment approaches. Although many clinicians assume that individualizing a child's intervention and assembling intervention techniques from various methods allow for better individualization and intervention than using a single published, manualized treatment, the findings from this study raise concerns about an eclectic delivery, a point to which we return next. Although this study included well-defined inclusion/exclusion criteria, blind assessors, treatment fidelity measures, and a manualized treatment, it meets criteria for a Type 2 study along Nathan and Gorman (2002) criteria because of lack of randomization.

**Effectiveness studies**—The final studies concerning Lovaas's treatment model evaluated the delivery of Lovaas's treatment model in communities rather than research programs—effectiveness studies. Does the treatment work when carried out by typical community representatives, as opposed to tight experimental conditions? Three of these have a control condition, one of which, by Sheinkopf and Siegel (1998), was reviewed in depth in Rogers (1998). Briefly, this was a retrospective study of 11 children who had received Lovaas's treatment as delivered by community professionals, matched to comparison participants by age, IQ, and length of time between assessments. The only assessment data reported involved nonverbal IQ measures, with the Lovaas treated group showing significantly greater gains than controls. The number of autism symptoms appeared unaffected by the treatment. Given the retrospective design and lack of fidelity measures, this study is considered Type 3.

A second effectiveness study (Smith, Buch, & Gamby, 2000) achieved control by conducting a multiple baseline design using 6 U.S. children who were consecutively referred to a public service agency for autism treatment. Inclusion criteria involved an existing diagnosis of AD or PDDNOS, residence in the agency catchment area, and age younger than 4 years. One child dropped out before the treatment began. Naive staff persons were hired as therapists and received six 1-day training workshops conducted over a 3-month period by an expert therapist from Lovaas's group, followed by a monthly 2-hr supervision session. Children received follow-up assessments of IQ, language, and adaptive behavior by a blind rater 2 to 3 years after community professionals initiated treatment. Measures of parent stress and parent satisfaction were also gathered. Treatment hours and treatment fidelity were assessed via parent logs of hours and videotaping of therapists and comparison with lab-based therapists.

Five of the 6 children showed early rapid gains in learning individual tasks. However, on standardized assessment 2 or more years later, only 2 of the 6 children showed accelerations in developmental rates, with final scores mostly in the borderline or normal range. Three children made little gain in any test scores over time, and 1 child's scores decreased markedly in all areas. This study is considered a Type 2 study given the multiple baseline single-subject design.

A third effectiveness study was published by Luiselli, Cannon, Ellis, and Sisson (2000), who used a pre-post design to examine progress of 16 children receiving 6 to 20 hr per week of treatment over 5 to 22 months from a private community program. The outcome instrument was a criterion-based developmental scale, and the main analyses examined variables that contributed to the amount of developmental change seen in the children over the course of treatment. Number of months of treatment, rather than total hours, contributed significantly to child progress. A variety of methodological problems—the study lacked a control group, lacked data on additional treatments, lacked fidelity measures, did not provide control for gains

expected by development alone, and did not report using independent raters—prevent interpretation of the gains reported.

A fourth effectiveness study was recently published by Cohen, Amerine-Dickens, and Smith (2006). This study closely followed Lovaas's curriculum; staff were trained by and maintained fidelity with Lovaas's group at UCLA. Twenty-one children, younger than 48 months of age, entered in to the Lovaas replication and received 35 to 40 hr of teaching for 3 years. All but 1 had a diagnosis of AD; this child was diagnosed with PDDNOS. A comparison group was assembled from other children in this catchment area who met inclusion criteria for the program but whose parents chose another intervention for the child. The groups did not differ on IQ, language, or adaptive behavior skills at entry, though parents of the comparison group had less education and there were more single parent families.

Children in the Lovaas replication site demonstrated statistically significantly higher IQs, receptive language (but not expressive), and adaptive behavior scores than the comparison group. Twelve of the 21 children in the Lovaas program (53%) had IQ scores in the normal range after treatment, compared to 7 in the comparison group (33%), a difference that did not reach statistical significance but nevertheless replicates the IQ outcomes from the original Lovaas study. Both groups improved functioning over time, but the Lovaas group made greater gains in all areas. Significantly more of the children in the Lovaas intervention attended typical schools after the intervention had ended (17 of 21 children in the Lovaas group compared to 1 of 21 comparison children). However, placement in typical settings was a specific focus in the Lovaas replication, and these posttreatment placements probably result from many factors in addition to child competence.

This community-based effectiveness study has methodological weaknesses in the lack of a randomized control group, lack of group equivalence in several family measures, and lack of information concerning the amount, type, and quality of intervention comparison children received. However, the outcomes of the children in the Lovaas group are quite similar to outcomes in other Lovaas studies, adding to the strength of the Lovaas model. This study is considered a Type 2 using Nathan and Gorman (2002) criteria.

Finally, two effectiveness studies examined the progress of children receiving Lovaas's model delivered in the community by people without established expertise in the model. The treatment teams learned the intervention either through the manuals or through a weekend workshop by a consultant. Bibby, Eikeseth, Martin, Mudford, and Reeves (2001) reported a study of 66 British children who entered treatment and whose progress was followed and outcomes measured. However, failure to include baseline data, a control group, or independent raters, in addition to other limitations (including multiple intervention methods without the use of fidelity measures), make it difficult to interpret the results from this Type 3 study using Nathan and Gorman (2002) criteria.

In a similar study, Takeuchi, Kubota, and Yamamoto (2002) reported on eight Malaysian children whose treatment was delivered by teams trained from the Lovaas manuals. Given the lack of measurement of outcomes, this study is similar to a case report and is classified as a Nathan and Gorman (2002) Type 6 study. The findings from both studies demonstrate that although this type of delivery results in children receiving many treatment hours, there is less developmental gain than reported from more rigorous treatment delivery.

To summarize findings from studies of Lovaas's treatment approach, two important points stand out. First, Sallows and Graupner's (2005) and Cohen et al.'s (2006) findings of “recovery” or best outcome status in approximately half of their groups of treated children support the original finding that “recovery,” defined as IQs in the normal range and educational placement in typical age-level classrooms without supports, may be possible for a significant subgroup

of children with autism, treated early enough and intensively enough. There may well be more plasticity in autism than the field has suspected.

Aside from the recovery question, Lovaas's treatment, delivered to young children with autism spectrum disorders at a high level of intensity and overseen by experts in the method with rigorous levels of training and supervision, results in group increases in standardized test scores. However, these gains may occur in children who nevertheless continue to show substantial levels of impaired intellectual, language, social, and adaptive functioning, as well as those who end up with near-normal scores. However, the treatment may result in no significant change in symptoms or test scores in as many as 50% of the children who receive it, according to the published outcome data across several groups.

The only comparative study (Eikeseth et al., 2002) to examine effects of Lovaas's treatment compared to another approach—an eclectic treatment package delivered with comparable intensity—demonstrated statistically significant differences in change scores in favor of Lovaas's treatment. Given the strength of the findings from the four best-designed, controlled studies—Lovaas (1987); Smith, Lovaas, and Lovaas (2002); Eikeseth et al. (2002); and Cohen et al. (2006) (Eikeseth's and Cohen's studies also involved comparison with alternative treatments)—this treatment meets both Chambless et al. (1998) and Chambless et al. (1996) criteria as a “well-established” psychosocial intervention for improving the intellectual performance of young children with autism spectrum disorders, based on the significant increase in IQ reported in these four studies compared to control groups. Although some of these four studies also report significant improvements in behavior, adaptive skills, and language skills, there is less consistency in the data in these areas. Important questions that remain concern (a) whether Lovaas's approach itself, independent of intensity, is inherently more effective than other organized and comprehensive treatment approaches; (b) if so, for which children with autism is it efficacious? and (c) for what areas of functioning is it more efficacious than other approaches of similar intensity? Certainly, no other name-brand treatment has yet been subjected to the rigorous examination that Lovaas's treatment has.

## CONTROLLED STUDIES OF OTHER APPROACHES

### Salt et al. (2002)

Few articles involving comprehensive treatment approaches other than Lovaas's have been published in the past 5 years. Salt et al. (2002) reported a Scottish study involving a 10-month developmental treatment for a small group of British children with autism ( $N = 12$ ). The children received 8 hr per week of a special developmentally based intervention in addition to their nursery school and other treatments (which occurred at a mean of about 15 hr per week for the experimental group and 20 hr per week for the control group).

**Design**—The intervention focused on areas known to be specifically affected in early autism: imitation, joint attention, language, social reciprocity, and play, delivered in a naturalistic, child-centered manner. Parents and children attended a small group program for eight 2-hr sessions per month for parent training, and parents delivered additional hours at home. The experimental children were compared to 5 waitlist children who received all the same interventions except the experimental treatment, at an average of 20 hr per week.

Children were assigned to groups based on availability of the therapists rather than by random assignment. The experimental children were somewhat older than comparisons, and with lower mental ages, yielding a significant IQ difference between the groups. A range of incomes was represented in both groups. There was 1 girl in the experimental condition and 2 in the waitlist comparison group. Assessments were carried out blindly and included a range of developmental, adaptive, play, and language tests.

**Findings**—In comparing pre- to posttreatment scores, the treated group performed significantly better than the comparison group over time on repeated measures multivariate analyses of variance for three measures: all of the Vineland scales except communication; the imitation measure; and two of the social–communicative variables, joint attention and social interaction. Calculating the ESs from data presented in the study for the imitation and joint attention measures yield ES greater than 1.0. However, there was no IQ change data reported by the authors, no significant difference in language performance between the groups, and no indication of acceleration in developmental rates on the Vineland. Rather, the experimental group tended to maintain their initial scores, whereas the comparison group's scores dropped in some areas. Many of the group differences involved frequency counts of skills like joint attention episodes and imitation tasks. However, the ESs are large in two areas, and the authors found treatment related changes in targeted areas known to be specifically affected by early autism. Thus, this is an important initial finding and one of the few controlled studies of a developmental treatment approach. Because of a lack of both randomization and fidelity measures, the study is classified as Type 3 using Nathan and Gorman (2002) criteria.

### Howard, Sparkman, Cohen, Green, and Stanislaw (2005)

Howard et al. (2005) conducted a 14-month study to address both the use of mixed methods from applied behavior analysis as well as eclectic treatment: the delivery of various treatment approaches based on the judgment of the interventionists rather than a priori, uniform treatment delivered to each and every child.

**Design**—The first group of 29 preschoolers received intensive one-on-one behavioral teaching for 25 to 40 hr per week, supervised by experts, which used a mixture of didactic and naturalistic behavioral teaching approaches. The parents were trained in behavior analysis, data collection, and delivery of child treatment in natural environments. The second group of 16 children received public school–based special autism classes for 30 hr a week, with teacher-to-student ratios of 1:1 and 1:2 and an autism-specific but eclectic curriculum, with additional 1:1 speech/language therapy for some. The third group of 16 preschoolers attended generic early intervention public school preschools with a 1:6 teacher-to-student ratio for 15 hr per week, where instruction was mainly small group and the curriculum was developmental. Most of these children also received individual speech language therapy.

Children were enrolled in one of the three groups based on the decision of parents and the educational teams for each child. Thus, it is likely that many variables—parent, child, and other—contributed to initial placement. Children were assessed at pre- and posttreatment by independent assessors, not necessarily blind to treatment status, carrying out routine yearly assessments of all preschoolers with autism in the district. A variety of test instruments were used, but the majority of children received the same IQ and language batteries.

At pretreatment, the groups did not differ on variables involving number of autism symptoms, cognitive, or language maturity. Pretreatment group differences included the following: Children receiving the experimental treatment were younger at diagnosis, a greater percentage was Caucasian (72% vs. 14% Hispanic and 14% other), a greater percentage was diagnosed with AD as opposed to PDDNOS, and their parents were better educated (14 M years of education) than parents in the other groups.

**Findings**—Several important findings from this study involved the two comparison groups. First, neither group demonstrated developmental acceleration reflected in increasing test scores over time. Second, the two groups showed comparable performance after 14 months of public school treatment, even though one group was getting twice as many hours of focused autism intervention as the other, and with much better teacher–student ratios. Third, the children in

the 15-hr-per-week generic developmental preschool program actually declined in standard scores on multiple measures over the course of intervention, reflecting a slowing of developmental rate. Based on this finding, one possible outcome is that those children might continue to lose ground compared to their typically developing peers the longer they receive such eclectic treatment. These findings underscore the concerns raised earlier about eclectic delivery. Furthermore, the findings underscore the point that many hours of teaching do not assure best possible progress.

The group receiving the specialized intensive behavioral intervention received much more intervention than the other groups, of higher quality given the level of supervision and training, and begun sooner. This group made significantly greater gains than the comparison groups over the 14 months of the study, in all areas except motor skills. Similar to Lovaas's original sample, the mean posttreatment standard scores for this group were in the normal range for cognitive abilities, with a mean 30-point IQ gain. Language quotients showed a mean 20-point gain, though still in the impaired range.

Data from individual subjects demonstrate dramatic gains in a significant proportion of experimentally treated children. Furthermore, it raises important questions about the effectiveness of eclectic community school programs and underlines the importance of the quality, in addition to quantity, of treatments being delivered to young children with autism. Because of a lack of both randomization and blind raters, this study is classified as Type 2 using Nathan and Gorman (2002) criteria.

## MEDIATORS AND MODERATORS OF TREATMENT OUTCOMES

What characteristics of young children with autism appear to influence their response to treatments? Wolery and Garfinkle (2002) documented that fewer than 20% of autism early intervention articles in their review article mentioned any moderating variables, and none of them actually conducted analyses to determine whether measures of mediating factors could account for individual variability in outcomes. Very few discuss factors involving risks and opportunities that are known to influence outcomes in other disorders (Wolery & Garfinkle, 2002).

### Pretreatment IQ

Several intervention articles in the past have identified pretreatment IQ as a predictor of treatment outcomes (see Rogers, 1998, for a review of these). Articles by Harris and Handleman (2000) and Ben-Itzhak and Zachor (2006) have replicated the predictive power of initial IQ in terms of better outcomes. A second predictor of better outcomes may involve age at entry. Harris and Handleman found that children who began treatment before 4 years of age had much better outcomes in terms of school placements and IQ scores than those who began at 50 months or older. In terms of school placement in regular or special education class, the older and younger groups were almost nonoverlapping, with 10 of the 11 children whose treatment began before 4 years of age in regular classes (most with supports) and 15 of the 16 who began treatment at or after 48 months of age in special education classes. Furthermore, there was no relation between age and IQ at entry. The age variable is one that is discussed frequently in autism early intervention and needs to be examined in a controlled fashion.

### Amount of Treatment

Another variable that has been examined as a moderator in some studies is amount of treatment. In a retrospective sample, Sheinkopf and Siegel (1998) demonstrated similar amounts of gain in children who received either a lesser or a greater number of hours of Lovaas's type of therapy. In a similar study, Luiselli et al. (2000) examined the roles of age, number of hours per week,

number of months of treatment, and total hours of treatment in a study of treatment outcomes for eight 2-year-olds and eight 3-year-olds who were receiving Lovaas's type of therapy in the home, anywhere from 6 to 20 hr per week, delivered by a specialized clinical program at the May Institute. Of those four variables, only the number of months of treatment was significantly related to amount of gain in language, cognitive, and social-emotional functioning across the treatment period.

Studies that examine relations between hours spent receiving therapy and treatment outcomes appear to assume that the child is only learning during therapy. However, children with autism have many additional learning opportunities outside of a specific treatment program. Researchers who examine relations between hours of a specific treatment and treatment outcomes should carefully consider the learning opportunities available outside of formalized treatment as well as those in a specific treatment to model the true relation between number of learning experiences and child gains.

### Family Characteristics

Although parents are often the deliverers of their children's interventions, the influence of family characteristics as a moderator for treatment outcomes have only begun to be addressed. Moes and Frea (2002) used a multiple baseline design to examine the effects of contextualizing a behavioral treatment plan involving functional communication training delivered by parents at home for three children. Fitting the interventions into each family's ecology appeared beneficial in this pilot effort and provides a first effort to integrate individual differences among families into parent-delivered interventions. Further, the incorporation of a contextualized functional treatment package, as well as systematic behavioral assessments and maintenance and generalization data, are additional strengths of this Nathan and Gorman (2002) Type 2 study.

### Biological Variables

Stoelb et al. (2004) examined the relations between specific biological variables and treatment outcomes in 19 preschool children with autism receiving intensive behavior interventions from one large university clinic. Inclusion criteria included a diagnosis of AD, completion of a full medical evaluation in a university specialty clinic, and participation in the treatment for at least 1 year. Fourteen boys and 5 girls were included from families with a wide range of economic resources and wide variation in their involvement in their child's treatment program. Interventions were carried out in the homes using a trained team, weekly phone monitoring, and supervisory workshops every 2 months.

The relations between pre- to postchange scores and 15 characteristics were examined, including dysmorphology (unusual physical features), MRI results, head circumference, history of seizures or regression, sleep problems, intensity of intervention, initial skill level, parental involvement, dietary supplements, and age of intervention onset and others. Using regression analyses, only dysmorphology significantly predicted treatment change, accounting for 58% in the variance in change scores over 6 months and 67% over the treatment year. This single variable also predicted with 90% accuracy which nonverbal children would develop language in the following year. There were also some indications that younger age at start of treatment predicted greater gains, whereas history of regression predicted poorer gains.

### Experimental Studies of Treatment Mediators

**Social variables**—L. K. Koegel, R. L. Koegel, Shoshan, and McNerney (1999) described their hypothesis that low frequency of social initiations may be a mediator of outcomes given the limitations it causes on children's social and language learning experiences. The authors describe a retrospective examination of outcome data on 3 patients with excellent treatment



outcomes and 3 with particularly poor outcomes from their particular treatment, Pivotal Response Training (PRT; L. K. Koegel, Koegel, Shoshan, and McNERNEY, 1999). At pre-treatment, these 6 children did not differ from each other in language or adaptive behavior abilities, but a number of social initiations distinguished these two groups.

L. K. Koegel, R. L. Koegel, Shoshan, and McNERNEY (1999) then developed interventions using PRT, delivered 2 hr per week in clinic and daily by parents at home, to teach subjects to initiate interactions. Interventions included asking questions (what, where, whose, what's happening) as well as other initiations designed to elicit attention (look at me), request help, and invite peers to play. They describe anecdotal outcomes from several treated children with initial low rates of social initiation and very good outcomes at 8 to 10 years of age. These children had high rates of social initiations, normal pragmatics of communication, adaptive behavior in age-appropriate range, regular education classes with average or above-average grades, friendships and peer activities outside of school, and a range of extracurricular activities. No child had a diagnosis or was receiving services for a disability and thus had outcomes comparable to those described as "recovered" in Lovaas's (1987, 1993) studies.

**Social avoidance**—Ingersoll, Schreibman, and Stahmer (2001) raised the question of the role of response to peers as a mediator of treatment effects. Six 2- and 3-year-olds with autism with little social avoidance of peers were matched on developmental, language, and autism severity variables to 3 children with autism with much social avoidance of peers. The children participated in a 3-hr-per-day inclusive group program for toddlers with autism. Outcomes measured 6 months later demonstrated that those children with low social avoidance made more gains than those with high social avoidance.

## PREDICTING TREATMENT SPECIFIC PROFILES OF RESPONDERS AND NONRESPONDERS

Treatments for young children with autism vary widely in interactive style and curriculum. Given the variability in autism, there are likely to be interactions between child and treatment characteristics. Sherer and Schreibman (2005) provided a method for examining such effects. They first evaluated differences between the three best and three worst responders to PRT from their own pretreatment behavioral assessment data, identifying three initial behaviors that predicted better outcomes: more toy play, less social avoidance, and more stereotypic language than worst outcome children. They then used these profiles to predict treatment responsiveness to PRT in a new cohort of children. As hypothesized, those children who fit the best responder profile pretreatment made gains, whereas three who fit the worst responder profile made no gains and were referred to a different treatment (where some made excellent gains, demonstrating that this was indeed a responder profile for only this specific type of treatment; Schreibman, Stahmer, & Cestone, 2001).

All of the studies just cited have been carried out using PRT, an approach that uses both a developmental framework and applied behavior analysis procedures to increase a child's motivation to participate in learning skills (R. L. Koegel, O'Dell, & R. L. Koegel, 1987; Laski, Charlop, & Schreibman, 1988; Schreibman & Koegel, 1996). PRT involves specific strategies such as (a) clear instructions presented only when the child is attending, (b) previously mastered tasks interspersed frequently with more difficult tasks, (c) child selected activities, (d) naturally occurring consequences, (e) reinforcement of attempts, and (f) turn taking (Dunlap, 1984; L. K. Koegel, Carter, & Koegel, 2003; R. L. Koegel & Egel, 1979; R. L. Koegel, O'Dell, & Dunlap, 1988; R. L. Koegel, O'Dell, & Koegel, 1987; R. L. Koegel & Williams, 1980).

PRT teaching methods have been tested with pre-schoolers in several different studies using single-subject designs. They have been shown to improve several core social communication

deficits in autism involving expressive communication, self-initiations (question asking, commenting), play skills, and joint attention behaviors (L. K. Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998; L. K. Koegel et al., 2003; Koegel, L. K., Koegel, R. L., Shoshan & McNernen, 1999; Stahmer, 1995; Thorp, Stahmer, & Schreibman, 1995; Vismara & Lyons, in press; Whalen & Schreibman, 2003). Because these studies have not used standardized measures, long-term designs, comparison groups, or alternative treatment designs to evaluate treatment outcomes, they cannot be classified on the Chambless et al. (1996) criteria and were not reviewed in the earlier part of the article. Yet the use of multiple baseline designs and careful quasi-experimental methods support the short-term efficacy of this approach.

To conclude this section, studies of mediators and moderators of treatment effects represent a great need in early intervention research in autism. The current intervention research focus on main effects models provides little information about who does well in which treatments and why. The next questions to be answered involve interactions between child and treatment characteristics. Which child characteristics, interacting with which treatment characteristics, lead to better outcomes on which dimensions? This kind of work will require large samples, multidimensional measurement of children's behavioral repertoires, and deconstruction and comparison of treatment models to determine what aspects of those models are responsible for the outcome effects.

## PSYCHOPHARMACOLOGICAL TREATMENTS FOR AUTISM

Although the focus of this article has been on psychosocial treatments, it is important to recognize studies examining psychopharmacological treatments. There is an extensive literature regarding psychopharmacological treatment of autism (e.g., Bryson, Rogers, & Fombonne, 2003; des Portes, Hagerman, & Hendren, 2003), and the reader is referred to one or more of these reviews. Two cautions are in order as we proceed. First, very few of these studies target preschoolers with autism, and it is unclear to what extent results from older children will generalize to preschoolers with autism. Second, there can be marked placebo effects on patients with autism, as demonstrated in the secretin studies (Unis et al., 2002). For that reason, we summarize controlled medication trials.

Briefly, the pharmacotherapy of autism involves treatment of targeted psychiatric symptoms rather than core autism features. Targets generally include hyperactivity, inattention, repetitive thoughts and behavior, self-injurious behavior, as well as aggression toward others or the environment (des Portes et al., 2003).

Increased levels of whole blood serotonin (5-HT) are found in about 30% of patients with autism (Anderson et al., 1987), and this has led to drug studies that target serotonin. Fenfluramine, an indirect 5-HT agonist, was initially tested with much enthusiasm but was later withdrawn from the U.S. market because of a lack of consistent efficacy, pulmonary hypertension, and valvular heart disease (see McDougle & Posey, 2002, for review). Serotonin selective reuptake inhibitors (SSRIs) have been found to be effective in treating anxiety and obsessive-compulsive behavior in other disorders and have been studied in autism as well. Results from open-label studies have yielded mixed results, and trials conducted in adolescents and adults with autism have generally resulted in more positive findings than those in children. The results from many of these studies suggest that SSRIs may be less well tolerated and effective in younger children with autism compared to adolescents and adults with autism, and thus pubertal differences among individuals with autism may affect SSRI tolerability and responsivity.

Stimulant medications for hyperactivity have generally not been recommended because of increases in irritability and stereotypic movements (des Portes et al., 2003). However, recently there have been several studies demonstrating improvements in children with autism who

exhibit significant attention-deficit/hyperactivity disorder (ADHD) symptoms, including substantial reductions in hyperactivity and inattention, with fewer side effects compared to other medication (i.e., neuroleptics; Handen, Johnson, & Lubetsky, 2000; Quintana et al., 1995). Although this evidence suggests that children with autism who have ADHD symptoms might benefit from this class of medications, researchers note that the response rate for this subgroup of children (50%–60%) is generally lower than the response rate reported in nonautistic, typically developing children with ADHD (80%–90%; Aman & Langworthy, 2000).

Antipsychotics have traditionally been shown to improve symptoms related to aggression, social withdrawal, hyperactivity, stereotypies, self-injurious behavior, and sleep disturbances. Although typical neuroleptics, such as pimozide and haloperidol, have been reported to be more effective in treating behavioral problems, the increased risk of tardive or withdrawal dyskinesia in a substantial proportion of children with autism continues to be a major concern (Campbell et al., 1997). Alternatively, increasing evidence has been generated by the use of atypical antipsychotics to treat children with autism. These medications appear to be better tolerated and have less risk of extrapyramidal effects compared with typical neuroleptics (Biederman, Spencer, & Wilens, 2004).

Currently, risperidone is the most investigated atypical agent in the treatment of autism. Although a number of open-label reports with risperidone describe improvement in a number of areas, there has been only one published controlled study to date demonstrating improvements in repetitive behavior and aggression toward self, others, and property (McDougle et al., 1998). The Research Units of Pediatric Psychopharmacology Autism Network (2002) completed an 8-week, randomized, double-blind trial of risperidone compared with placebo in 101 children and adolescents with autism ages 5 to 17 years. Risperidone was reported to improve self-injury, aggression, and agitation in 70% of the children and adolescents compared to the placebo response rate of 11.5%. More adverse effects, including increased appetite with associated weight gain, transient sedation, tremor, and drooling, were more common with risperidone than placebo. Although this initial evidence supports the use of risperidone in treating tantrums, aggression, and self-injurious behavior in children and adolescents with autism, additional research using a longer term treatment phase is needed.

## IMPLICATIONS AND EVALUATIVE CONCLUSIONS

As we close, we highlight five points. One concerns the very small number of Nathan and Gorman (2002) Type 1 studies for young children with autism from which to draw conclusions. There is a low number of RCT studies, and these use small samples and examine different treatments with radically different delivery approaches and intensities, delivered over different time spans (12 weeks to 2 years), using different measurement approaches. One can generalize from these RCT studies that young children with autism, as a group, demonstrate accelerated developmental gains in response to focused daily interventions of several different kinds. Significant increases in language and communication abilities in the treated group occurred in most studies and interventions with many targeted hours per week resulted in increases in IQ at the group level as well. Reduction in severity of autism symptoms has also been reported.

Lack of comparative studies prevents us from answering questions concerning which comprehensive treatment approach is best for young children with autism, a question that requires a comparative RCT design with long-term follow-up data to answer. Given the many different characteristics seen in individual children and in various intervention approaches, the better question is, “Which teaching approaches appear most effective for teaching specific skills given certain profiles of child and contextual characteristics?”

Across all the studies we cited, improvements in language, communication, and IQ, and reduction in severity of autism symptoms indicate that the core symptoms of autism appear malleable in early childhood. Descriptions of recovery from several different treatment studies support the idea that some children who had autism early in life no longer demonstrate disability by school age or later. The proportion of treated children who may be capable of such outcomes is still unknown, and this is another area in which RCT designs are needed.

However, we must be cautious about overemphasizing the RCT design. Although the RCT design is the best methodology to answer *some* questions, it is inappropriate for answering others. The RCT design has important limitations in early intervention studies of autism. In initial development of a new intervention, or in field trial work regarding effectiveness studies, the rigidity of an RCT design may interfere with the flexibility needed both in initial tests and in applications in the field, especially when considering the variation of features and behaviors within the autism spectrum (Schopler, 2005). Further challenges in community-based trials may be encountered with respect to maintaining adherence to the rigid methodology of RCT design (e.g., controlling participant variables, randomized group assignments to treatment vs. control groups, single treatment approaches) while remaining ethically and legally aware of pertinent social, educational, and federally mandated policies.

A new intervention needs to be developed and tried with a few children and a few different treatment givers. Initial piloting of new intervention approaches may involve single-subject designs using a small number of participant and detailed qualitative analyses via case reports or pre–post designs to generate evidence of initial promise (Lord et al., 2005). Such designs may not allow one to demonstrate a causal relationship between change and treatment, but they may provide some indication that an intervention appears useful and needs to be evaluated more rigorously, similar to the use of open-label trials of a new medication. Single-subject designs can test the causal relation between independent and dependent variables with small numbers of participant and short time periods. These designs are extremely helpful when evaluating efficacy of interventions that target only one or two behaviors. (See Smith et al. (2006) for an excellent description of the stages of developing a new treatment and useful designs for evaluating each stage.)

An RCT design is a late-stage design, perhaps best used in autism for answering questions about the *comparative* effects of well-established complex interventions, those that require longer time periods to have effects. However, comparative studies are badly needed in autism intervention that are large and well powered enough to answer such questions. These are expensive studies to conduct and will require greater treatment research funding than has typically been awarded to autism studies.

Regardless of the design used, independent cross-site replications and longer term follow-up to examine maintenance and generalization are critical for documenting efficacy of an intervention. As in all areas of science, it is crucial that experimenters carefully match the study design with the question being asked.

The second point involves treatment efficacy. We have already identified Lovaas's intervention approach as one that meets the Chambless et al. (1996) criteria for probably efficacious. Are there others? The work of Laura Schreibman, Lynn Koegel, and Robert Koegel using PRT to teach a variety of communication, language, play, and imitation skills deserves consideration. There is no specified curriculum for PRT, which involves a set of teaching practices rather than specific teaching content. However, there have been multiple publications of single-subject design studies demonstrating the efficacy of the PRT approach to teach these skills. Single-subject designs are classified as Type 2 studies according to the Nathan and Gorman (2002) system. However, the number of published single-subject studies on PRT coming from

different authors and different sites and including several that compare PRT to another treatment indicate that PRT also meets the Chambless et al. (1996) criteria as a probably efficacious intervention (R. L. Koegel, Dyer, & Bell, 1987; R. L. Koegel et al., 1988; R. L. Koegel, O'Dell, & Koegel, 1987; Schreibman, Kaneko, & Koegel, 1991; see Delprato, 2001, for a review of 10 comparative studies using a PRT type approach compared to a didactic approach).

Lack of strong designs and independent replications, or lack of any peer-reviewed published data at all, prevents other well-known autism treatments for meeting criteria as either well-established or probably efficacious treatments. There is currently a great need in autism intervention research for initial testing and replication of existing models. Other well-known interventions may be as or more efficacious as Lovaas's model or PRT, but they have not been rigorously evaluated.

Autism interventions are “branded” at this point in time. It can be quite helpful to the intervention field when a brand-name intervention provides empirically derived efficacy data for its approach and a well-written treatment manual for the public that specifies both the content to be taught (the curriculum) and the teaching procedures to be used. This provides an efficient “package” for early interventionists to implement compared to the laborious and time-consuming practice of assembling teaching plans derived from empirically supported practices for each of the Individual Educational Plans (IEPs) objectives a child might have.

There are several downsides to this branding of interventions, however. First, evaluating a comprehensive autism treatment as a whole package does not allow one to determine which of the many elements in a certain model are the ones responsible for change. Second, the branding immediately results in difficulties accessing the treatment, for treatment givers and for consumers. The press for well-publicized branded treatments can become an economic nightmare for families and schools, and the high demand for a treatment may result in increasing numbers of providers providing poor delivery of the brand-name program, compromising its possible benefits. Third, the packaging and publicizing of autism treatments may make it more difficult for parents and others to appreciate effective generic teaching practices. The desire for an effective treatment may become synonymous with a particular brand of treatment, and the brand-name issue may obscure the strengths of a very well-designed generic intervention plan for an individual child built on empirically sound practices and solid data. It would be helpful to the field for treatment givers to point out commonalities between the brand-name interventions and others, and to document empirically the specific generic efficacious practices underlying the effects in the brand-name program.

The third point involves how much improvement can be expected from the best of these interventions. It is clear that the developmental delays associated with autism can be reduced for some children in some areas by specific intervention approaches. The studies with the best outcomes demonstrate that as many as half of children show marked accelerations in developmental rate and perform within normal limits. Can early intervention produce recovery in autism? Recovery, defined by test scores in the normal range, regular successful school placement and performance, and lack of disability, occurs occasionally, both in intensively treated children and in comparison children. There is no evidence thus far from a Type 1 study that a treatment leads to recovery, but two Type 2 or Type 3 studies report recovery in a significant proportion of the treated sample (Howard et al., 2005; McEachin et al., 1993; Sallows & Graupner, 2005). There appears to be the promise of “recovery” in autism, but we do not know how often recovery occurs. Until we have multisite studies with sufficient numbers to examine mediators and moderators of intervention effects, will we know the predictors of “recovery”?

The fourth point involves the lack of cultural considerations in autism intervention. Treatment programs have thus far been developed and evaluated primarily with children from European American backgrounds (Forehand & Kotchick, 1996). Cultural issues may well moderate the effects of autism intervention programs. Variables including language barriers; different views on the etiology of autism; cultural differences in expectations regarding child independence, parental authority, and extended parental care; and stigma and shame associated with mental impairments that may interfere with the use of social, educational, and mental health services. Other barriers to service might relate to a family's socioeconomic status, such as not having access to a car to attain clinical services, or to cultural dissonance between the family and service provider. Because the majority of interventions summarized in this article did not include ethnically diverse participant groups, generalization of effects across groups is premature. Efforts to augment resources for culturally diverse populations must include systematic recruitment and comprehensive education and training programs designed to promote cultural competence among researchers and early service providers for young children with autism. Cultural and socioeconomic variables must be considered in intervention delivery to culturally diverse families (Santarelli, Koegel, Casas, & Koegel, 2001).

To conclude this section, the kind of treatment research needed in autism may be unique, given the enormous scale of interventions needed. Treatment research in other areas of clinical child and adolescent psychology focuses on specific symptoms such as non-compliance, or disorders with a more limited set of symptoms than autism. Autism treatment needs to address every developmental area, all areas of adaptive behavior, and then a whole set of aberrant behavioral responses, involving both positive and negative symptoms. Even treatment for schizophrenia, or alcoholism, while needing to address multiple aspects of behavior, does not face the need to target every aspect of a person's life virtually from infancy on. Interventions for disorders of similar severity, such as addictions and schizophrenia, are often delivered in a protected and restricted setting, making measurement easier, while autism interventions require least restrictive environments, where it is hardest to do research. As can be seen from the studies just reviewed, the field is making progress, but the task is large and the obstacles are many.

## **PRACTICE GUIDELINES FOR CLINICAL CHILD AND ADOLESCENT PSYCHOLOGISTS**

Practitioners providing diagnostic evaluations, treatment, or ongoing consultation and follow-up for young children with autism can provide help to families in several ways. Although the task of locating appropriate interventions may be the most pressing for families at the point of initial diagnosis, clinical child and adolescent psychologists can also provide helpful care by assisting families with the challenges involved in the IEP process, by monitoring child progress in intervention and helping to optimize progress, and by guiding families in skilled management of child behavior at home. Further clinical assistance might be provided by psychologists attending to the bigger picture concerning well-being of the child and family by monitoring the family's overall well-being, including both parents and siblings, as well as the child with autism's psychological functioning in areas of mood, behavior, sleep, and eating problems.

### **LOCATING APPROPRIATE INTERVENTIONS**

When psychologists are first involved in initial assessment and diagnosis for a child with autism, they are faced with a barrage of questions as families try to sort through the intervention literature available to them.

One challenge for practitioners is helping families translate the outcome literature that they read based on empirical studies to choices available in typical American communities. The real choices that families must make involve the services that they can access in their

community, which typically do not include “name-brand” intervention programs carried out with the careful organization and intense supervision that marks a lab-based experimental intervention study. Decisions about appropriate interventions for a specific child must involve the intervention that can actually be *delivered* to an individual child rather than practices that were carried out by authors of a research article. Families may have questions about the helpfulness of other allied medical therapies; medications; nutritional supplements and diets; and medical exams for allergies and immune function, gastro-intestinal problems, sleep, and help for siblings.

Several groups of experts have turned to the literature to extract practice guidelines for delivering early intervention to children with autism based on the current state of our empirical knowledge. The resulting publications are in the public domain, and the literature reviews that support them are by and large also in the public domain. Please see the National Research Council (2001) report and the special issue of the *Journal of Autism and Developmental Disorders* (2002) for summaries of the research and practice guidelines developed from the national U.S. review panel. For individual practitioners helping families to choose or evaluate programs, the most crucial guidelines are summarized as follows:

1. Treatment of unwanted or challenging behaviors should follow the principles and practices of positive behavior supports: the use of functional analysis to determine the function(s) of the unwanted behavior followed by the development of a positive teaching plan for teaching appropriate, functional (generally communicative) skills that serve as replacement behaviors for the unwanted behavior (Carr et al., 2002). Although this approach is currently considered best practice, there are few empirical studies involving preschoolers with autism (see Horner, Carr, Strain, Todd, & Reed, 2002, for review).
2. Building spontaneous functional communication skills is a core aspect of effective treatment/educa-education for children with autism at all ages and all levels of disability. Opportunities for using and increasing communication should occur throughout the day (NRC, 2001).
3. Children with autism need to be engaged in meaningful (to the child as well as others), age-appropriate learning activities that are functional in multiple settings. Use of naturalistic teaching approaches that begin with child choice and use intrinsic reinforcers foster child motivation and generalization and are considered by many to be best practice (NRC, 2001). If didactic, massed trial, adult-directed one-on-one teaching is used, it is not recommended as the only teaching approach to be used (Smith, 2001).
4. Effective early intervention can occur in a number of settings. Positive findings have resulted from studies involving children in home-based intervention, children in special classroom situations, and children in inclusive group settings (as reviewed in Rogers, 1998). Three aspects essential for progress seem crucial. The first involves a well-defined and coherent set of teaching plans for developing functional skills, fitted to the child's current developmental level, delivered at a high frequency throughout the day and across multiple settings using effective teaching practices demonstrated by progress data. The second involves ongoing monitoring of child progress and adjustment of teaching practices and content to accelerate and maximize progress. The third involves attention to the ecological validity of skills being taught and their maintenance and generalization in functional daily routines in natural settings and with multiple people (NRC, 2001).
5. Peer interactions are a crucial part of intervention programs for children with autism; children with autism of all ages and all levels of disability have been shown to gain

from these approaches. Many such approaches use typically developing peers to foster social growth in children with autism. National reviews recommend that children with autism have frequent access to typical peers (NRC, 2001).

6. Assuring generalization of new skills and behaviors is a critical aspect of intervention programs for children with autism. Generalization is fostered when the skills that are taught are functional and ecologically valid in natural settings and daily routines; children with autism use their new skills with multiple adults and children; and children use them in a variety of different types of activities and settings throughout their day (NRC, 2001).
7. Parents and family members need to be included in the intervention in a variety of ways, including setting goals and priorities for their child's treatment, locating supports for themselves, supporting their child's new skills in home and community activities, and receiving training in effective ways of teaching their children to function in family and community routines (NRC, 2001).

### **Monitoring Progress**

In addition to supporting families in their decision making about interventions, practitioners can help families monitor child progress through regular assessments, both educational/developmental and behavioral. Although evidence-based treatments generally involve frequent assessment of progress and adjustment of the teaching to maximize progress, this is a very expensive part of intervention programs and may not be carried out as rigorously in a community-based program. Determining whether a particular treatment is helping a given child requires progress data, and psychologists are particularly well trained in designing and implementing assessment procedures to answer such questions. Monitoring the ongoing progress of a child can include examining acquisition and generalization of new skills, following changes in developmental rate over time, and monitoring the frequency and severity of unwanted behaviors, including disruptions in sleep and eating. The bottom line concerning evidence of treatment efficacy for an individual child is reflected in the data being gathered to evaluate treatment effects.

### **Coordinating Care**

The clinical child and adolescent psychologist who provide assessments or care for young children with autism should be communicating with the child's primary care physician to assure that the child's current needs are being met in all areas: medical, psychological, and educational. Children with autism have multiple needs and multiple symptoms, and a psychologist providing follow-along care is in an excellent position to coordinate with family and primary care physicians about additional needs for professional input that may arise. Providing information that will assist the primary physician to determine when referral to other health professionals is needed, and following up with other professionals to assure that care is coordinated among all the players can be tremendously helpful to families. It is not unusual for families to have multiple professionals, even within the same profession, on their child's treatment team. Coordinating care across many professionals can be difficult and unwieldy, and psychologists' training places them in an excellent position to coordinate this kind of care, when requested by families.

### **Support With the IEP Process**

Families who are receiving a diagnosis of autism for their child for the first time face a daunting set of activities involving attainment of appropriate educational services through the IEP process that is mandated by federal law. A third area of help that psychologists can provide for families involves help with the IEP process. Families often need support in understanding these



very complex laws, determining their child's educational needs, and advocating for their children in a knowledgeable way in the IEP process, which can be unfriendly and intimidating for families. Psychologists can help families in several ways, including helping them prepare for the IEP meeting; helping them verbalize their questions, goals, hopes, and expectations; providing an opportunity to debrief after IEP meetings; and reviewing the IEP plan with them. Their children will likely receive special education services for 15 years or more, and the sooner the families learn the laws and practices the more effective advocates they can be. Of course, this requires that psychologists become well educated in the laws involving special education services and knowledgeable about the IEP process as it is carried out in specific local school districts. Families may ask the psychologist to attend, and the psychologist may offer to participate in the IEP meeting. This can be extraordinarily helpful to the families as well as the children.

### Monitoring the Overall Situation

A final area of support involves assessing the bigger picture surrounding a young child with autism and his or her family. Although families focus closely on the intervention, a consulting psychologist can step back to take in the larger worldview. How is each person in the family doing? How comfortable are the parents with the lifestyle that their family has evolved around their child with autism? Are there clear needs that are going unmet, or problem areas that are not being addressed? Providing nonjudgmental support and an empathic ear, along with the knowledge of children's, parents', and siblings' needs, can be a tremendous source of help for families during the early intervention period of their life in autism. Parents often struggle with balancing the needs of each member of the family, and a supportive relationship with a clinical psychologist can help them reflect on the needs and well-being of each member of the family. Psychologists may provide these kinds of supports for families of children with autism for many, many years.

### FUTURE DIRECTIONS: QUESTIONS THAT NEED ANSWERS

In closing, we point researchers' attention to several questions that arise frequently during clinical interventions with families but for which the field currently lacks definitive answers.

1. *The issue of inclusive education* arises in the educational planning for most young children with autism. Some have argued that given the diverse and widespread needs of children with autism, their educational needs may be better served in self-contained classrooms where special educators, therapists, and other resources are concentrated (Baker & Zigmond, 1990; Fuchs & Fuchs, 1994). Critics have also argued that an inclusive setting might further expose children with autism to social rejection from their peers (Lowenthal, 1999). However, there is extensive literature on the positive effects of inclusion on children with autism (McGee, Paradis, & Feldman, 1993; Peck, Odom, & Bricker, 1993). In particular, research has shown that typically developing peers can be effectively used as active intervention participants in modeling age-appropriate behavior and providing opportunities for children with autism to improve social, play, and language skills (Ingersoll et al., 2001; McGee, Almeida, Sulzer-Azaroff, & Feldman, 1992; Pierce & Schreibman, 1997; Stahmer & Ingersoll, 2004).

Two groups have reported that children with autism demonstrate more typical play and social behavior, and less atypical behavior, when in the presence of typical peers as compared to peers with autism, both in dyadic play (Smith et al., 2002) and in a preschool classroom (McGee et al., 1993). However, inclusive education requires specialized, autism specific educational expertise from the teaching team. This issue of inclusion has deep philosophical and political meanings in the field of disability in the United States (for a variety of viewpoints, see Downing & Eichinger, 1996; Fullan, 1991; Goodlad, 1984; Sandler, 1999). The importance of inclusive experiences for optimal early development in autism needs to be studied.

2. *What skills are most important to target?* As Kasari, Freeman, and Paparella (2001) pointed out, early intervention approaches for young children with autism often bear little resemblance to the research-based findings concerning early autism-specific deficits. The role of joint attention behavior as a predictor of language development in both typically and atypically developing children is one such example. Mundy, Sigman, and Kasari (1990) demonstrated that joint attention behavior was a more powerful predictor of later language development than was early language development itself! Kasari, Freeman, and Paparella (2005) conducted a brief RCT study involving three groups of preschool children: one receiving joint attention training, one receiving symbolic play training, and one receiving neither. The intervention involved 30 min per day of individual instruction. Even though all children were also engaged in comprehensive behavioral interventions for 6 hr per day, these brief, specific interventions had statistically significant effects on the specific skill being taught, measured after the 5- to 6-week intervention. These findings raise the possibility that the current omnibus approach to early intervention in autism is less efficient, in terms of time spent teaching and amount of change in learning rate over time or long-term outcome measures of skill, than a more targeted approach that focuses on key areas of learning for children with autism.

This is similar in concept to the idea of teaching pivotal learning skills (L. K. Koegel, R. L. Koegel, Harrower, & Carter, 1999; Smith, Groen, & Wynn, 2000; Mahoney & Perales, 2003). Adults cannot directly teach children all the skills needed for adult life. Appropriate learning depends on the child himself or herself taking on the responsibility for learning throughout the day by imitating others, engaging others, and exploring the potential of the various environments. What are the key or pivotal skills that young children use to learn from others? Language, imitation, social engagement, creative use of objects, sharing attention and other mental states with others—these come to mind immediately. Interventions that result in child initiation, exploration, and ongoing engagement of the social as well as the physical world are likely to lead to greater child learning long term, and these self-learning behaviors need to be identified as treatment goals and examined when assessing children's response to treatment.

3. *Individualizing treatment approaches.* Interventionists are well aware of the heterogeneity of preschoolers with autism, and clinical experience demonstrates the individuality of each child's response to a given treatment. Many turn to teaching practices from a variety of sources in an effort to individualize treatments to individual child profiles. Yet two studies described earlier, comparing a manualized behavioral approach to an eclectic approach, have raised serious questions about the efficacy of general eclectic approaches (Eikeseth et al., 2002; Howard et al., 2005). However, in both of these, the eclectic approach was not necessarily built from empirically supported teaching practices. Those who are tempted to mix a variety of approaches need to be mindful of these findings and of the empirical support for the various teaching practices that are being contemplated for use. They must carefully assess the underlying assumptions of the various methods and goals of the approaches being combined as well as carefully documenting child progress. It may be that one advantage of any manualized model is the clear direction and step-by-step curriculum provided. Mixing methods may detract from progress if the methods work at cross-purposes or if there is not a clear curricular scope and sequence to the overall plan.

Frequency counts and graphs of new learning are not by themselves a complete standard for determining treatment success, as Smith et al. (2000) demonstrated. Daily progress may be made without improving the overall picture of long-term significant intellectual and linguistic impairments. For long-term improvement to occur, children need to accelerate their learning rates and increase standard scores in addition to making forward progress.

4. *Integration of developmental and behavioral practices.* Although the behaviorally based interventions dominate the research literature, developmentally based interventions are widely

represented in the community. Children receiving services through public school districts are generally being taught by early childhood special educators, occupational therapists, and speech and language pathologists; all of these disciplines tend to work from a developmental rather than behavioral perspective. Although developmental and behavioral approaches are often discussed as mutually exclusive, in reality they are often blended. Educational curricula are frequently developmentally informed and often explicitly based on developmental sequences. Good teaching practices and procedures share many common elements between developmentalists and behaviorists. Lifter, Sulzer-Azaroff, Anderson, Coyle, and Cowdery (1993) demonstrated that children made maximum progress in symbolic play learning when behavioral teaching practices followed a developmental sequence for deciding the content of the teaching. It would be helpful for researchers of specific models to discuss separately the content of teaching (the curriculum) and the process of teaching (the teaching procedures and practices used). Then, comparative studies can be designed to determine the most effective combinations of curricular sequences and teaching practices for specific outcomes.

*5. Interventions for infants.* Autism is being identified earlier and earlier, given the publication of several articles that demonstrate valid diagnosis in 2-year-olds (reviewed by Rogers, 2000) and the related push for earlier detection (Filipek et al., 1999). The field is rapidly approaching the point where autism will be diagnosed for many or most children before 3 years of age. However, we have no empirically supported treatments for children with autism 2 years and younger, and little other than a few case reports (Green, Brennan, & Fein, 2002; McGee, Morrier, & Daly, 1999). Children with autism who are younger than 3 years of age qualify for public intervention services, but these programs often provide little more than about a 1 hr home visit or play group every week. The current emphasis for early identification requires a parallel emphasis on identifying efficacious intervention approaches for infants with autism.

In closing, early intervention for children with autism is currently a politically and scientifically complex topic. Positive effects of early intervention programs have been demonstrated in both short-term and long-term studies, but initial reports of dramatic changes and excellent outcomes in a large minority of children receiving a specific treatment have been reported in few studies thus far. The amount of plasticity in early autism is still unknown. Given the few RCT studies, the few models that have been tested, and the large differences in interventions that are being published, it is clear that the field is still very early in the process of determining what kinds of interventions are most efficacious in early autism, the variables that mediate and moderate treatment effects, and the degree of both short-term and long-term improvement that can be expected for an individual child.

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**TABLE 1**  
Controlled and Single-Subject Studies of Early Intervention in Autism: 1998–2005

Authors and Date	Sample	Outcome Measures	Treatment Procedures	Findings	Nathan and Gorman (2002) Criteria
Aldred et al. (2004)	14 children dx with AD ( <i>M</i> age 48 months, 13 male) in tx group and 14 children ( <i>Mdn</i> age 51 months, 12 male) in control group. All parents Caucasian, except for 2 mothers African Caribbean.	ADOS, PSI, Vineland, semistructured parent-child interaction.	Tx group: Monthly parent-training pragmatic language workshops for 6 months, with additional 6 month follow-up of 2-monthly consolidation sessions. Parents asked to spend 30 min daily implementing techniques with child. Both groups received speech and language therapy, TEACCH, and social skills training.	Tx group showed improvements in autism severity scores, expressive vocabulary and communication (esp. for younger, lower functioning group), increased parental responsibility. No significant differences in adaptive behavior or parental stress.	Type 1 study + RCT + Blind assessments + Incl/excl criteria. + Standardized dx battery + Comparison group – Tx fidelity – Tx manual.
Bibby et al. (2002)	66 children with autism or ASD (55 male, <i>M</i> CA 45 months at the start of receiving ongoing intervention). No other information provided.	BSID-II, BAS, Griffiths, WISC-III or WPPSI-R, Reynell, Merrill-Palmer, Vineland, school placement, behavioral ratings, parent interviews of tx onset, duration, intensity, tx personnel, supplementary tx).	Treated by 25 different early intervention consultants. Workshop-model programs provided for approximately two 6-hr days in child's home and 1-day follow-up workshops with a median frequency of 4 times/year. Teaching methods included discrete trials training and incidental teaching. Parent-selected alternative treatments (e.g., diets, vitamins, sensory treatments) for 81% of children.	No changes in group mean IQ across 31.6 months of intervention ( <i>N</i> = 22). Vineland scores sig increased by 8.9 points to a mean of 63.4 ( <i>N</i> = 21). No children younger than 72 months achieved normal functioning (i.e., IQ > 85 and unassisted mainstream school placement; <i>N</i> = 42). Gain in mental age (5.4 months), adaptive behavior (9.7 months), and language (5.1 months) were found across 12 months ( <i>N</i> = 60).	Type 3 study – RCT – Blind assessments – Incl/excl criteria – Standardized dx battery – Comparison group – Tx fidelity + Tx manual. Other: Post-tx data only, no baseline, data.
Cohen et al. (2006)	42 children ages 18–12 months dx with ASD: 21 children in EIBT treatment, matched to 21 children receiving community care. No other information provided.	ADI, ADOS, BSID-II, VABS, Reynell, Merrill-Palmer, WPPSI.	EIBT group received 35–40 hr for 3 years from trained therapists following Lovaas's manual with in home 1:1 instruction, peer play training, and regular education placements. Parents had weekly training. Comparison group received services through schools in special classes, 10–25 hr per week, ratios 1:1 to 1:3.	Sig group diff on IQ score and three of the four Vineland scores. EIBT <i>M</i> IQ posttreatment score 87 (25-pt. gain), comparison 73 (14-pt. gain), after 3 years. Diff on receptive language approached significance. EIBT changed from 52 to 72; comparison from 53 to 62, diff on expressive language was not sig (25 vs. 15 point gains). 17 of 21 EIBT children	Type 2 study – RCT – Blind assessments + Incl/excl criteria. + Standardized dx battery + Comparison group + Tx fidelity + Tx manual.

Authors and Date	Sample	Outcome Measures	Treatment Procedures	Findings	Nathan and Gorman (2002) Criteria
Drew et al. (2002)	24 children dx with autism ( <i>M</i> CA 23 months) randomized to parent training group ( <i>N</i> = 12; 11 male, 11 nonverbal, 1 single words) or to local services only ( <i>N</i> = 12; 8 male, 11 nonverbal, 1 single words). No other information provided.	ADI-R, Griffiths, MCDI, PSI, parent-completed activity checklists of type and amount of health and education services every 3 months.	Parent training adopted a psycholinguistic and social-pragmatic approach to language development with emphasis on teaching joint attention skills, joint action routines, and behavioral management integrated into everyday, natural routines. Parents received in-home speech and language consultation every 6 weeks for a 3-hr session. Local services group received a mixture of services including speech and language therapy, occupational therapy, physiotherapy, some parents provided direct treatment, and 3 children received in-home 1:1 discrete trial formats ( <i>M</i> = 33 hr/week).	No group diff on NVIQ, symptom severity, parental report of stress, or words or gestures produced at follow-up, though parent-report measures indicated greater word production and comprehension for parent training group.	Type 2 study + RCT – Blind assessments + Incl/excl criteria + Standardized dx battery + Comparison group – Tx fidelity – Tx manual. Other: Concerns about low power given small group size, uniform assessment.
Eikeseth et al. (2002)	13 children dx with autism in Lovaas tx, 12 in eclectic, <i>M</i> CA 66 months, <i>M</i> IQ 62–65. Assigned based on availability of therapists. 75% male. No other information provided.	BSID-II or WISC-R or WPPSI-R, Merrill-Palmer, Reynell, Vineland, amount of tx, type of tx goals.	Both groups of children received a mean of 28 hr per week of 1:1 tx at an integrated school setting for 1 year. For the behavioral tx only, parents were required to be trained for 3 months. The eclectic tx was designed by experienced special ed staff, incorporated elements from TEACCH, sensory-motor therapies, and ABA, and delivered in 1:1 clinician-directed format.	Group diff not sig at follow-up, except in maladaptive behaviors. However, Lovaas group made sig pre-post changes, unlike eclectic group. Greater number of children in Lovaas group and IQ in normal range at posttest.	Type 2 study – RCT + Blind assessments + Incl/excl criteria + Standardized dx battery + Comparison group. + Tx fidelity + Tx manual. Other: Analytic plan clear.
Howard et al. (2005)	29 children dx with AD or PDDNOS in IBT (86% male, 83% autism, 72% Caucasian, 79% married), 16 in AP (81% male, 75% autism, 50% Caucasian, 80% married), 16 in GP (100% male, 56% autism, 57% Caucasian, 56% married).	BSID-II, DP-II, Merrill-Palmer, Reynell, S-B, Vineland, WPPSI-R. Other measures used only one time for one child, while some measures used only at in-take or follow-up (missing data on intake and follow-up measures).	IBT consisted of 25–30 (younger than 3 years) or 35–40 (older than 3 years) hr/week of 1:1 intervention, includ. discrete trial, incidental teaching, parent training in behavior analytic procedures. AP consisted of public school autism classrooms (staff:child ratio of 1:1 or 1:2) of 25–30 hr/week of eclectic tx (discrete trial, PECS, SIT, TEACCH, speech therapy). GP consisted of local community special ed classrooms (staff:child ratio 1:6) of 15 hr/week with speech therapy, developmental curriculum.	No sig diff between AP and GP groups at follow-up vs. higher sig mean scores in all developmental domains (except motor) and 30 point IQ gain for IBT group. GP showed losses in multiple developmental domains.	Type 3 study – RCT – Blind assessments + Incl/excl criteria – Standardized dx battery + Comparison group – Tx fidelity + Tx manual. Other: Combined approaches – not further described.
Ingersoll et al. (2001)	6 children with ASD and 3 typically developing children (CA 26–41 months). No other information provided.	Videotaped samples of peer social avoidance behavior (opportunities and	Inclusive toddler tx program and day care with teacher: student ratio of 1:3. Developmentally appropriate toddler classroom	Peer social avoidance appeared to predict outcome for subsequent	Type 2 study – RCT – Blind assessments + Incl/excl criteria – Standardized dx battery + Comparison group + Tx fidelity + Tx manual

Authors and Date	Sample	Outcome Measures	Treatment Procedures	Findings	Nathan and Gorman (2002) Criteria
Jocelyn et al. (1998)	35 children dx with AD or PDDNOS randomized to exp. or control group. 34 male, ages 24–72 months ( <i>M</i> CA 44 months). 33 Caucasian, 33% in severe range on CARS, range of SES on Hollingshead. 16 in experimental group. Mean NVIQ 58 exp. group & 67 comp group.	Autism Behavior Checklist, EIDP, Family Assessment Measure, PSDP, Stress-Arousal Checklist, and TAQ.	12 weeks of tx delivered in a typical day care center by child care workers (and at home by parents) after 15 hr of training and additional consultation. Strategies targeted language, social, and play development, and decreasing of unwanted behaviors. Control group attended community day care alone.	Sig tx effects on language development, mother and child care worker knowledge about autism, maternal perception of control, and parent satisfaction.	Type 1 study + RCT + Blind assessments + Incl/excl criteria + Standardized dx battery + Comparison group – Tx fidelity – Tx manual Other: Sample large enough for power. Clear analytic plan
L. K. Koegel et al. (1999)	10 children with autism participated in phase 1 ( <i>N</i> = 6; <i>M</i> CA 42 months, <i>M</i> language age 27 months) and phase 2 ( <i>N</i> = 4; <i>M</i> CA 37 months, <i>M</i> language age 23 months). No other information provided.	Pre-tx language age from archival videotapes of unstructured parent/child interactions, spontaneous initiations from 15-min videotape samples of parent-child interaction, and Vineland. Posttx data on pragmatic ratings from 15-min video samples of parent-child interactions, social and community functioning, and Vineland.	Both phases received 1.5–2 hr of PRT intervention in clinical settings and community programs for approximately 4 years, with follow through by parents that participated in parent education programs. PRT consists of motivational factors (child choice, reinforcing attempts, interspersing maintenance tasks, natural and direct reinforcers, turn taking and response to multiple cues). The motivational and self-management procedures were used to teach communication, self-help, academic, social, and recreational skills. Phase 2 intervention taught a series of verbal child-initiated questions and other initiations to elicit attention, request assistance, and seek play partners.	Phase 1 indicated that children who responded favorably to intervention exhibited more spontaneous self-initiations at pre-tx. Phase 2 showed that children who were initially poor responders to intervention could be taught a variety of self-initiations, including question-asking and achieve similarly favorable outcomes.	Type 3 study – RCT – Blind assessment + Incl/excl criteria – Standardized dx battery + Comparison group – Tx fidelity + Tx manual Other: Exploratory single-subject design with 3 ss in each of two groups. No multiple baseline designs. Outcomes are described anecdotally.
Luiselli et al. (2000)	16 children started tx younger than 3 years ( <i>N</i> = 8; <i>M</i> CA 2.63 years) or older than 3 years ( <i>N</i> = 8; <i>M</i> CA 3.98 years). All dx with AD or PDDNOS. No other information provided.	Developmental rating checklists from ELAP or LAP. Measured hours/week of tx, duration of tx, and total hours of tx.	In-home discrete trial and incidental teaching 6–20 hr/week over 5–22 months.	Children received tx before 3 years showed sig developmental changes but no between group diff. Overall improvement in communication, cognitive, and social-emotional functioning predicted by duration of time in tx.	Type 3 study – RCT – Blind assessment – Incl/excl criteria – Standardized dx battery – Comparison group – Tx fidelity + Tx manual Other: Retrospective study. Measures not standardized.
Mahoney & Perales (2003)	20 children with AD or PDDNOS, <i>M</i> CA 32 months, 60% male, <i>M</i> CA of mothers 34 years, 95% were Caucasian, 100% were married, <i>M</i> average of 15.5 years of education, and 60% were in middle-upper SES.	Videotaped samples of mother-child interactive behaviors from CBRS and MBRS, social-emotional functioning from ITSEA and TABS.	One-hr/week center based tx and approx. 2.5 hr/day in-home parent based tx in RT. Tx lasted for a mean of 11.4 months and focused on reciprocity, contingency, shared control, affect, and matching pace during daily routines.	Sig increases in maternal responsiveness (35%) and affect (27%) for 80% of mothers. Increased responsivity associated with improvements in children's social-emotional functioning	Type 3 study – RCT – Blind assessment – Incl/excl criteria – Standardized dx battery – Comparison group + Tx fidelity + Tx manual Other: Pre-post design.

Authors and Date	Sample	Outcome Measures	Treatment Procedures	Findings	Nathan and Gorman (2002) Criteria
Mahoney & Perales (2005)	20 children with PDDNOS ( <i>M CA</i> 32 months), 30 children with other DDs ( <i>M CA</i> 23 months), overall 62% males. <i>M CA</i> of mothers 33 years, 89% Caucasian, 93% married.	Developmental Rainbow, TBPA, Videotaped samples of mother-child interactive behaviors from CBRS and MRBS, social-emotional functioning from ITSEA and TABS.	Weekly 1-hr parent-child sessions either at center or in-home by early intervention specialist over course of 1 year ( <i>M</i> 11 months). Average of 15 hr/week of parent-reported implementation. Tx focused on pivotal developmental behaviors related to cognitive, communication, and socio-emotional functioning and influenced by maternal responsiveness.	(incl. engagement, cooperation, joint attention, and affect). Sig increase in maternal responsiveness and in children's communication, cognitive, and socio-emotional functioning, greater developmental gains for PDDNOS group. Group diff related to degree of maternal responsiveness.	Type 3 study – RCT – Blind assessment – Incl/excl criteria – Standardized dx battery – Comparison group + Tx fidelity + Tx manual. Other: Pre-post design.
Moes & Frea (2002)	3 children with autism ( <i>M CA</i> 41 months) with severe disruptive behaviors. No other information provided.	% of 10-sec intervals with problem behaviors, intervals with functional communication, and an index of tx package's fit with family context.	In-home parent-implemented functional assessment and functional communication training, 1–2 days/week training sessions, with follow-up at 2-month intervals for 1 year after training completed.	Contextualized FCT within family's routines decreased problem behavior and increased functional communication and moderate scores in parents' ratings of sustainability with tx package.	Type 2 study – RCT – Blind assessment + Incl/excl criteria – Standardized dx battery – Comparison group + Tx fidelity + Tx manual. Other: Single-subject design with 3 cases. Careful assessment. Maintenance and generalization data.
Sallows & Graupner (2005)	23 children with autism randomly assigned to clinic-directed ( <i>N</i> = 13, 11 male, <i>M CA</i> 33 months at pre-tx) or parent-directed group ( <i>N</i> = 10, 8 male, mean <i>CA</i> 34 months at pre-tx). Median income per group provided.	ADI-R, BSID-II, CBC, CELF-III, ELM, Personality Inventory for Children, Reynell, Vineland, WISC-III or WPPSI-R, Woodcock-Johnson, classroom placement, therapeutic services.	Both groups received Lovaas tx. Clinic directed received mean of 39 hr/week for Year 1 and 37 hr/week for Year 2, 6–10 hr/week of in-home supervision, and weekly consultation. Parent directed received <i>M</i> of 32 hr/week for Year 1 and 31 hr/week for Year 2, 6 hr/month of in-home supervision, and consultation every 2 months.	Similar outcomes across measures for both groups (48%). Tx outcome best predicted by pre-tx imitation, language, and social responsiveness.	Type 1 study + RCT + Blind assessment + Incl/excl criteria + Standardized dx battery + Comparison group + Tx fidelity + Tx manual.
Salt et al. (2002)	12 children dx with autism in exp group, <i>M CA</i> 42 months, <i>MA</i> 17 months. Received approx. 15 hr per week of other tx. Comparison group, <i>M CA</i> 38 months, <i>M MA</i> 21 months, received approx 20 hr per week of other tx. Sig higher IQ than exper group (56/39). All children Caucasian except 1, even distribution of SES.	ECSC, MCDI, PSI, PICS, Symbolic Play Test 2nd ed., Vineland.	Exp group: parent-delivered developmental, naturalistic based tx focused on imitation, joint attention, language, social reciprocity, and play. Comp group: Waitlist for services, primarily speech and language therapy.	Exp. group improved sig on imitation measure, joint atn and social interaction from ECSC, and all the Vineland scales except communication. No diff in parent measures. Outcome on language measures not reported.	Type 3 study – RCT + Blind assessment – Incl/excl criteria – Standardized dx battery + Comparison group – Tx fidelity – Tx manual.
Sheinkopf & Siegel (1998)	11 children in exp. tx group ( <i>M CA</i> 34 months), 11 children in control group ( <i>M CA</i> 35 months). Groups matched on <i>CA</i> , <i>MA</i> , dx (AD vs. PDDNOS), length of tx. No other information provided.	BSID-II, Cattell, <i>DSM-III-R</i> symptom severity, Merrill-Palmer, WPSSI.	Exp. tx: home-based parent-implemented Lovaas tx. for approx. 16 months with community based clinicians, average of 6 hr/week school-based services and 1 hour/week OT, ST. Control group:	Exp. group scored sig higher IQ (difference about 25 points). Smaller sig effect on symptom severity but exp group still met dx	Type 3 study – RCT + Blind assessment – Incl/excl criteria – Standardized dx battery + Comparison group – Tx fidelity – Tx manual. Other: Dx does not use gold standard tools. Retrospective, outcome measures very limited. Analysis is clear.

Authors and Date	Sample	Outcome Measures	Treatment Procedures	Findings	Nathan and Gorman (2002) Criteria
Sherer & Schreibman (2005)	6 children with autism: 3 responders to tx (2 male, <i>M CA</i> 39 months), 3 nonresponders to tx (2 male, <i>M CA</i> 50 months), 1 child from each group matched on language, age, IQ.	Pre-, post- and follow-up data on BSID-II or DAS, CARS, EOWPVT, Leiter, PPVT-R, Vineland, videotaped samples (four 5-min samples) on language, play (functional, symbolic, varied), and social-behavioral interaction.	average of 10 hr/week school-based and 45 min./week OT, ST.  90 min of clinician-based 1:1 PRT (i.e., behavioral naturalistic tx) 4-5 times/week for 6 months for responders and 5 months for nonresponders. Limited follow-up data.	Responders improved in language, play, and social skills and generalized gains to untrained environments and stimuli vs. no change in nonresponders. Responders had more functional play, stereotypic language, and less avoidance behaviors.	Type 2 study – RCT – Blind assessment – Incl/excl criteria + Standardized dx battery + Comparison group + Tx fidelity + Tx manual. Other: Comparative design. Strong single-subject design with 3 ss in each group. Maintenance and generalization data.
Smith, Buch, & Gamby (2000)	6 children dx with AD or PDDNOS ( <i>M CA</i> 36 months, <i>M IQ</i> 50). No other information provided.	Pre-tx and once/month during first 5 months of tx, data on ELM. Pre-tx and 2-3 year follow-up on BSID-II or WPPSI-R, Reynell, Vineland. Retrospective parent-report of therapy hours, PSI at 3 months and follow-up.	Parents and therapists attended six 1-day training workshops in Lovaa model over 3 months in child's home for 6 hr.	5 of 6 children showed rapid acquisition of learning skills but only 2 made gains on standardized tests at 2-3 year follow-up. Therapists in parent-run programs implemented correct tx procedures but less consistent than lab-based therapists. High parental satisfaction with in-home tx.	Type 3 study – RCT + Blind assessment + Incl/excl criteria – Standardized dx battery – Comparison group + Tx fidelity + Tx manual. Other: Descriptive study of outcomes of 6 Ss receiving a home-based model.
Smith, Groen, & Wynn (2000)	28 children ( <i>M CA</i> 36 months & <i>IQ</i> 51 months) randomized to intensive tx group ( <i>N</i> = 15; 12 male, 7 autism, 8 PDDNOS) or to parent training group ( <i>N</i> = 13; 11 male, 7 autism, 6 PDDNOS), 14 Caucasian, 6 Hispanic, 4 African American, 4 Asian.	Pre-tx, follow-up ( <i>CA</i> of 7-8 years) data on BSID-II or S-B, Merrill-Palmer, Reynell, Vineland. Follow-up measures of WIAT, social-emotional functioning from CBC and Teacher Report Form, Family Satisfaction Questionnaire, class placement, first 4 months of tx, assessed progress from ELM.	Intensive tx group received 30 hr/week of discrete trial format for 2-3 years in teams of 4-6 student therapists with 5 hr/week of parent-implemented tx for first 3 months of tx. Initial 1:1 instruction implemented in children's home with gradual transitions to classroom settings. Parent training group received two sessions/week in homes for 3-9 months and implemented an additional 5 hr/week of independent instruction. Parents taught discrimination learning, discrete trial formats, and functional analyses.	Intensive tx group showed sig diff in IQ, visual-spatial skills, language development, academic achievement and had less restrictive school placement, no group diff in mean Vineland scores and on standardized tests of behavior problems. Between group diff in follow-up IQ were about half that reported by McEachin et al. (16 vs. 31 points), as well as in the proportion of children placed in regular classes without special services (27% vs. 47%).	Type 1 study + RCT + Blind assessment + Incl/excl criteria + Standardized dx battery + Comparison group + Tx fidelity + Tx manual. Other: Clearly described analytic approach.

Authors and Date	Sample	Outcome Measures	Treatment Procedures	Findings	Nathan and Gorman (2002) Criteria
Stahmer & Ingersoll (2004)	20 children with ASD (16 male, M CA at start 28 months, mean time enrolled 10 months), 90% married, 60% Caucasian, 10% Asian, 10% Filipino, 20% Hispanic.	Data on BSID-II, GARS, Vineland, behavioral evaluation to determine functional skill level at program entry and exit.	CTS inclusive program includes incidental and other evidence-based teaching techniques (e.g., PRT, discrete trial, PECS, modified sign language) for 3 hr/day, 5 days/week; 2 hr/week of individualized special skills training; and weekly 2-hr home visits for parent training with 10 hr/week of parent-implemented tx. Teacher-to-child ratio (1:3); autism to typical development ratio (8:8).	Sig increases on standardized assessments (37% functioning in typical range at exit vs. 11% at entry), in functional communication skills (90% at exit vs. 50% at entry), and social and play behaviors.	Type 3 study – RCT – Blind assessment + Incl/excl criteria + Standardized dx battery – Comparison group + Tx fidelity + Tx manual. Other: Pre-post design. No control for maturation.
Stoelb et al. (2004)	19 children dx with autism (14 male, mean CA 55 months), wide range of SES and parent participation in tx. 6 with abnormal brain structure, 11 with regression, 5 were macrocephalic, 2 were microcephalic, 13 with sleep difficulties.	Medical assessment (MRI, EEG, morphologic measurements, dermatoglyphic analysis, skin tests, parent interviews), pre-tx functioning, 4-point scale of parental involvement, tx intensity.	In-home therapist-based discrete training, weekly phone monitoring, and supervisory workshops every 2 months.	Physical dysmorphology sig predicted tx change (58% of variance in change scores over 6 months, 67% over tx year) and language acquisition for 90% of nonverbal children. Age at onset of tx predicted greater gains vs. history of regression predicted poorer gains.	Type 3 study – RCT – Blind assessment + Incl/excl criteria – Standardized dx battery – Comparison group – Tx fidelity – Tx manual. Other: Retrospective design. No standard tx.
Takeuchi et al. (2002)	8 children dx with autism (7 boys, mean CA 63 months). All English-speaking families living in Malaysia.	One pre- and post-tx direct observation of % of correct responses, categories of rewards, and social validity measure of quality of child-trainer interaction. Parent questionnaire.	Nine 20-min supervising sessions for parent-implemented Lovaas tx in 3 days. Parents received feedback in selecting appropriate tasks, using strategies to minimize learning errors, and presenting a variety of rewards.	Supervision increased children's correct response rates and variety of rewards.	Type 6 study – RCT – Blind assessment – Incl/excl criteria – Standardized dx battery – Comparison group + Tx fidelity + Tx manual. Other: Similar to a case report. No outcome data presented.

*Note:* dx = diagnosis; AD = Autistic Disorder; tx = treatment; + = present in the study; – = absent in the study; ADOS = Autism Diagnostic Observation Schedule; PSI = Parenting Stress Index; RCT = randomized controlled trial; Incl/excl = inclusion/exclusion; ASD = ; CA = chronological age; BSID-II = Bayley Scales of Infant Development, 2nd edition; BAS = British Ability Scales; Griffiths = Griffiths Scale of Infant Development; WISC-III (or WISC-R) = Wechsler Intelligence Scale for Children, 3rd edition; WPPSI-R (or WPPSI) = Wechsler Preschool and Primary Scales of Intelligence Revised; Reynell = Reynell Developmental Language Scales 3rd UK edition; Merrill-Palmer = Merrill-Palmer Scales of Mental Tests; EIBT = Early Intensive Behavioral Treatment; ADI-R = Autism Diagnostic Interview-Revised; VABS (Vineland) = Vineland Vineland Adaptive Behavior Scales; SES = socioeconomic status; MCDI = MacArthur Communicative Developmental Inventory; NVIQ = nonverbal intelligence; ABA = Applied Behavior Analysis; diff = difference; sig = significant; PDDNOS = Pervasive Developmental Disorder Not Otherwise Specified; IBT = Intensive Behavior Therapy; AP = Comparison group; GP = Comparison group; DP-II = Developmental Profile-II; S-B = Stanford-Binet Intelligence Scale, 4th edition; PECS = Picture Exchange Communication System; SIT = Sensory integration therapy; exp = experimental; CARS = Childhood Autism Rating Scale; EIDP = Early Intervention Developmental Profile; PSDP = Preschool Developmental Profile; TAQ = TRE-ADD Autism Quiz; PRT = Pivotal Response Training; ELAP = Early Learning Accomplishments Profile; LAP = Learning Learning Accomplishments Profile; CBRS = Child Behavior Rating Scale; MBRS = Maternal Behavior Rating Scale; ITSEA = Infant Toddler Social Emotional Assessment; TABS = Temperament and Atypical Behavior Scale; DD = Developmentally disabled; TBPA = Transdisciplinary Play-Based Assessment; FCT = Functional Communication Training; CBC = Child Behavior Checklist; CELF III = Clinical Evaluation of Language Fundamentals, 3rd edition; ELM = Early Learning Measure; Woodcock-Johnson = Woodcock-Johnson III Tests of Achievement; MA = Mental Age; ESCS = Early Social Communication Scales; MCDI = MacArthur Communicative Developmental Inventory; PVCS = Preverbal Communication Schedule; Cattell = Cattell Infant Intelligence Scale; DSM-III-R = *Diagnostic and Statistical Manual of Mental Disorders-Revised* (3rd ed.); DAS = Differential Abilities Scale; EOWPVT = Expressive One-Word Picture Vocabulary Test; Leiter = Leiter International Performance Scale; PPVT-R = Peabody Picture Vocabulary Test-Revised; WIAT = Wechsler Individual Achievement Test; GARS = Gilliam Autism Rating Scale; CTS = Children's Toddler School.