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# Educational Interventions for Young Children with Autism Spectrum Disorders

Svein Eikeseth and Lars Klintwall

The way autism is viewed has changed considerably over the past 3 decades. During the 1960s and 1970s, autism was considered rare. It was estimated to affect approximately four in 10,000 (DeMyer et al. 1981). The majority of individuals with ASD were offered residential or institutional care, because research had suggested that children with ASD had a 1–2 % chance of living a normal life. Research also indicated that 65–70 % had a poor or very poor outcome, and researchers concluded that autism was “accompanied by severe and, to a large extent, permanent intellectual/behavioral deficits” (DeMyer et al. 1981, p. 432).

Today, autism is considered the most common developmental disorder. However, despite a large international research effort, there has been no major breakthrough in finding causes of the condition. The major breakthrough in autism research to date has been in treatment, and although autism is biological with a genetic component, the most notable progress in treatment has been in the area of educational interventions (Filipek et al. 2006; Howlin 2005).

Much of this progress in educational interventions can be traced back to the work of Lovaas and colleagues in the 1970s and 1980s. Based on a study published in 1973, Lovaas and colleagues (1973) made a number of important observations which came to inspire, in one way or another, much of the educational interventions that are available today. These observations also guided the design of the Lovaas (1987) study, which has become the seminal study on what is known as Early and Intensive Behavioral Intervention (EIBI; see the chapter dedicated to EIBI, “► [Early and Intensive Behavioral Intervention \(EIBI\) in Autism](#),” in this volume).

First, Lovaas and colleagues (1973) observed that the youngest children made the greatest gains; hence, focus for future research and intervention was placed on early intervention. Second, treatment effects were found to be situation-specific; hence, treatment was moved away from hospital or clinic settings and into the children’s homes and communities. Third, the participants with autism did not become more social after learning language; hence, Lovaas and colleagues

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designed treatment targeting all of the children's excess and deficit behaviors and not only key behaviors such as language and communication. Fourth, with training, parents became skilled teachers for their children, and they were found to be the best allies in helping accelerate and maintain treatment gains. Fifth, treatment was provided for most of the child's waking hours, for several years, and focused on teaching the children to develop friendships with typical peers. This intervention, according to Lovaas, more closely resembled the type of learning environment available to typical children, who learn from their environment from the time they wake up in the morning until they go to sleep, 365 days per year (Lovaas 1993).

In his subsequent outcome study, Lovaas (1987) studied 19 children who received 40 h per week of one-to-one EIBI for a minimum of 2 years. A comparison group received 10 h or less per week one-to-one EIBI. A second comparison group received services generally available for children with autism in the area. When reevaluated at a mean age of 7 years, children in the experimental group had gained an average of 20 IQ points, and they had made major advances in educational placement. Forty-seven percent of the participants achieved IQ scores of 85 or above and regular educational placement without assistance, and the group as a whole scored a mean IQ at post-treatment of 83. In contrast, the control group that had received 10 h or less of behavioral treatment obtained an average IQ score of 52, and the group who had received treatment-as-usual obtained a mean follow-up IQ score of 58.

Although creating a great deal of controversy (Gresham and MacMillan 1998; Lovaas et al. 1989; Schopler et al. 1989), this study suggested that children with autism may make substantial gains in cognitive and adaptive functioning and that it is possible for a child with a diagnosis of autism to reach normal functioning as a result of treatment. These findings challenged the prevailing view on autism; they sparked hope and optimism among parents, teachers, and other professionals; and they occasioned a vast research interest and effort in the development of effective educational interventions.

In this chapter, the term "comprehensive intervention" for children with autism will be defined. Next, existing comprehensive interventions will be described and reviewed, followed by an evaluation of which interventions have been subjected to outcome research. Finally, the chapter will evaluate which interventions can be considered evidence based and hence, on a scientific basis, can be recommended as appropriate treatment for children with autism.

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## **What Defines Comprehensive Educational Interventions**

Comprehensive educational interventions are those interventions that address all three core deficits defining autism and are distinguished from those interventions that address specific deficits such as communication difficulties, joint attention, or motor planning. In other words, comprehensive interventions aim to establish social skills and social interests, they address the communication difficulties, and they aim to reduce ritualistic and/or stereotyped behaviors.

Children with autism may exhibit other behavioral excesses and deficits in addition to the core deficits. Examples are aggression and self-injurious behavior, attention deficits, general learning difficulties, eating problems, and difficulties with motor development and self-help skills. Hence, ideally, comprehensive interventions should address these types of difficulties in addition to addressing the three core deficits defining autism.

Some well-researched examples of non-comprehensive interventions are Picture Exchange Communication System (PECS; Yoder and Lieberman 2010), parent-delivered pragmatic language interventions (Aldred et al. 2004), functional analysis to determine causes of aberrant behaviors (Neef and Iwata 1994), noncontingent reinforcement to reduce aberrant behaviors (Carr et al. 2009), and eating interventions (Matson et al. 2009), among others. However, non-comprehensive procedures may well be components of a comprehensive educational intervention.

Since the 1960s and until today, a large number of comprehensive intervention programs for children with autism have been developed. The next section provides a brief description of these programs. We will apply a somewhat loose definition of “comprehensive interventions,” by including also those interventions that do not necessarily target all areas in their intervention but target key or pivotal areas that are assumed or postulated to have comprehensive impact on the children’s functioning.

Following this definition of comprehensive interventions, seven interventions were identified. These were as follows: (1) Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH), (2) Sensory Integration Therapy, (3) FloorTime, (4) Early and Intensive Behavioral Intervention (EIBI), (5) Pivotal Response Training, (6) Relationship Development Intervention Program (RDI), and (7) the Early Start Denver Model (ESDM). In what follows, each of these interventions will be briefly described, starting with TEACCH.

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## **Overview of Comprehensive Educational Interventions Programs**

### **Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH)**

TEACCH was founded at the University of North Carolina in 1966 by psychologist Eric Schopler (Mesibov et al. 2004). TEACCH is the most influential special education program for children with autism and is used by schools and school districts worldwide. The program is comprehensive, addressing multiple problems such as communication, cognition, perception, imitation, social skills, and motor skills. It emphasizes teaching in multiple settings with the involvement of several teachers. TEACCH was traditionally used in segregated self-contained classrooms for children with autism, but focus has shifted towards integrating children with autism to inclusive settings with typically developing children. In addition, increased emphasis has been placed on home programs using parents as co-therapists (Ozonoff and Cathcart 1998). TEACCH has also been

**Table 1** Key elements of TEACCH

#	Component description
1	Structured teaching: a teacher and a teacher's assistant share the responsibility of teaching a small group of children. Focus is placed on teaching independent work skills
2	Visual teaching: strategies to enhance visual processing are emphasized, including: <ul style="list-style-type: none"> <li>(a) The physical structure of the classroom</li> <li>(b) The use of a visual activity schedule to help children anticipate future events</li> <li>(c) Visual organization of the work materials to teach the tasks and their sequences</li> <li>(d) A visual system to teach complicated skills such as language and imitation</li> </ul>
3	Visual communication: the teaching of a communication system based on gesture, pictures, signs, or printed words
4	Pre-academic skills: teaching colors, numbers, shapes, drawing, writing, and assembly
5	Parent inclusion: encouragement for parents to work as co-therapists with their child in the home using the same techniques and materials as employed during the TEACCH clinic sessions

adapted for use in preschools and kindergartens and for use with adults in residential care settings.

An important philosophy behind the TEACCH approach is a respect for “the autism culture.” It embraces a philosophy that although individuals with autism are different, individuals with autism are not inferior to the non-autistic population. Therefore, TEACCH focuses on designing an educational environment that accommodates the “autistic” needs of individuals with autism.

A key element of the TEACCH approach is structured teaching. This involves a highly structured and predictable classroom environment and the use of visual learning. The preference for structure and visual learning is a strength of many persons with autism. A typical TEACCH classroom has separate, defined areas for different types of work, such as one specific area for individual work, one area for group activities, and one for play. Teachers use pictures (or other means of visual support) to help communicate the child's schedule, aiming to help the student to transition between activities.

The TEACCH approach, as described in several manuals and books (Mesibov et al. 2004; Schopler et al. 1995), typically contains the five components presented in Table 1.

## Sensory Integration Therapy

The Sensory Integration approach was developed by occupational therapist and psychologist Jean Ayres in the 1970s (Ayres 2005). Ayres had noted that children with autism commonly experience sensory difficulties such as low arousal levels, a decreased sensitivity to visual or auditory stimuli, poor organizational and motor planning skills, and hypersensitivity to sound or touch. The aim of SIT is to remediate the sensory integration dysfunctions exhibited by children with autism (Parham et al. 2007). This is done by providing various types of sensory stimulation to the vestibular, proprioceptive, and tactile systems. Such stimulation may

**Table 2** Key elements of Sensory Integration Therapy (SIT)

#	Description
1	Offer the child a variety of stimulation (tactile, vestibular, proprioceptive)
2	Adjust exercises so as to challenge the child appropriately
3	Stimulate the child so as to find an optimal level of arousal
4	Stimulation may consist of brushing or rubbing part of the body, spinning or swinging, sitting on a bouncy ball, riding a scooter board, wearing a weighted vest, or being squeezed between pads or pillows
5	Type of sensory stimulation is based on a sensory profile derived from an assessment of the child’s sensory deficits

consist of brushing or rubbing part of the body, spinning or swinging, sitting on a bouncy ball, riding a scooter board, wearing a weighted west, or being squeezed between pads or pillows. Which type of sensory stimulation used for a particular child is based on a profile derived from an assessment of the child’s sensory deficits. SIT is among the most common educational interventions provided to children with ASD, and key features of the intervention are summarized in [Table 2](#).

**FloorTime**

FloorTime was developed by child psychiatrist Stanley Greenspan and colleagues in the late 1980s (Greenspan and Wieder [2006](#)). It is a type of play therapy designed to increase the social relationship between the child and the adult and to help advance the child’s emotional development though a specific developmental sequence. In this developmental sequence, one step must be mastered before moving on to the next step. FloorTime starts with an assessment of the child’s level of emotional functioning, and based on the results of this assessment, an intervention program is designed.

FloorTime is currently used in home-based programs, clinics, schools, and hospitals, and in contrast to Sensory Integration, which target sensory difficulties in order to foster normal development, FloorTime address emotional development to achieve the same goal.

Initially, FloorTime involves meeting the child at his or her current developmental level. The parent or therapist follows the child’s initiative and tunes into the child’s leads and interests while providing playful positive input to the child. Once a child-adult interaction is established, specific techniques are used to help the child to move up a developmental ladder outlined in the DIR Model (Developmental, Individual differences, Relationship-based Model). As a result, it is postulated that children can become more social and less repetitive and also develop symbolic language (Greenspan and Wieder [2006](#)).

Greenspan has described six stages of emotional development that children need to master to achieve normal emotional development and learning. The steps in the DIR Model are shown in [Table 3](#). Most typically developing children have

**Table 3** The steps of the DIR Model in FloorTime

#	Step
1	Shared attention: the child regulates his or her attention and behavior and is interested in the full range of sensations (e.g., sights, sounds, smells, own movement patterns). The child shows shared attention with another person. The goal is that the child is calm, organized, and able to attend and interact
2	Forming relationships: the goal is that the child is able to engage with others through a range of emotions and activities, that he/she does not disengage when upset, and that the child displays a range of affect
3	Purposeful interaction: the child enters into two-way purposeful communication. At its most basic level, this involves helping the child open and close circles of communication. The goal is that the child is intentional, purposeful, and persistent, and can use gestures to convey intent
4	Problem solving: the child strings together many circles of communication/problem solving into a larger pattern leading the child to begin developing a sense of self and self-esteem. The goal is that the child can sustain interactions for longer periods of time, using motor planning to solve problems; is persistent in interactions; and displays a strong sense of self
5	Symbolic thinking: the child is able to create mental representations, to engage in pretend play, or use words, phrases, or sentences to convey some emotional intention
6	Emotional thinking: the child makes connections between different internal representations or emotional ideas. The goal is that the child can connect ideas logically, answer “why” questions and understand the underlying meaning behind ideas, give reasons behind their emotions, and display higher-level thinking abilities

mastered these six stages by time they are 5 years of age. Children with autism, on the other hand, struggle with or have missed some of these developmental stages. The reasons for this may be that children with autism experience individual differences in sensory systems, experience problems with motor planning, and/or are unable to connect their desires with performing intentional actions and communication. As a consequence, normal development is hampered, and instead, autistic symptoms emerge. FloorTime is sometimes used during a child's daily playtime in conjunction with other interventions such as EIBI (see below).

## Early and Intensive Behavioral Intervention

EIBI builds on Applied Behavior Analysis (ABA) and was pioneered by psychologist O. Ivar Lovaas and colleagues in the 1970s and 1980s. EIBI rests on several hundred experimental studies on ABA published in peer-reviewed journals (Cunningham and Schreibman 2008; Matson and Lovullo 2008; Matson et al. 2007). A working hypothesis is that children with autism have a biologically based learning deficit and that principles derived from learning psychology may be used to help the children to acquire skills exhibited by typical children and to reduce aberrant behaviors. Moreover, it is hypothesized that some children may overcome their learning deficit, enabling them to learn age-appropriate behaviors and, eventually, to learn from typical education (Lovaas 2003).

**Table 4** Defining features of EIBI

#	Description
1	Comprehensive: individualized and comprehensive treatment, addressing all skill domains
2	Normal developmental sequences guide intervention goals and short-term objectives
3	ABA procedures: several behavior analytic procedures are used to teach new skills and to reduce interfering behavior (e.g., differential reinforcement, prompting, discrete trial teaching, natural environment teaching, and task analysis)
4	Supervision: professionals with advanced training in ABA and advanced training in EIBI with young children with autism direct and supervise the intervention
5	Parents serve as active co-therapists for their children
6	Intervention is initially delivered one-to-one, with gradual transitions to small-group and large-group formats when warranted
7	Variety of settings: intervention typically begins in the home and continues in other environments, with gradual, systematic transitions to preschool, kindergarten, and elementary school when children develop the skills required to learn in those settings
8	Intensive, year-round teaching, including 20–40 h of structured sessions per week plus informal instruction and practice throughout most of the children’s other waking hours
9	Ideally, most children start intervention in the preschool years

EIBI is an individualized and comprehensive treatment, addressing all skill domains. The defining features of EIBI are described in [Table 4](#). Normal developmental sequences (i.e., data from developmental psychology) guide the selection of intervention goals and objectives. A number of behavior analytic procedures and principles are used to teach new skills and to reduce interfering behavior, such as discrete trial teaching, natural environment teaching, reinforcement, prompting, errorless learning, and task analysis. Moreover, professionals with advanced training in ABA and advanced training in EIBI with young children with autism supervise the intervention. Parents serve as active co-therapists for their children, and they receive the same type of training as the other teachers on the child’s team. The intervention is initially delivered one-to-one, with gradual transitions to small-group and large-group formats. Intervention typically begins in the home and is carried over into other environments, with gradual, systematic transitions to preschool, kindergarten, and elementary school classrooms when children develop the skills required to learn in those settings. It involves intensive, year-round teaching, including 20–40 h/week of structured teaching, plus informal instruction throughout most of the remaining time. In most cases, this intensive intervention lasts for a minimum of 2 years, and most children start intervention in the preschool years. For more information, see the chapter dedicated to EIBI, “► [Early and Intensive Behavioral Intervention \(EIBI\) in Autism](#),” in this volume.

**Pivotal Response Training**

Pivotal Response Treatment (PRT) is another intervention derived from ABA and was developed in the 1980s (Koegel and Koegel [2012](#)). PRT is a play-based and



**Table 5** Pivotal areas taught in Pivotal Response Training (PRT)

#	Description
1	Responding to multiple cues: the child is taught to respond to many features of a stimulus, or combinations of stimuli
2	Motivation: teacher follows the child’s lead and uses natural reinforcers. Teacher reinforces attempted responses
3	Self-management: teaching self-monitoring and shifting the responsibility of training from the therapist/teacher to the child
4	Maximizing initiatives from the child, making responses functional and spontaneous in natural settings

child-initiated intervention and is designed to decrease disruptive and stereotyped behaviors and to increase communication, social, and academic skills. In contrast to EIBI, PRT does not involve discrete trial teaching (DTT). DTT is a procedure which targets individual behaviors based on an established curriculum. Rather than focusing on individual behaviors, PRT is designed to address critical, or “pivotal,” behaviors that affect a wide range of behaviors, summarized in [Table 5](#). These pivotal behaviors include response to multiple cues, motivation, self-management, and the initiation of social interactions. Responding to multiple cues focuses on teaching children to be responsive to a number of different stimuli. Instructions must contain more than one cue to which the child must attend, in the hope that this will facilitate learning and generalization across various settings such as home, school, and community. Improving the child’s motivation is done by providing the child with opportunities to choose materials, topics, and toys during sessions and by use of natural reinforcers. For example, if a child makes a meaningful attempt to request a stuffed animal, the reinforcer is the stuffed animal, and not other items that the child likes. Increasing self-management capacity involves teaching children to be aware of their inappropriate behavior, to collect data on those behaviors, and to reward themselves or to request rewards from others. Increasing self-initiations involves teaching children to make initiations as a result of natural cues in the environment. Specifically, self-initiation training primarily consists of teaching children to spontaneously ask questions to gain information. By targeting these pivotal areas, PRT aims to produce broad improvements.

**Relationship Development Intervention Program**

RDI was developed by psychologist Steven Gutstein in the 1990s (Gutstein [2009](#)). RDI is a parent-based, cognitive-behavioral-developmental approach, in which primary caregivers are trained to provide daily opportunities for successful functioning in increasingly challenging dynamic systems. RDI builds on the theory that “dynamic intelligence” is a key to helping individuals with autism to develop typical behaviors. Dynamic intelligence is the ability to think flexibly, appreciate

**Table 6** Teaching goals for Relationship Development Intervention Program (RDI)

#	Teaching goal
1	Emotional referencing where the child learns from the emotional and subjective experiences of others
2	The ability to observe and control behavior to successfully participate in social relationships
3	Declarative language, where the ability to use language and nonverbal communication to express curiosity, invite interactions, share perceptions and feelings, and coordinate with others
4	Flexible thinking: the ability to adapt and alter plans as circumstances change relational information processing
5	The ability to put things into context and solve problems that lack clear-cut solutions
6	Foresight and hindsight: the ability to anticipate future possibilities based on past experiences

different perspectives, cope with change, and integrate information from multiple sources (e.g., auditory and visual stimuli).

RDI has six main objectives. These are emotional referencing, social coordination, declarative language, flexible thinking, relational information processing, and foresight and hindsight (See [Table 6](#)).

The core philosophy behind RDI is that individuals with ASD can participate in authentic emotional relationships if they are exposed to them in a gradual, systematic way. The goal of the intervention is to systematically build up the motivation and tools so that the child can successfully develop social relationships and to correct the behavioral excesses and deficits exhibited by children with ASD. Although RDI is a home-based, parent-based approach, it is also used by professionals, and it can be delivered at home or in preschools and kindergartens (Gutstein [2009](#)).

### The Early Start Denver Model

The ESDM is the most recent comprehensive education model for children with ASD (Dawson et al. [2010](#)). It is an extension of the Denver Model, which was developed by psychologist Sally Rogers and colleagues in the 1980s. ESDM is a comprehensive early behavioral intervention for infant to preschool-aged children with ASD that integrates applied behavior analysis with developmental and relationship-based approaches. Its core features are shown in [Table 7](#).

The program encompasses a developmental curriculum defining the skills to be taught and a set of teaching procedures used to help the child develop these skills. It can be provided by therapists and/or parents in group programs or individual therapy sessions in either a clinic setting or the child’s home. Its core features include naturalistic ABA procedures such as PRT, and it is similar to PRT in the way that it does not use discrete trial teaching. The intervention focuses on interpersonal exchange and positive affect, shared engagement, and joint activities with the child during play sessions. Language and communication is taught inside a positive, affect-based relationship (Dawson et al. [2010](#)).

**Table 7** Defining features of Early Start Denver Model (ESDM)

#	Feature
1	Naturalistic applied behavioral analytic strategies
2	Sensitive to normal developmental sequence
3	Parental involvement
4	Focus on interpersonal exchange and positive affect
5	Shared engagement with joint activities
6	Language and communication taught inside a positive, affect-based relationship

**Outcome Research**

In the following part of this chapter, outcome studies evaluating the various treatment models described above are identified and reviewed. To identify relevant outcome studies, two different search methods were used. First, electronic searches on Medline (US National Library on Medicine) were conducted. Second, recent studies were inspected to confirm that the computer search identified all relevant studies.

In general, with the possible exception of EIBI, the literature review identified a lack of outcome research evaluating educational interventions for children with ASD. Also, for the studies that have been conducted, the scientific quality varied greatly, and scientific quality needs to be taken into account when drawing conclusions regarding treatment efficacy.

To help evaluate the scientific quality of outcome studies on educational interventions for children with ASD, Eikeseth (2009) set up criteria pertaining to the quality of the research design used, the quality of the diagnostic work-up, the type and quality of outcome measures, and treatment fidelity. Four levels were used to classify scientific merit: Level 1 represented the highest possible rating, Level 2 a moderate scientific merit, Level 3 a low scientific merit, and, finally, Level 4 represented Insufficient Scientific Value. The criteria for the different levels of scientific merit are shown in Table 8, and studies identified at different levels of scientific merit are presented in Table 9.

In what follows, we will briefly review Level 1–3 scientific-merit studies. Studies classified with Insufficient Scientific Value are shown in Table 9 but will not be reviewed here.

**TEACCH**

One Level 1 scientific-merit study evaluating TEACCH was recently published by Welterlin et al. (2012). The study evaluated the efficacy a 3-month, TEACCH parent-training intervention. Twenty families were randomly assigned to a treatment group or a waitlist group. All families were compared at pre- and posttreatment on the Mullen Scales of Early Learning, Scales of Independent Behavior-Revised, and the Parenting Stress Index. Direct measure of the children’s

**Table 8** Criteria for scientific merit

Scientific merit	Description
Level I	Randomized group assignment, independent diagnosis based on diagnostic instruments or manual (e.g., DSM), independent or blind pre-/post-assessments of both IQ and adaptive behavior, and measurement of treatment fidelity or reference to specific manual
Level II	Same as above but without randomization between treatment and control groups
Level III	Lacking any other of the criteria of a Level I study
Insufficient Scientific Value	Pre-post designs without a comparison group, retrospective (archival) studies without comparison group, or pre-post designs without single-case control

**Table 9** Studies with a scientific Level of 1, 2, 3 or insufficient scientific value

Level	Intervention	Studies
1	TEACCH	Welterlin et al. <a href="#">2012</a>
	EIBI	Smith et al. <a href="#">2000a, b</a>
	ESDM	Dawson et al. <a href="#">2010</a>
2	TEACCH	Panerai et al. <a href="#">2009, 2002</a>
	EIBI	Cohen et al. <a href="#">2006</a> ; Eikeseth et al. <a href="#">2002, 2007</a> ; Howard et al. <a href="#">2005</a> ; Remington et al. <a href="#">2007</a> ; Grindle et al. <a href="#">2012</a>
3	TEACCH	Mukaddes et al. <a href="#">2004</a> ; Ozonoff and Cathcart <a href="#">1998</a>
	SIT	Piravej et al. <a href="#">2009</a> ; Pfeiffer et al. <a href="#">2011</a> ; Fazlioglu and Baran <a href="#">2008</a>
	EIBI	Anderson et al. <a href="#">1987</a> ; Bimbrauer and Leach <a href="#">1993</a> ; Eldevik et al. <a href="#">2006</a> ; Lovaas <a href="#">1987</a> ; Magiati et al. <a href="#">2007</a> ; McEachin et al. <a href="#">1993</a> ; Sallows and Graupner <a href="#">2005</a> ; Sheinkopf and Siegel <a href="#">1998</a> ; Smith et al. <a href="#">2000a, b</a> ; Weiss <a href="#">1999</a> ; Ben-Itzhak, and Zachor <a href="#">2007</a> ; Perry et al. <a href="#">2008</a> ; Hayward et al. <a href="#">2009</a> ; Peters-Scheffer et al. <a href="#">2010</a>
	FloorTime	Casenhiser et al. <a href="#">2011</a> ; Pajareya and Nopmaneejumruslers <a href="#">2011</a>
	Insuf. TEACCH	Lord and Schopler <a href="#">1989</a>
Insuf.	SIT	Ayres and Tickle <a href="#">1980</a> ; Hodgetts et al. <a href="#">2011a, b</a>
	EIBI	Bibby et al. <a href="#">2002</a> ; Handleman et al. <a href="#">1991</a> ; Harris et al. <a href="#">1991, 1990</a> ; Hoyson et al. <a href="#">1984</a> ; Luiselli et al. <a href="#">2000</a>
	FloorTime	Solomon et al. <a href="#">2007</a> ; Mahoney and Perales <a href="#">2005</a>
	PRT	Baker-Ericzén et al. <a href="#">2007</a> ; Pierce and Schreibman <a href="#">1997</a> ; Smith et al. <a href="#">2010</a> ; Koegel et al. <a href="#">1999</a>
	RDI	Gutstein et al. <a href="#">2007</a>
	ESDM	Vismara et al. <a href="#">2013</a>

“independent” behavior was compared across three matched pairs using a multiple-probe design. The results of the multiple-probe design showed the children’s independent behaviors increased for the majority of the six children after intervention started, but there was no statistically significant between-group differences between the intervention group and the control group on the Mullen Scales of Early Learning, Scales of Independent Behavior-Revised, or the Parenting Stress Index.

Two Level 2 scientific-merit studies have evaluated TEACCH. Panerai et al. (2009) compared the effectiveness of three different educational approaches: a residential TEACCH program, a TEACCH program implemented at home and at mainstream schools, and a group receiving inclusive education in mainstream schools using a nonspecific educational approach. Group assignment was based on applications for admissions for the various programs and, hence, was quasi random. Participants were 34 children with ASD and severe mental retardation with a mean chronological age of 9 years. Each participant was assessed at intake and 3 years into intervention, using the PEP-R and Vineland Adaptive Behavior Scale. Children in both TEACCH programs made greater progress on PEP-R raw scores and Vineland raw scores as compared to the children in the control group. Progress in raw scores, however, was not sufficient to increase standard scores. In fact, standard scores seem to have decreased over the course of the study for the participants in the experimental group. This is because the PEP-R developmental age increased with a mean of only 5 months over a 3-year intervention period.

The second Level 2 scientific-merit study was published by Panerai, Ferrante, and Zingale in 2002. Two educational interventions were compared: TEACCH and the integration program for individuals with disabilities. Participants were 16 children with ASD, matched on gender, chronological age, mental age, and diagnosis. Data on between-group differences were not reported. Pre-post comparisons showed that children in the TEACCH group made significant progress on PEP-R raw scores on all scales except fine motor. Progress in raw scores was also found on the Vineland Adaptive Behavior Composite Scale. However, as in Panerai et al. (2009), standard scores on the PEP-R and the Vineland seem to have decreased over the course of the study. For example, the PEP-R developmental age increased with a mean of only 4 months as a result of the 1-year intervention.

Two Level 3 scientific-merit studies have been published (Mukaddes et al. 2004; Ozonoff and Cathcart 1998). In the Ozonoff and Cathcart study, children in the treatment group improved significantly more on overall PEP-R scores and on several of the PEP-R subscales, as compared to a no-treatment control group. Progress was measured in months (developmental age).

Mukaddes et al. (2004) studied two clinical populations: reactive attachment disorder and ASD. Progress was measured by the Ankara Developmental Screening Inventory, which assesses parental reports of children's social, language/cognitive, social/self-care, fine motor, and gross motor functioning. Results showed that children with reactive attachment disorder showed greater improvement as compared to children with ASD in their total development score, on the language-cognitive subscale, and in social/self-care abilities, but not on the fine or gross motor subscales. Both groups showed significant improvements in raw scores on all subscales and on the total developmental score following the intervention.

In sum, although researchers report some benefits of TEACCH when this intervention is compared to other educational interventions or to nonspecific interventions, the gains obtained are modest. This is because gains are reported as changes in raw scores or developmental age and not as changes in standard scores.

Improvement in raw scores or developmental age may be obtained even if the participants fall further behind the norm group. As will be evident below, other treatments have reported gains in standard scores.

## SIT

We have identified three Level 3 scientific-merit studies evaluating SIT. Piravej et al. (2009) assessed whether traditional Thai massage resulted in positive therapeutic effects on behavioral and emotional behaviors in children with autism. Sixty children (3–10 years old) were randomly assigned to a SIT group or a SIT plus massage group. Dependent measures were the Conners' Parent Rating Scale (CPRS) and Conners' Teacher Rating Scale (CTRS) measuring conduct problems, learning problems, hyperactivity, anxiety, psychosomatic issues, and inattention. Both groups received SIT twice per week, 1 h per session for 16 sessions. In the SIT plus massage group, the child was instructed to lie down facing upward while the masseuse applied pressure to the soles of the feet. Both groups showed significant improvement on the CTRS and sleep behavior. On the CPRS, only anxiety was reported to have improved. Significant improvements were not reported in conduct, learning, psychosomatic, impulsivity, or hyperactivity.

Another Level 3 study was published by Pfeiffer et al. (2011). Participants were 32 males and five females (aged 6 to 12 years), 21 with autism and 16 with PDD-NOS. All participants had an additional diagnosis of sensory processing disorder. A stratified random assignment was used to assign participants to a SIT group or to a control group targeting fine motor behavior. Dependent measures were (a) the Sensory Processing Measure (SPM) assessing processing issues, praxis, and social participation; (b) the Social Responsiveness Scale (SRS) measuring social impairments, awareness, information processing, and communication, anxiety, and autism traits; (c) the Goal Attainment Scale (GAS) which measures progress on individualized goals; and (d) the Quick Neurological Screening Test 2nd Edition (QNST-II) which identifies possible neurological interference with learning. SIT involved 18 sessions of 45min each over a 6-week period. Results showed that the SIT group displayed significantly fewer autistic mannerisms than the fine motor group as measured by one subscale of the SRS. No between-group differences were found on the GAS, QNST-II, SPM, or other SRS subscales. Both groups made significant improvement on the GAS.

Another Level 3 study was published by Fazlioglu and Baran (2008). Thirty children with autism were randomly assigned to treatment or control group. SIT consisted of brushing and joint compression, followed by a set of activities designed to meet the child's sensory needs and integrated into the child's daily routine. Concurrently, prompting, reinforcement, and extinction were used to teach specific motor behaviors to children in the experimental group. A checklist created by the researchers was used to determine the severity of sensory processing abnormalities.

There was a statistically significant between-group effect for total scores. The results are difficult to interpret, however, due to the simultaneous implementation of ABA components that directly targeted skills related to the dependent variable.

In sum, none of the studies evaluating SIT involve assessment of cognitive functioning or adaptive functioning, as is required to receive Level 1 scientific merit. Also, the studies did not assess long-term effects of SIT. Rosen et al. (2012) performed a comprehensive review of SIT and concluded that SIT may be acceptable as one of the components of a comprehensive treatment plan. They also noted that the amount of research regarding the effectiveness of SIT is limited and inconclusive.

## Floor Time

Two studies reached Level 3 scientific merit (Casenhiser et al. 2011; Pajareya and Nopmaneejumrulers 2011).

Casenhiser et al. (2011) reported results from an ongoing randomized controlled trial of 51 children aged 2 to 5 years. Participants were assigned to either a FloorTime or community treatment group. Families in the FloorTime group were given 2 h of therapy and coaching each week. Children in the community treatment group received a variety of services averaging 4 h per week. After 12 months, outcomes were measured to determine changes in the groups in social interaction and communication. Results suggest that children in the treatment group made significantly greater gains in social interaction skills in comparison to the community treatment group, but no between-group differences were found for standardized measures of language.

Pajareya and Nopmaneejumrulers (2011) evaluated FloorTime compared to the routine care of preschool children with autistic spectrum disorder. After the parents added FloorTime intervention at an average of 15 h/week for 3 months, the intervention group made significantly greater gains on the Functional Emotional Assessment Scale, Childhood Autism Rating Scale, and the Functional Emotional Questionnaire.

In sum, the two Level 3 scientific-merit studies indicate that FloorTime may improve social and emotional behaviors and autism symptoms of children with autism, but similar to what was found with SIT, none of the studies involve assessment of cognitive functioning or adaptive functioning.

## ESDM

Two outcome studies have been published evaluating ESDM. One of the two studies has reached Level 1 scientific merit (Dawson et al. 2010) and the other has Insufficient Scientific Value (Vismara et al. 2013). Dawson et al. (2010) conducted a randomized, controlled trial to evaluate the efficacy of the ESDM.

Forty-eight children, age 18–30 months, were randomly assigned to either ESDM intervention or to treatment-as-usual. Children in the ESDM group received 20 h of one-to-one treatment for 2 years, and participants in the treatment-as-usual group received 9.1 h of differing interventions for 2 years. Children who received ESDM showed significant improvements in IQ, adaptive behavior, and autism diagnosis as compared to children in the control group. Two years after entering intervention, the ESDM group on average improved their standard scores on intellectual functioning by 17.6 points as compared to a gain of seven points for the children in the control group. Children who received ESDM were more likely to experience a change in diagnosis from autism to pervasive developmental disorder, not otherwise specified, than the control group. However, the ESDM group did not improve their standard scores in adaptive behavior.

In sum, one well-designed study has evaluated ESDM, and this study reported reduction in autism symptoms and gains on standard scores in intellectual functioning. However, standard scores in adaptive functioning did not increase as a result of the intervention.

## **PRT**

Four outcome studies have been published, and all have Insufficient Scientific Value. Hence, there is an urgent need to evaluate PRT using more enhanced research methodology than has been the case to date.

## **Relationship Development Intervention (RDI)**

We were able to identify only one study evaluating outcome of RDI (Gutstein et al. 2007), and this study was classified with Insufficient Scientific Value. Hence, there is an urgent need for research evaluating outcomes of RDI.

## **EIBI**

Eikeseth (2009) identified one Level 1 scientific-merit study, four Level 2 scientific-merit studies, nine Level 3 scientific-merit studies, and six studies with Insufficient Scientific Value. Several of the studies evaluating outcomes of EIBI reported significant increases on standard scores in both intellectual functioning and adaptive functioning, as well as reductions in autistic symptoms and aberrant behaviors (Eikeseth 2009).

Since the Eikeseth (2009) review, several additional outcome studies have been published; one has reached Level 2 scientific merit (Grindle et al. 2012) and five studies have reached Level 3 scientific merit (Ben-Itzhak and Zachor 2007; Eldevik et al. 2012; Hayward et al. 2009; Peters-Scheffer et al. 2010; Perry et al. 2008). These studies report results similar to the ones reviewed in Eikeseth (2009).



Recently, several meta-analyses evaluating outcome of EIBI have been published. Meta-analysis is used to analyze the combined results of several studies to allow for a more thorough analysis of intervention effects. Reichow and Wolery (2009) performed a meta-analysis based on 12 EIBI outcome studies and reported a mean effect size of 0.69 for IQ change. By convention, this is considered a moderate effect size in terms of clinical impact and Reichow and Wolery concluded that EIBI is an effective treatment for children with autism.

Another recent meta-analysis was conducted by Eldevik and colleagues (2009) and replicated and extended the meta-analysis by Reichow and Wolery (2009). In contrast to Reichow and Wolery, Eldevik et al. included only those studies containing comparison or control groups and based the analysis on individual participant's data (obtained from the authors) rather than group average data, as reported in the original studies. Results showed an effect size of 1.10 for IQ and 0.66 for adaptive behavior. The effect size of 1.10 for IQ change is considered, by convention, large and was larger than the moderate effect size reported by Reichow and Wolery (2009). There may be at least two explanations for this difference. First, Eldevik et al. used the more methodologically rigorous standardized mean difference effect size, whereas Reichow and Wolery computed their mean effect size based on the change within the EIBI group only. The mean change effect size is computed without comparison data and does not include spontaneous maturation. Second, Eldevik et al. applied a more precise yet inclusive definition of EIBI, introduced by Green et al. (2002), similar to how professionals normally define EIBI. The effect size for adaptive functioning obtained by Eldevik et al. is considered moderate. Reichow and Wolery (2009) did not include effect size on adaptive behavior in their analysis.

Makrygianni and Reed (2010) reported a moderate mean change effect size for IQ and a moderate to high effect size for adaptive functioning. The meta-analysis was based on 14 studies, but the studies selected for the analysis were somewhat different from those included in the previously mentioned meta-analyses. Peters-Scheffer et al. (2011) included 11 studies in their meta-analysis and reported that EIBI outperformed the control groups on IQ, nonverbal IQ, expressive and receptive language, and adaptive behavior. Differences between the EIBI and control groups on standard scores were 11–16 points on standardized and normed tests of cognitive functioning.

The results of these meta-analyses support the assertion that EIBI may facilitate clinically and socially valid gains in intellectual, social, language, and adaptive functioning in preschool-aged children with autism (Reichow 2012).

In sum, EIBI is by far the best researched and best documented intervention for children with ASD and has been shown to produce significant increases on standard scores in both intellectual functioning and adaptive functioning, and reductions in autistic symptoms and aberrant behaviors. A more thorough description of these studies is found in the chapter describing EIBI, “► [Early and Intensive Behavioral Intervention \(EIBI\) in Autism](#),” in this volume and in Eikeseth (2011).

## Evidence-Based Interventions

Governmental agencies, including the United States National Research Council Committee on Educational Interventions for Children with Autism (2001), have set up national review groups to review research on treatment for autism to establish which types of interventions may be considered evidence based and could thus be recommended as appropriate interventions for children with autism. In an attempt to do so, Rogers and Vismara (2008) reviewed comprehensive intervention programs using the criteria for “well established” or “probably efficacious” from Chambless and Hollon (1998). “Well-established” interventions required that (a) the treatment was described in treatment manuals, (b) participant groups were clearly specified, and (c) either (i) two independent well-designed group studies showing the treatment to be better than placebo or alternative treatment or equivalent to an established effective treatment or (ii) nine or more single-subject design studies using a strong research design and a comparison to an alternative treatment.

To achieve status as a “probably efficacious” intervention, requirements included (a) clearly specified subject groups and (b) either (i) two studies showing better outcomes than a no-treatment control group; or (ii) two strong group studies by the same investigator showing the treatment outperformed placebo or alternative treatment, or treatment was equivalent to an established treatment; or (iii) three or more single-subject design studies that have a strong design and compare the intervention to another type of treatment.

Based on these criteria, Rogers and Vismara (2008) concluded that EIBI (“Lovaas method”) could be considered “well established” and that no other educational interventions were either “well established” or “probably efficacious.” Since Rogers and Vismara’s (2008) review, several outcome studies evaluating EIBI have been published, together with a number of meta-analyses. These meta-analyses report large to moderate effect sizes for IQ and adaptive behavior (Reichow 2012).

Although the ESDM carries considerable promise, it is neither well established nor probably efficacious since only one outcome study has been published. Hence, to date, only EIBI can be considered an evidence-based intervention for children with ASD.

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## Conclusions

Since the 1960s and until today, a large number of comprehensive intervention programs for children with ASD have been developed. Our review identified seven comprehensive educational interventions. These were (1) Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH), (2) Sensory Integration Therapy, (3) FloorTime, (4) Early and Intensive Behavioral Intervention, (5) Pivotal Response Training, (6) Relationship Development Intervention Program, and (7) the Early Start Denver Model.

A literature review identified a lack of outcome research evaluating these educational interventions. Also, for the studies that have been conducted, the scientific quality varied greatly, and scientific quality needs to be taken into account when drawing conclusions regarding treatment efficacy.

Results of the literature review shows that EIBI is by far the best researched and best documented intervention for children with ASD. Several studies have demonstrated that EIBI might produce significant increases on standard scores in both intellectual functioning and adaptive functioning as well as reductions in autistic symptoms and aberrant behaviors. Another recent comprehensive intervention, the ESDM, carries considerable promise. However, to date, only one outcome study evaluating ESDM has been published. Hence, only EIBI can be considered an evidence-based intervention for children with ASD.

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## Key Terms

*Comprehensive Educational Intervention.* A comprehensive educational intervention for autism is one which addresses all the core deficits in autism.

*TEACCH.* TEACCH is an intervention which stresses the need for structured visual teaching.

*SIT.* SIT assumes that autism is caused by a dysfunctional sensory system, which the treatment aims to reintegrate.

*FloorTime.* FloorTime is a mainly parent-directed intervention which stresses the need for relationships and shared attention.

*EIBI.* EIBI aims to teach the full range of social and language skills by intensive use of teaching techniques derived from behavior analysis.

*PRT.* PRT is a behavior analytic intervention which targets key behaviors needed for the child to continue learn social and language skills.

*RDI.* RDI is an intervention which aims to build flexible thinking.

*ESDM.* ESDM integrates behavior analysis with developmental and relationship-based approaches.

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## Key Facts of Educational Interventions

- There are several non-comprehensive interventions for children with autism, with sound scientific support. These include PECS, functional analysis of problem behaviors, and eating interventions.
- To achieve generalized and profound therapeutic results for children with autism, comprehensive educational interventions are necessary.
- Many comprehensive interventions have been developed, based on different theoretical understandings of learning and the specific problems of children with autism.

- EIBI is the comprehensive intervention which has been most extensively studied and which has shown the largest treatment effects for children with autism.
- More research on educational interventions is needed.

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## Summary Points

- There are a number of interventions for children with autism, of which only a minority has been studied scientifically.
- EIBI remains the intervention with the best scientific support.
- Other comprehensive interventions such as ESDM have shown promising results, but more research is needed before this can be considered a scientifically supported treatment.
- For an intervention to be considered scientifically supported, it should be well defined, as in a manual, and have been investigated in a randomized study with outcome measures including both adaptive behaviors and IQ.
- The scientific support is scarce for many of the educational interventions that currently are offered children with autism.

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