

## A Systematic Review of Social Communication and Interaction Interventions for Patients with Autism Spectrum Disorder

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### Abstract

**Background:** Autism spectrum disorder (ASD) is currently not curable, but it may be malleable to varying degrees in response to different interventions to improve outcomes.

**Objective:** We conducted a systematic review of interventions aimed at ameliorating social communication impairments in patients with ASD. This study was registered in the International Prospective Register of Systematic Reviews (no. CRD42013003780).

**Methods:** We focused on the ASD interventions that are frequently applied in Swedish clinical practice to address ASD. To ensure stakeholder involvement, we also conducted two surveys with three major Swedish ASD interest organizations to assess perceived research priorities for ASD treatment. With the use of this rationale for selection, Early Intensive Behavioral Intervention [EIBI], Treatment and Education of Autistic and Related Communication Handicapped Children [TEACCH], social skills training groups, and interventions that involved significant others were reviewed. A bibliographic search was conducted via five databases: Medline, PubMed, PsycInfo, CINAHL, and ERIC. Identified articles were screened for relevance by two independent reviewers, who also assessed the risk of bias in randomized controlled trials using systematic checklists.

**Results:** A total of 7264 citations were identified as being published before February 2013, and 109 studies (18 of EIBI, 18 of social skills training, 4 of TEACCH, and 69 of interventions involving significant others) were included in the analysis. The included studies provided some support for the positive effects of each of the interventions; this is especially true if the most recently published research (March 2013 through August 2015) is considered, and a crude updated search for relevant randomized controlled trials was performed. The interventions that involve the significant others of individuals with ASD form a heterogeneous area of treatment strategies that require subcategorization for future review.

**Conclusions:** These findings provide preliminary support for treatments that are commonly used in clinical practice for the treatment of ASD in Sweden. However, larger and more rigorously designed and controlled studies are still needed before definitive conclusions regarding their effects can be made.

**Key words:** Autism spectrum disorder; pervasive developmental disorder; treatment; intervention; therapy; review.

### Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that is defined in the

*Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V)* as involving either current or historical deficits in social communication and

interaction across multiple contexts; it also includes restricted and repetitive patterns, interests, or activities as manifested by at least two prototypically inflexible behaviors. An internationally increasingly accepted prevalence estimate for ASD among school-aged children is approximately 1% (1), although some more recent studies have reported figures that are substantially higher (2), and the percentage of diagnosed cases among adolescents between the ages of 13 and 17 years in Stockholm County, Sweden, reached 2.6% in 2011 (3). Males are affected three to four times more often than females, and comorbidity with other neurodevelopmental disorders and other psychiatric or neurological disorders is the rule rather than the exception (4). ASD is a brain-based disorder of complex origin that is currently not considered curable, although many have claimed that certain developmental, educational, psychological, pharmacological, and complementary and alternative interventions have resulted in improvements or even cured this condition (5,6).

Recent systematic reviews of some behavioral interventions for individuals with ASD have demonstrated low to moderate evidence for the improvement of ASD symptoms as well as cognitive or adaptive functioning; these have included early behavioral intervention and social skills and social cognition training (7-11). Systematic reviews are deemed the gold standard for evaluating evidence in clinical science. The method summarizes the existing scientific knowledge in terms of randomized controlled trials (RCTs), which may serve as a basis for the making of political decisions that affect future clinical services development and prioritization. Systematic reviews describe the availability of high-quality studies for certain interventions, but they should not be confused with immediate or absolute recommendations by clinicians for the use (or ceasing of use) of certain techniques in clinical practice. They are not intended and are equally unable to assess the actual quality of regional clinical services, so their findings should therefore be interpreted with prudence (12). In addition, many systematic reviews of interventions for patients with ASD have focused on efficacy rather than effectiveness and directed relatively little attention toward implementability (13).

The aim of this study was to conduct a systematic review of ASD interventions that are aimed at ameliorating social communication impairments. As compared with earlier systematic reviews, this work not only incorporates the current state of science but also addresses health care practices as well as societal and social network issues, which accounts for several aspects of the generalizability and applicability of intervention methods. In addition to providing an

update on intervention techniques covered by prior studies—particularly Early Intensive Behavioral Intervention (EIBI), Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH), and social skills training—this article also covers interventions that involve significant others, which are assessed here for the first time. The choice of intervention techniques to be reviewed was based on those commonly applied during the clinical treatment of individuals with ASD in Swedish child and adolescent psychiatry and habilitation services. We also addressed those interventions deemed important by stakeholders, such as those that involve the relatives of the affected individual. We will first briefly and generally describe the different interventions reviewed as well as their objectives, concepts, and target groups. This will be followed by a discussion of the selection process and then the actual systematic literature review for each of the four study areas selected.

### **Reviewed social communication and interaction interventions for autism spectrum disorder**

*Early Intensive Behavioral Intervention.* EIBI is currently one of the most widely used and accepted treatments for infants and young children with ASD. It involves several typical components: a 1:1 trainer-to-child ratio, intense intervention of 20 to 40 hours per week for up to 4 years, and discrete trial training in home or preschool settings. Discrete trial training is a teaching method in which learning units are simplified and structured: a skill is not taught as a whole but rather broken down and then conveyed one step at a time. Normally, the method is carried out or supervised by personnel who are certified in applied behavior analysis (14). This type of analysis seeks to develop appropriate behavior repertoires and to decrease or reduce inappropriate behaviors by employing the following methods: 1) positive reinforcement, such as praise, a token, or a favorite activity; 2) shaping, which involves reinforcing the individual for exhibiting behavior that approaches the target behavior or goal; 3) fading, which reduces the individual's dependence on the trainer for help; 4) prompting, which includes providing cues as to the performance of an appropriate behavior; and 5) maintenance strategies, which help to ensure the generalization of the learned behavior and the avoidance of inappropriate behaviors (e.g., analyzing and manipulating the antecedents that trigger the behavior, ignoring the behavior, providing undesired or unpleasant consequences). Possible variables that affect EIBI outcomes may be the treatment provider (e.g., parent, clinician, teacher), the treatment intensity and duration, the quality of the supervision and the intervention settings, and the allegiance to the method (15).

*Treatment and Education of Autistic and Related Communication Handicapped Children.* TEACCH is an educational program that was developed during the 1960s at the University of North Carolina (16). It is broadly used by organizations that provide services for individuals with ASD and their families to improve the affected subject's functioning at home (or in a group home) and in the classroom. TEACCH acknowledges that ASD is a disorder of neural development that affects both cognitive and emotional development, and it tries to identify ways to facilitate everyday activities with the use of visual information processing, visual clarity and frugality, and the reduction of distractibility. The latter aims to compensate for attention deficits; difficulty with organizing ideas, materials, and activities; poor use and understanding of verbal and non-verbal language in social interactions; and difficulty with generalization processes. TEACCH suggests that individuals with ASD benefit from a highly structured teaching approach that provides routine and predictability (17). This so-called "structured teaching" builds on several principles, such as the individualized assessment of communication, self-care, vocational, and leisure time skills. Specific instruments such as the Psychoeducational Profile (18) are used to identify the patient's strengths and interests to facilitate learning processes, and family involvement is assessed to facilitate the generalization of skills. Major components of structured teaching include the organization of the physical environment by visual cues (space is adapted for specific activities [e.g., colored areas for play]), the sequential organization of activities (visual schedules show activities for the day), the introduction of routines (increasing predictable events), and the organization of tasks and materials (activity materials are located in the places where activities are being carried out).

*Social skills training.* This intervention approach attempts to teach children with ASD the skills they need to engage in social interaction and communication to create opportunities for social contact, to behave in socially expected ways, to build social relationships, and to increase the likelihood that they will experience social interaction as both meaningful and enjoyable (19). Social skills training is usually conducted in a group setting, and it typically involves rather high-functioning individuals with ASD in a structured lesson format. For young children, the training may focus on simple acts such as offering a greeting, joining a peer in playing with a toy, or sharing a preferred object. For older individuals, the training commonly involves the acquisition of social rules, social cognition exercises, perspective and turn taking, and the avoidance of and

copied with conflicts. Social skills training is generally designed for individuals who are 6 years old and older. Groups range in size to include up to eight participants, with one to three trainers. Many manualized training programs involve weekly sessions of 60 to 90 minutes that occur over a period of 12 weeks or more. Targeted skills are modeled in different ways (e.g., role playing, group discussion), and group members are welcome to suggest topics of individual relevance.

*Interventions involving significant others.* These interventions included a range of partly different interventions that are offered to parents and other relatives. They all aim to support the relatives or to improve the relatives' capacities to better understand and nurture their family members with ASD. These interventions include everything from providing information about the diagnosis and treatment options to more complex education about certain intervention techniques. This is surely an area that is under development. Carrying out a classical systematic review is compromised as a result of heterogeneity of both the interventions and the target groups (20,21).

## Methods

### *Protocol and registration*

This study was conducted on behalf of the National Board of Health and Welfare, Sweden and registered in the International Prospective Register of Systematic Reviews ([crd.york.ac.uk/NIHR\\_PROSPERO/](http://crd.york.ac.uk/NIHR_PROSPERO/); no. CRD42013003780).

The selection of target interventions was based on three criteria: 1) the availability of scientific evidence; 2) current applicability to Swedish clinical practice and recommendation by regional clinical guidelines; and 3) the values, preferences, needs, and attitudes put forth by interest organizations and stakeholders in Sweden. We first selected three treatment methods for systematic review on the basis of the first two criteria: EIBI, TEACCH, and social skills group training. In August 2012, before the current review and database searches were conducted, we assessed the viewpoints of stakeholders regarding the focus and objectives of the project and the selection of interventions to review. Three major Swedish interest organizations participated in this survey: The Autism and Asperger Association (Autism- and Aspergerförbundet; [www.autism.se](http://www.autism.se)); The Attention National Association (Riksförbundet Attention; [www.attention-riks.se](http://www.attention-riks.se)); and the Organized Aspies (Organiserade Aspergare; [www.aspergare.org](http://www.aspergare.org)). The survey results indicated a strong preference for the inclusion of interventions that involved significant others.

**Eligibility criteria**

*For studies of EIBI, TEACCH, and social skills group training*

**Participants.** Children and adolescents ( $\leq 18$  years old) diagnosed with autism, Asperger syndrome, atypical autism, or pervasive developmental disorders not otherwise specified according to DSM-IV, DSM-IV-TR, or *International Statistical Classification of Diseases and Related Health Problems, 10th Revision*, criteria; studies of adult populations ( $> 18$  years old) were excluded

**Interventions.** TEACCH, EIBI, and social skills group training

**Comparators.** Any comparators

**Outcome measures.** *Primary outcomes:* Social communication/interaction skills at the time point when the study or treatment is terminated and long-term follow up

*Secondary outcomes:* Adaptive behaviors; core symptoms of ASD; symptoms of comorbid conditions; cognitive development; quality of life; caregiver burden; parental stress, parental knowledge of ASD

**Study design.** RCTs and observational studies with comparison groups; case studies were excluded

*For studies of interventions involving significant others*

**Participants.** Family members (i.e., parents, grandparents, siblings, or caregivers in a home setting) of individuals with any kind of ASD diagnosis, as described previously

**Interventions.** Any interventions involving significant others

**Comparator.** As described previously

**Outcome measures.** As described previously

**Study design.** RCTs and observational studies with or without comparison groups; case studies were excluded

**Information sources**

Electronic searches were conducted using Medical Subject Headings (MeSH) and relevant text word terms. Five databases (Medline, PubMed, PsycINFO, CINAHL, and ERIC) were searched up to February 15, 2013. The search was performed by an information specialist at the University Library of Karolinska Institutet. For studies published between February 2013 and August 2015, we only added an unsystematic crude update search that was conducted via PubMed. These results are added at the end of the Results section and discussed in the Conclusion section.

**Search strategy**

We used search terms relevant for the study interventions and population. Search results were limited to original studies from 1990 or later and to

those written in English, Danish, Norwegian, or Swedish. Animal studies and case studies were excluded. For a detailed description of search terms, see Appendix 1.

**Study selection**

*For studies of EIBI, TEACCH, and social skills group training*

Two reviewers independently screened the titles and abstracts identified by the search strategy. Studies of potential relevance were grouped according to intervention and then screened a second time by two reviewers. If it was deemed necessary at this stage, the full text of the article was obtained, and two reviewers then independently assessed the text to determine inclusion. Any disagreements were resolved by discussions between the reviewers. Reference lists and systematic reviews were screened for additional studies of relevance.

*For studies of interventions involving significant others*

As a result of the heterogeneity of the identified studies in this area and to enable a descriptive synthesis, the search results for studies of interventions involving significant others were divided by two researchers (TH and AL) into two major subcategories: interventions involving parents and interventions involving significant others other than parents. The interventions were then further subclassified into several content-valid subcategories on the basis of the target group/receiver of the intervention (type of relative) and the primary focus of the treatment: either the relative receives treatment (e.g., parents learn how to cope with stress) or the relative conducts treatment (e.g., parents support their children in the development of social skills).

**Data collection process**

From each included RCT with a moderate or low risk of bias (as discussed later in this article), data were extracted and inserted into a table by one reviewer. A second reviewer then audited the data extraction. Any disagreements were resolved by discussion.

**Data items**

Information about the following topics was extracted from the included RCTs: 1) participants (e.g., age, diagnosis); 2) treatment; 3) type of comparator; 4) relevant outcome measures; and 5) adverse events or deterioration.

**Risk of bias in individual studies**

Two reviewers independently assessed the risk of bias of the selected RCTs with the use of checklists developed by the Swedish Council on Health Technology Assessment. The risk of bias is the

systematic tendency that any aspect of the study may make the estimated treatment effect deviate from its true value (i.e., the extent to which the results of an included trial can be believed). The checklist for RCTs is very similar to the Cochrane Collaboration's tool for assessing the risk of bias (22), and it includes 31 items to consider related to randomization (methods and outcomes; 3 items); treatment (blinding, compliance, therapists, and confounding variables; 5 items); assessment (blinding, reliability, validity, timing, and analysis; 9 items); dropout (size, balance, covariates, and analysis; 5 items); reporting bias (protocol, primary/secondary outcome, adverse events, and assessment; 6 items); and conflicts of interest (3 items). A rating of low, moderate, or high risk of bias was given to each category of items and then combined into a global rating for the trial. The risk of bias was not assessed for observational or quasi-experimental studies or for those studies involving significant others.

### ***Methods of analysis for social communication interventions***

Initially, a quantitative synthesis of RCTs (using RevMan 5 software) related to each of the research questions was planned. If quantitative synthesis was not meaningful or possible, a descriptive synthesis was performed. For observational or quasi-experimental studies, only a descriptive synthesis was planned. If systematic reviews of high quality were available from previous studies of the areas examined, they were used as resources for consistency checks and cross-validation.

## **Results**

### ***Early Intensive Behavioral Intervention***

A total of 161 studies of potential relevance for EIBI were identified by the literature search; 18 studies remained after screening by two reviewers (AL and LH). There were 17 observational studies that included control groups and 1 RCT, which was conducted in the United States (23). The RCT included 28 children, of which 15 were in the EIBI group; the boys-to-girls ratio was 12:3 in the intervention group and 11:2 in the control group. The children in the EIBI group received a mean of 30 hours of treatment per week for two to three years; the control group had supervised parental training twice a week for a total of five hours per week, training with parents for five hours per week, and education in a special class for ten to 15 hours per week for three to nine months. The outcome measures are presented in Table 1. There were no significant differences between groups before treatment with regard to outcome variables. After treatment, there were statistically significant differences in intelligence as measured by the

Stanford-Binet Intelligence Scales, in visuospatial abilities as measured by the Merrill-Palmer Scales of Development, and in verbal ability according to the Reynell Developmental Language Scales between the EIBI group and the control group. However, there was a certain risk for bias, because the groups were not comparable with regard to the interval between completed treatment and follow-up measurement.

Of the 17 non-randomized studies with control groups that were identified, 4 were from the United Kingdom (24-27), 4 were from the United States (28-31), two were from Italy (32,33), two were from Israel (34,35), one was from Canada (36), one was from Sweden (37), one was from Norway (38), one was from Norway and Sweden (39), and one was from Norway and the United States (40). Two of the non-randomized studies with control groups (25,27) examined the same sample, with the later study being a 2-year follow-up study of the intervention. One more study with a control group from the United Kingdom was identified, but the intervention consisted of more than EIBI, and the control and intervention groups differed only by the intensity of the same treatment interventions (41), so it was not further considered.

All non-randomized studies reported improvements in different areas at the group level for both children who underwent EIBI treatment and control children. Of these, 13 studies showed superior improvement for the EIBI groups in some outcome measures as compared with the control groups (23-30,32,36-38,40). Outcome measures varied among studies, with most studies applying several outcome measures. Results showed relative improvements in intelligence quotient (10 studies), adaptive behavior (10 studies), language and communication (7 studies), symptom reduction (6 studies), and the need for school assistance (1 study). Results also demonstrated changes in diagnostic status (1 study) and personality and other behaviors (2 studies). Many of these studies had relatively small sample sizes.

One study with relatively large study groups showed no difference in outcomes between the EIBI group ( $n = 45$ ) and the control group ( $n = 33$ ) after intervention (35). The control group in this trial received "individualized eclectic treatment" of the same magnitude as and parallel to the EIBI group. In the other study that did not demonstrate better outcomes after high-intensity EIBI treatment, the control group received low-intensity EIBI treatment (37). However, in this design, the study groups were not comparable, the study lacked both the control of what was actually administered and the quantity (number of hours) of the treatment, and the health care professionals were not comprehensively trained in EIBI techniques.



**TABLE 2.** Randomized controlled trials of TEACCH (until 2/2013)

Publication	Risk of bias	Participants		Intervention		Outcome measures	Main results Mean post-treatment (Standard deviation)	
Name Year Country		Study group	Comparison group	Study group	Comparison group		Study group	Comparison group
Tsang, Shek, Lam, Tang & Cheung 2007 China	High	Clinical ASD-diagnosis according to DSM-IV; Age: 3-5 yrs; n=18	As in study group; n=16	Full time center-based TEACCH training: structured physical set-up and tasks organization with use of schedule, visual support and Independent Work System (IWS); 12 months, 7 h per day	Treatment as usual; non-TEACCH classroom set-up and teaching mode	Tests: Psycho Educational Profile-Revised Chinese version; Merrill-Palmer Scale of Mental Tests; Hong Kong Based Adaptive Behavioral Scales (Chinese adaptation of Vineland Adaptive Behavior Scales)	<i>Adjusted means corrected for pretest and covariates</i> CPEP-R: Perception 10.067 (SD .693) Fine Motor 11.091 (SD .729) Gross Motor 15.425 (SD .915) Other subscales ns HKBABS: Daily Living Skills 54.951 (SD 2.309) Sum of Domains 253.425 (SD 7.881) Other subscales ns Merril-Palmer: 48.106 (SD 2.233)	<i>Adjusted means corrected for pretest and covariates</i> CPEP-R: Perception 7.300 (SD .740) Fine Motor 8.522 (SD .778) Gross Motor 11.522 (SD .978) Other subscales ns HKBABS: Daily Living Skills 69.680 (SD 2.473) Sum of Domains 284.771 (SD 8.513) Other subscales ns Merril-Palmer: 51.505 (SD 2.387)
Welterlin, Turner-Brown, Harris, Mesibov & Delmolino 2012 USA	High	Clinical autism-diagnosis; Age: 2-3 yrs; n=10	As in study group; n=10	Home TEACCHing Program: training parents to work with child on cognitive, fine motor and language skills; 12 weekly sessions of 1.5h	Wait-list	Tests: Mullen Scales of Early Learning; Scales of Independent Behavior-Revised; Parent self-report: Parent Stress Index-3rd edition	<i>MSEL:</i> 63.7 (SD 17.4) <i>SIB-R – social interaction:</i> 18.4 (SD 7.3) <i>SIB-R – language comprehension:</i> 12.0 (SD 4.7) <i>SIB-R – language expression:</i> 16.2 (SD 7.1) <i>PSI:</i> 242.4 (SD 41.5)	<i>MSEL:</i> 58.1 (SD 25.0) <i>SIB-R – social interaction:</i> 16.0 (SD 5.0) <i>SIB-R – language comprehension:</i> 10.9 (SD 4.8) <i>SIB-R – language expression:</i> 14.2 (SD 7.1) <i>PSI:</i> 256.2 (SD 70.0)

Note. CPEP-R = Psycho Educational Profile-Revised Chinese version; HKBABS = Hong Kong Based Adaptive Behavior Scale (Chinese adaptation of Vineland Adaptive Behavior Scales); MPSMT = Merrill-Palmer Scale of Mental Tests; MSEL = Mullen Scales of Early Learning; SIB-R = Scales of Independent Behavior-Revised; PSI = Parent Stress Index-3<sup>rd</sup> edition

social adaptive functioning as indicated by higher scores on the Daily Living and Adaptive Behavior Composite scales of the Hong Kong Based Adaptive Behavior Scale (i.e., adjusted Vineland Adaptive Behavior Scales). Cognitive functioning as measured by the Merrill-Palmer Scales of Development did not improve in either of the two groups.

In the other RCT, Welterlin and colleagues (44) evaluated the effect of a TEACCH-based home training program on children with ASD and their parents. Parents were trained to support their children in the areas of cognitive, fine motor, and language skills. Twenty families were randomly assigned to the treatment group or the waiting list group. The results suggested that participation in the home training program led to improvements in the children's independence and in the parents' ability to structure the children's learning environment and to effectively prompt their children in teaching

situations. However, group comparisons did not reveal significant differences in child developmental outcomes (Mullen Scales of Early Learning), adaptive behavior (Scales of Independent Behavior, Revised), or parent stress (Parenting Stress Index, Third Edition).

In the non-randomized study with a control group (45), parents were trained to implement TEACCH at home in the treatment group; members of both the treatment and the control groups were enrolled in a regular day treatment program. Twenty-two children between the ages of two and six years were assigned non-randomly to the treatment or the control groups ( $n = 11$  in each group). The results demonstrated that children in the treatment group improved significantly more than those in the control group on the PEP-R subscales of imitation, fine motor, gross motor, and non-verbal conceptual skills as well as on their overall PEP-R scores. Correlations between

pretreatment scores and total change scores indicated that subjects with mild ASD and good language skills benefited the most.

Panerai and colleagues (46) compared two educational treatments in schools: the TEACCH program and the integration program for individuals with disabilities that is commonly used in Italian schools. Two groups of children with ASD—an experimental group ( $n = 8$ ) and a control group ( $n = 8$ )—were matched by gender (all males) and diagnosis (ASD and severe intellectual disability combined). The mean chronological age was 9 years. The authors found improvements on the PEP-R scales (test items were scored as “passing,” “emerging,” and “failing,” depending on specific scoring criteria) for all “passing” categories except that of fine motor skills, but this was not the case with the “emerging” categories. The analysis of the results from the Vineland Adaptive Behavior Scales did not yield improvements in communication and interpersonal relationships. The authors concluded that the TEACCH program was more effective than the treatment applied to the control group.

### ***Social skills training***

During the first screening of abstracts (by UJ and VN), 204 unique citations of potential relevance for social skills training were identified. A total of 186 of these reports were excluded: 57 case studies; 30 observational studies without comparison groups; 76 studies with irrelevant research questions; eight studies of other interventions; three studies with adult participants; six study protocols; and 6 reviews. The remaining reports—11 RCTs and seven non-randomized studies with comparison groups—were included. A recent systematic review of high quality that included five of the 11 RCTs was identified (11).

The systematic review by Reichow and colleagues searched the literature up to December 2011 and included five RCTs of social skills training as compared with a waitlisted control group. All five of these trials were conducted in the United States. The sample sizes of all included trials were relatively small and ranged from 18 to 76 participants (Table 3). In total, 196 participants were included in the studies. The participants were children between the ages of 7 and 12 years, with the exception of one trial that included adolescents between the ages of 13 and 17 years (47). To some extent, the outcome measures differed between the trials: 4 trials measured social competency (47-50), and 2 trials measured friendship quality (48,51). The social skills groups improved in overall social competence (effect size = 0.47; 95% confidence interval, 0.16 to 0.78) and friendship quality (effect size = 0.41; 95% confidence interval, 0.02 to 0.81), but there was no effect on emotional recognition and understanding of idioms. Overall,

the quality of evidence was rated as low. Given the nature of the intervention and the selected outcome measures, the authors concluded that the risk of bias was high.

Our search identified two additional trials of comparable interventions (52,53), which were published after the final search in the review by Reichow and colleagues (11). In a trial from the United States (52), a total of 35 children were randomized to social skills group training or to being waitlisted. The intervention consisted of group sessions 5 days a week for 5 weeks. A number of outcome measures were used to assess improvements in social competency and social communication, and the effects were comparable to the effects observed in previous trials. DeRosier and colleagues (53) compared a social skills training intervention specifically designed to address multiple social skill areas for children between the ages of 8 and 12 years with high-functioning ASD with a similar intervention developed for typically developing children; 55 children were included in the study, and the results indicated that the specifically designed intervention had better effects on social skills. We have determined that these trials do not change the conclusions drawn in the review by Reichow and colleagues.

An additional four RCTs of social skills training were identified, but the interventions differed substantially from the ones included in the Cochrane review. Beaumont and Sofronoff (54) tested a 7-week program that included computer games, group sessions, parent training, and information being given to teachers. A total of 49 children were randomized to either the intervention group or being waitlisted. Parent and teacher ratings indicated that children who received the intervention had more improved social skills and that the effects were maintained at a 5-month follow-up appointment. The remaining 3 trials were assessed as having a high risk of bias factors, such as a small sample size and baseline differences between the intervention and control groups. One of these trials evaluated a training program for theory of mind (55), one compared two forms of skills training programs (56), and one studied the effect of a multimodal intervention for social skills and anxiety (57).

A range of different outcome measures was used in the trials. One questionnaire, the Social Responsiveness Scale (58), was used in five studies. another questionnaire, the Social Skills Rating system for Parents (59), was used in three studies. In only one of the 11 RCTs were both of these questionnaires used. In addition, three of the studies that used the Social Responsiveness Scales had

TABLE 3. Randomized controlled trials of social skills training (until 2/2013)

Publication	Risk of bias	Participants		Intervention		Outcome measures	Main results	
		Study group	Comparison group	Study group	Comparison group		Mean pre- and post-treatment (Standard deviation)	Mean pre- and post-treatment (Standard deviation)
Name Year Country							Study group	Comparison group
Beaumont et al. 2008 Australia	Moderate	Clinical ASD-diagnosis confirmed by parent questionnaires IQ $\geq$ 85 Age: 7½-11 years; n=26 Attrition: N/A	As in study group; n=23 Attrition: N/A	A multi-component social skills intervention; computer game + small group sessions + parent training sessions + teacher handouts; introduction + 7 weekly sessions; follow-up 6 weeks and 5 months post-treatment	Wait-list	Tests: Emotion recognition measure; James and the Maths test; Dylan is being teased Parent questionnaires: SSQ-P, ERSSQ Teacher questionnaire: SSQ-T	SSQ-P: Pre 25.30 (7.43) Post 38.8 (SD 9.84)	SSQ-P: Pre 23.16 (SD 9.05) Post 25.11 (SD 7.91)
Begeer et al. 2011 The Netherlands	High	Clinical ASD-diagnosis confirmed by parent questionnaires IQ $\geq$ 70; Age: 8-13 years; n=20; Attrition: 1	As in study group; n=20; Attrition: 3	"The Theory of Mind training"; 16 weekly group sessions + parent program	Wait-list	Tests: Theory of Mind test; LEAS-C Self-reported empathy: The index of empathy for children and adolescents Parent questionnaire: CSBQ	Theory of mind test total score: Pre 50.89 (SD 5.31) Post 58.21 (SD 4.00)	Theory of mind test total score: Pre 54.00 (SD 5.93) Post 58.00 (SD 5.78)
DeRosier et al. 2011 USA	Moderate	Prior ASD-diagnosis confirmed by parent questionnaires IQ $\geq$ 85; Age: 8-12 years; n=27; Attrition: 3	As in study group; n=28; Attrition: 2	"The Social Skills Group Intervention – High Functioning Autism" (development of original program); 15 weekly group sessions + parent program	"The Social Skills Group Intervention" (original program for children with typical development); 10 weekly group sessions	Self-report: Social Dissatisfaction Questionnaire Parent questionnaires: SRS, ALQ Parent and child report: Social Self-efficacy Scale	SRS – communication (individual change scores): -0.38 (SD 1.07)	SRS – communication (individual change scores): 0.50 (SD 0.78)
Frankel et al. 2010 USA	Moderate	ASD (according to ADI-R + ADOS)+ verbal IQ>60 + basic level of communication and play Age: mean 103.2 months (SD 15.2) n=40; Attrition: 5	As in study group; Age: mean 101.5 months (SD 15.0); n=36; Attrition: 3	"Parent-assisted Children's Friendship Training"; 12 weekly sessions for children and parents separately + homework assignment	Wait-list	Self-reports: The Loneliness Scale; PHS Parent questionnaires: QPQ; SSRS-P Teacher questionnaire: PEI	SSRS-P (Self-control): Pre 10.2 (SD=3.4) Post 12.2 (SD 2.9)	SSRS-P (Self-control): Pre 9.0 (SD 3.9) Post 10.1 (SD 3.7)
Koenig et al. 2010 USA	Moderate	Prior ASD-diagnosis confirmed by ADOS parent questionnaires IQ $\geq$ 70; Age: 8-11 years; n=25; Attrition: 2	As in study group; n=19; Attrition: 1	Training based on social learning and behavior theory; 16 weekly group sessions; peer tutors included	Wait-list	Blinded rating: CGI-I Parent questionnaire: SCI	Post-treatment much or very much improved on the CGI-I: 16/23	Post-treatment much or very much improved on the CGI-I: 0/18
Laugeson et al. 2009 USA	Moderate	Prior ASD-diagnosis IQ $\geq$ 70; Age: 13-17 years; n=17; Attrition: 3	As in study group; n=16; Attrition: 0	"Program for the Education and Enrichment of Relational Skills" (the UCLA PEERS program adapted for teens); 12 weekly group sessions for teens and parents separately + homework assignment	Wait-list	Self-report: TASSK; QPQ; FQS Parent questionnaires: QPQ; SSRS-P Teacher questionnaire: SSRS-T	SSRS-P: Pre 80.2 (SD 8.8) Post 89.7 (SD 12.1)	SSRS-P: Pre 77.9 (SD 12.1) Post 79.8 (SD 11.7)

Publication	Risk of bias	Participants	Intervention	Outcome measures	Main results			
					Mean pre- and post-treatment (Standard deviation)			
Lerner & Mikami 2012 USA	High	Study group 1: Prior diagnosis of high-functioning ASD confirmed by parent questionnaires Age: mean 10.86 (SD 1.68); n=7 Attrition: N/A	Study group 2: As for group 1 Age: mean 11.33 (SD 1.63); n=6 Attrition: N/A	Study group 1: "Sociodramatic Affective Relational Intervention (SDARI)" (use of games targeting specific social goals); 4 weekly sessions	Study group 2: "Skill-streaming" (training steps of social interaction); 4 weekly sessions	Blinded observation: SIOS; Socio-metrics Parent questionnaires: SRS, SSRS-P Teacher questionnaire: SSRS-T	SRS (parent): Pre 76.57 (SD 10.74) Post 75.57 (SD 13.05)	SRS (parent): Pre 82.17 (SD 10.68) Post 76.17 (SD 9.56)
Lopata et al. 2010 USA	Moderate	Prior diagnosis of high-functioning ASD + IQ>70; Age: 7-12 years; n=18 Attrition: N/A	As in study group; n=18 Attrition: N/A	Intervention according to "Skill-streaming": summer camp, 5 weeks, 5 days per week + weekly parent training	Wait-list	Tests: SKA; DANVA-2 Child Faces; CASL, Idiomatic Language subtest Parent questionnaires: SRS; ASC; BASC-2-PRS – social skills and withdrawal Staff questionnaires: ASC, SRS; BASC-2	SRS (parent): Pre 79.94 (SD 11.02) Post 73.67 (SD 11.42)	SRS (parent): Pre 81.12 (SD 13.78) Post 82.53 (SD 13.77)
Solomon et al. 2004 USA	High	Prior ASD-diagnosis confirmed by ADI-R and ADOS IQ>75; Age: 8-12 years; n=9 Attrition: N/A	As in study group; n=9 Attrition: N/A	"The Social Adjustment Enhancement Curriculum"; 20 weekly group sessions + psychoeducational parent groups	Wait-list	Tests: DANVA-2-AF; DANVA-2-CF; Strange Stories Task; Faux Pas Stories Task; TOPS-Elementary Revised Self-report: CDI Parent questionnaire: BDI	DANVA-total faces (expression recognition) Age 8-10: Pre 23.8 (SD 1.3) Post 26.6 (SD 1.5) Age 10-12: Pre 22.5 (SD 2.9) Post 24.8 (SD 3.4)	DANVA-total faces (expression recognition) Age 8-10: Pre 24.8 (SD 3.1) Post 24.0 (SD 2.3) Age 10-12: Pre 25.2 (SD 3.3) Post 23.6 (SD 3.3)
Thomeer et al. 2012 USA	Moderate	Prior ASD-diagnosis confirmed by ADI-R IQ>70; Age: 7-12 years; n=17 Attrition: N/A	As in study group; n=18; Attrition: N/A	Intervention according to "Skill-streaming": summer camp, 5 weeks, 5 days per week + weekly parent training	Wait-list	Tests: SKA; DANVA-2 CF; CASL, Idiomatic Language subtest Parent questionnaires: ASC; SRS; BASC-2-PRS Teacher questionnaire: BASC-2-TRS Staff questionnaire: ASC, SRS; BASC-2	SRS (parent): Pre 83.24 (SD 17.27) Post 75.24 (SD 13.54)	SRS (parent): Pre 83.06 (SD 12.61) Post 84.29 (SD 13.84)
White et al. 2013 USA	High	ASD-diagnosis supported by ADOS and ADI-R + verbal IQ>70 Met criteria for anxiety disorder Age: 12-17 years; n=15; Attrition: 2	As in study group; n=15; Attrition: 3	"Multimodal Anxiety and Social Skill Intervention (MASSI)"; 14 weeks with group social skills training + individual therapy + parent coaching	Wait-list	Blinded rating: PARS; CGI-I; DD-CGAS Parent questionnaires: SRS; CASI-Anx	SRS (parent): Pre 88.87 (SD 12.32) Post 74.33 (SD 12.63)	SRS (parent): Pre 85.73 (SD 14.14) Post 84.80 (SD 12.18)

Note. ADI-R = The Autism Diagnostic Interview-Revised; ASC = Adapted Skill-streaming Checklist; ADOS = The Autism Diagnostic Observation Schedule; ALQ = Achieved Learning Questionnaire; ASD = Autism Spectrum Disorders; BASC-2PRS = Behavior Assessment For Children; BDI = Beck Depression Inventory; CASI-Anx = Child and Adolescent Symptom Inventory-4 ASD Anxiety; CASL = Comprehensive Assessment of Spoken Language; CDI = The Children's Depression Inventory; CGI-I = Clinical Global Impressions - Improvement scale; CSBQ = The Children's Social Behavior Questionnaire; DANVA-2 = Diagnostic Analysis of Nonverbal Accuracy-2; DD-CGAS = Developmental Disabilities Children's Global Assessment Scale; ERSSQ = Emotion Regulation and Social Skills Questionnaire; FQS = Friendship Qualities Scale IQ = Intelligence quotient; LEAS-C = The levels of Emotional Awareness Scale for Children; n = Number of patients; N/A = Not applicable; PARS = Pediatric Anxiety Rating Scale; PEI = The Pupil Evaluation Inventory; PHS = Piers-Harris Self-Concept Scale; QPQ = The Quality of Play; SCI = Social Competence Inventory; SD = Standard deviation; SIOS = Social Interaction Observation System; SKA = Skill-streaming Knowledge Assessment; SRS = Social Responsiveness Scale; SSQ-P = Social Skills Questionnaire – Parent; SSQ-T = Social Skills Questionnaire – Teacher; SSRS-P = Social Skills Rating System – Parent; SSRS-T = Social Skills Rating System - Teacher; TASSK = Test of Adolescent Social Skills Knowledge; TOPS = Test of Problem Solving

comparable participant groups but different training programs.

The studies included few blinded or objective measurements. The Diagnostic Analysis of Nonverbal Accuracy (60), which measures an individual's ability to recognize facial expressions, was used in two studies (50,51). In 2 other studies, the improvement subscale of the Clinical Global Impressions Scale (61) was used by blinded investigators (49,57). Four of the trials were determined to have a high risk of bias, mainly as a result of uncertainties related to missing information (51,55-57). For the remaining seven trials, the risk was assessed as moderate.

We identified a total of seven non-randomized studies with control groups that evaluated different forms of social skills group training interventions. Of these, 5 were conducted in the United States (62-66), one took place in the United Kingdom (67), and one occurred in Australia (68). Some of the studies included children (62,63,67,68), whereas others focused on adolescents (64-66).

A study by Kroeger and colleagues compared two kinds of social skills groups for 4- to 6-year-old children with ASD (62). A 3-year retrospective study by Legoff and colleagues (63) compared the long-term outcomes of children with ASD who participated in Lego-based interactive playgroups and a matched comparison group who had received comparable non-Lego therapy. A study by Owen and colleagues (67) evaluated Lego therapy as well as another social skills intervention, the Social Use of Language Program, for 6- to 11-year-old children with high-functioning autism and Asperger syndrome. Participants were matched and randomly assigned to one of the interventions and compared with a control group that was not randomly assigned. A pilot study by Castorina and Negri (68) compared social skills training (alone or with a sibling) with waitlisting for boys with Asperger syndrome who were between the ages of 8 and 12 years.

A small study by Ozonoff and Miller (64) evaluated the effectiveness of a social skills training program for adolescent boys with high-functioning autism as compared with a no-treatment control group. Another study compared a parent-assisted social skills group intervention for high-functioning adolescents with ASD with a delayed-treatment control group (65). Finally, another study examined the effectiveness of an intervention that adapted dramatic training activities to improve social skills among adolescents with Asperger syndrome and high-functioning ASD diagnoses (66).

The number of included participants was exceptionally small in most studies, with between 5 and 14 participants in the intervention groups. The only exception was the retrospective study of the

Lego-based interactive playgroups (63), which included 60 participants in the intervention group. Although all 7 studies reported beneficial effects of the interventions, we assessed that the results should be interpreted with caution due to the small sample sizes and the non-randomized design.

### ***Interventions involving significant others***

A total of 441 studies of potential relevance were identified. After screening (by AL and TH), 71 studies remained. We identified the following subclasses of interventions that involved relatives: 1) parent-mediated treatment of children with ASD (excluding EIBI and TEACCH; these studies are presented above); 2) support and education for the parents of children with ASD (i.e., help for the parents themselves); 3) support for parents while their children are receiving professional treatment; 4) education for parents with the aim of improving their skills related to teaching others about ASD and their children; 5) sibling-mediated intervention for the individual with ASD; 6) support for siblings of individuals with ASD (i.e., support for the siblings themselves); and 7) interventions involving grandparents.

#### *Parent-mediated treatment of children with ASD (excluding EIBI)*

In this category, the focus was on intervention that aimed at the parent-mediated treatment of the child with ASD rather than at support for the parents. The parent-mediated, communication-focused treatment of children with autism has been studied in a multicenter RCT in the United Kingdom called the Preschool Autism Communication Trial (PACT) (89). Children were assigned to PACT (n = 77) or treatment as usual (n = 75). The PACT intervention did not reduce autism symptoms; however, there was a clear benefit for parent-child dyadic social communication. Sofronoff and colleagues (70,71) evaluated an intervention program aimed at improving parental self-efficacy for the management of problem behaviors associated with Asperger syndrome among children of primary school age. In this research, 51 parents were randomly assigned to different formats (i.e., a 1-day workshop or six individual sessions) of the parental self-efficacy program or to a waiting list. Parents in both intervention groups reported fewer problem behaviors in children and increased parental self-efficacy after the interventions at both four weeks and three months of follow up. In addition, 22 families participated in an accelerated parental educational program for 12 weeks, and half of them also participated in an additional weekly parent education support group. Results indicated that the addition of a parent support group may increase

parental mastery of teaching techniques as well as the success of accelerated programming (72). In a study by Keen and colleagues (73), families were assigned to a professionally supported intervention that included a workshop and 10 home visits ( $n = 17$ ) or to a self-directed video-based intervention ( $n = 22$ ). The professionally supported intervention resulted in greater development in social communication and adaptive behavior in children as well as more reduced parenting stress and increased parenting self-efficacy as compared with the self-directed intervention.

Other studies within this category were open studies, most of which were small pilot studies (74-92); others were randomized small pilot studies (93) or the further analysis of previously published studies (94,95).

*Support and education for parents (i.e., help for parents themselves)*

Interventions with primary outcome measures that reflected parental stress, mental health, or parenting style (i.e., with the primary focus on parents) were classified as belonging to this category. In one of the RCTs (96), parents were allocated to either a 20-week manual-based parent education and behavior management intervention ( $n = 35$ ) or a manual-based parent education and counseling intervention ( $n = 35$ ). Both programs provided improvements in parental mental health and adjustment. In another RCT (97), 59 families were randomized either to the Stepping Stones Triple P program or to a waiting list. The results indicated significant improvements in parenting styles, parental satisfaction, and conflicts related to parenting. Additional effects were observed in parental reports of child behavior.

Other identified studies were small randomized studies ( $n \leq 31$  in total) or non-randomized controlled studies that indicated positive effects on family interaction (98), decreased hopelessness and improved coping (99), and perceived self-efficacy regarding the care of autistic children (100). Internet-based parent support group participation had no effect on parental well-being, although participant satisfaction was high (101).

No effects were observed in response to increased counseling with a pediatric nurse practitioner in conjunction with the diagnostic assessment (102) or to parent support group participation on mental health or quality of life (103); this was possibly related to the small sample sizes.

*Support and education for parents while their children are receiving professional treatment*

In an RCT (104), 35 preschool children were randomized to an intervention group or a control group. In the intervention group, the child's parents and child care workers received a 12-week

intervention that consisted of lectures and on-site consultations with day care centers. In addition, supportive work was undertaken with the children's families. Control subjects received day care alone. The intervention was significantly superior to day care alone with regard to its effects on caregivers' knowledge of autism, the perception of control on the part of mothers, and greater parental satisfaction. In another RCT, children with ASD and serious behavioral problems ( $n = 124$ ) were randomized to pharmacological treatment alone (risperidone) (105) or pharmacological treatment in combination with a parent training program. The combined treatment showed modest additional benefit over pharmacological treatment alone. In another RCT, parents of preschoolers with ASD and minimal speech received parent responsiveness training, whereas the children were allocated to a discrete trial or a naturalistic language treatment (106). However, because the parents of all children received the same intervention, it was not possible to distinguish the specific effects of parent responsiveness training.

A trial of transition planning intervention included training sessions for families in the transition process as well as other components that were aimed at facilitating the transition process of an adolescent with ASD from high school to adult life (107). As compared with waitlisted controls, the transition intervention group showed improved student and family expectations as well as higher levels of self-determination and career decision-making ability.

Other studies within this area were open or non-randomized studies with promising preliminary effects on subjective stress and well-being after participation in parallel parent support and education programs when the children with ASD were being treated by professionals (90,108-111).

*Parents are educated with the aim of educating and informing others in the networks of their children with ASD*

A few open trials have reported positive outcomes in response to educating parents, who in turn educate other people in their children's networks (112,113).

*Sibling-mediated intervention for individuals with ASD*

Both children with ASD and their typically developing siblings were reported to benefit from interventions that involved siblings to improve the social skills of the children with ASD (68,114). Both of the studies found were open pilot studies.

*Support for siblings of individuals with ASD (i.e., support for the siblings themselves)*

Two pilot studies with an open study design (115,116) described preliminary positive effects of sibling support groups.

*Interventions involving grandparents*

A small pilot study with an open study design (117) reported preliminary positive effects of involving grandparents in the treatment of their grandchildren with ASD through a joint activity.

***Crude search update on randomized controlled studies of all interventions from February 2013 through August 2015***

Our crude search update on all examined interventions that were aimed at ameliorating social communication impairments in children and adolescents with ASD yielded a notheworthy recent increase in RCTs. We identified 2 additional studies of EIBI (118,119), one of TEACCH (120), four of social skills training (121-124), and five of interventions involving significant others related to the parent-mediated treatment of children with ASD (excluding EIBI) (125-129). All studies reported findings that were in favor of the respective intervention method evaluated, with small to large effect sizes; however, study samples were mostly small to medium large (i.e., N = 11 to N = 86).

**Discussion*****Early Intensive Behavioral Intervention***

Results of the identified studies of EIBI mostly showed improvements for both the EIBI group and the control group, although the effect for the EIBI group as compared with the control group ranged from no difference to better effect. However, we only found a single RCT that compared the EIBI method with another (or no) intervention. Non-randomized studies indicate a risk for systematic differences between the compared groups (e.g., the motivation for treatment). The interventions for the control groups of the described studies varied considerably, and most of the studies offered some kind of active treatment to the control group. In several studies, it was not clear exactly which form of EIBI treatment was administered, and the treatment fidelity was not assessed. Most of the studies included higher proportions of boys than girls. The male-to-female ratio also varied with respect to known gender differences in ASD prevalence, and it was not always reported. Thus, the impact of EIBI on girls with ASD is probably even more uncertain than the effects on boys. All of this can obviously contribute to heterogeneous results from the different studies. Furthermore, the study groups were generally small, which may in fact have masked smaller differences in outcome between the EIBI groups and the control groups, considering the vast interindividual differences and the fact that children in general develop and make progress independently of intervention.

A Cochrane report that evaluated the effects of EIBI for children with ASD included four non-randomized controlled studies (all included in this report) as well as an RCT study (10). It concluded that the quality of the evidence is low (as rated by the Grading of Recommendations Assessment, Development and Evaluation system) when it comes to judging the effects of the EIBI method.

Clearly, more sound scientific evidence is needed to be able to draw definitive conclusions about the effects of EIBI as a treatment method for ASD. Criticism against the EIBI method has been put forward from clinical researchers, which may also complicate the clinical application of the method. For example, the effect of EIBI on the core symptoms of ASD has been questioned. The impact of the baseline functioning of the children on the intervention effects, the consequences for the children and their families (e.g., distress), and the possibility of implementing the method considering its intensity and extensiveness have also been discussed (23,27). In addition, questions have been raised about the costs associated with the EIBI method, although these may need to be weighed against lowered future costs if the method is effective (130).

Our survey of three Swedish interest organizations showed inconsistent stakeholder viewpoints. While one organization advocates the EIBI method as the treatment method to offer all preschool children with autism or ASD, another association views the EIBI method as too directive and less desirable as a treatment method. These differences in attitude illustrate the importance of accurate information regarding the purpose and contents of the intervention as well as of actively involving all concerned individuals in the making of decisions about interventions.

***Treatment and Education of Autistic and Related Communication Handicapped Children***

Few studies have evaluated the effectiveness of TEACCH. All four of the studies identified in this review (two RCTs and two quasi-experimental studies with matched controls) reported positive effects on outcome measures for children with ASD, mainly with regard to cognitive, motor, and language skills and, to a lesser extent, to social adaptive functioning and communication skills. However, these studies were of low quality and had a high risk for bias as a result of their unclear and non-randomized procedures for recruitment and assignment to a treatment or control group. This made it hard to determine whether the participants were representative of the population. In addition, neither the participants nor the researchers were blind to the treatment condition, which may have

created a placebo effect in the participants and a bias in the assessment of the treatment effect by the researchers. These and other factors made it difficult to draw any strong conclusions about the reliability of the findings reported in these studies. More controlled trials are necessary to scientifically establish the effectiveness of TEACCH.

The promotion of a “culture of autism,” which is a central concept in the TEACCH program and which refers to the specific characteristics that are common among individuals with ASD, has led to the criticism that the TEACCH method does not facilitate inclusion but rather creates a separation of autistic and neurotypically developing individuals. According to the creators of the TEACCH method, however, the objective is to facilitate inclusion in addition to respecting and promoting an individual’s specific skills, interests, strengths, and needs. This is why increasing the understanding of ASD is an important part of the TEACCH method, which aims to create an environment in which there is space for the individual with ASD to function.

Other criticisms that are often heard are that the TEACCH method is too structured, that it focuses too much on task completion, and that it does not leave room for spontaneous interaction and communication. This criticism seems to be supported by the findings of the present study, in which effects on cognitive skills are clearer than those on social and communication skills. Such effects might make the method less suitable for higher-functioning individuals with ASD.

### ***Social skills training***

A core deficit in individuals with ASD is difficulty with social communication and functioning. Another core feature involves repetitive patterns of behaviors. This latter feature can contribute to social impairment by restricting the child with ASD’s range of interests as well as his or her opportunities to collect social experiences. Children with ASD without severe mental retardation will experience more serious social difficulties as could be expected from cognitive abilities. In this group of children, loneliness and isolation may give rise to comorbid psychiatric disorders (e.g., depression, anxiety disorders). Continued isolation will result in more obvious social exclusion as children with ASD grow older. Group activities that involve both children with ASD and typically developing children without other simultaneous interventions have not been shown to increase social interaction for children with ASD (131). Therefore, training in social skills is a logical step in the support of children with ASD, both at schools and via health care services.

In summary, the RCTs included in this review provide some scientific support for the positive

short-term effect of social skills training delivered in a group format. We judge that our analysis of further trials does not differ from the conclusions drawn by Reichow and colleagues (11): the quality of evidence is low. We also concur with the conclusion of those researchers that there is limited generalizability from the studies because they were mainly conducted in the United States, they mainly focused on children between the ages of 7 and 12 years, and they included participants of average or above-average intelligence.

The broad range of social and communication deficits that are common to individuals with ASD requires a comprehensive approach. The training programs include different amounts of such tactics as direct instruction, modeling, role playing, computer games, behavior feedback, and reinforcement. Parent training and parent and teacher handouts are used. It is not possible to conclude if any program is better than any other. Only one replication RCT has been published (52); there are no RCTs of the long-term effects of any program.

In the included RCTs, both study and comparison samples were adequately matched on key variables. The interventions were well described. A central factor that confers a high risk of bias ratings for these studies is the small sample sizes that were used. The use of delayed treatment (i.e., placement on a waiting list) was the usual method used for comparison. This might lead to the confounding of results by attention-related factors. Another risk factor for bias is the dependence on parent questionnaires as outcome measures. In many programs, the parents are engaged as coworkers as well (e.g., helping with exercises and activities of daily living). When asked, parents reported high satisfaction with the program (132). This is clearly a desirable element of a social skills training program, but it also increases the risk for biased assessment. For future studies, more objective or blinded outcome measures should be used.

### ***Interventions involving significant others***

Family-based interventions have been shown to be effective for several mental disorders (133). The involvement of significant others in assessment and treatment has been found to be of importance for patients with ASD as well (134-138), and this was clearly endorsed by the involved interest organizations in the current project. Increased knowledge of ASD may improve significant others’ ability to participate in everyday family life with an autistic relative (137). In this study, interest organizations also stressed the importance of parallel interventions for individuals with ASD and their significant others as well as information about and the involvement of individuals with ASD (adjusted

to their developmental phase) in interventions given to significant others. Moreover, a lack of support for parents who have adult offspring with ASD was highlighted by the interest organizations. Parents of adult offspring with ASD may experience high levels of stress due to their own health problems in addition to the burden of the lifelong care and support of their affected children (139).

Interventions for the significant others of individuals with ASD is a broad and heterogeneous area that is currently under development, and there is an urgent need for further studies that apply stringent research methods (21), with well-defined intervention targets and formats (20). Furthermore, long-term follow up and generalizability to other contexts should be further explored (140). Evidence-based practice and clinical guidelines for these types of interventions were also called for by the interest organizations addressed in the current research. The interest organizations further stressed the need for different kinds of family interventions, depending on the family dynamics and the affected individual's characteristics. Other future challenges include the development of interventions that are targeted at specific issues, such as sexuality in adolescents with ASD (141), transitioning to adulthood (107), and the use of new technological possibilities (e.g., internet-delivered interventions) (142).

## Conclusion

This systematic review examined the evidence related to social communication interventions for the treatment of ASD. The present results update and largely confirm previous findings of low to moderate scientific support for several commonly applied techniques in Swedish clinical practice of ASD treatment (e.g., EIBI, TEACCH, social skills training), despite the need for more thorough and large-scale research. Our crude update search found an increased number of RCTs to have taken place in the last two years, especially for social skills training and parent-mediated training methods, thereby indicating developments in the area of increasing study quality and broadening the evidence base for these techniques. Moreover, according to registered trials at ClinicalTrials.gov and Controlled-Trials.com, several large-sized RCTs are currently being conducted (e.g., NCT01854346, ISRCTN94863788).

In this study—for the first time and based on the recommendations of interest organizations and stakeholders—we explored the interventions that specifically involve the significant others of children and adolescents with ASD. These interventions are heterogeneous in terms of addressees and procedures, thereby making scientific support hard to judge and the need for more rigorous research especially apparent. Although the current study

tackles some of the most frequently used interventions, it covers only a small proportion of the methods claimed by some to be effective or that are used in international clinical practice (143). For many of these interventions, systematic reviews will only serve the purpose of showing that they have never been evaluated in RCTs.

This review suffers from at least two limitations. First, it may already be somewhat obsolete, because only studies that occurred before the beginning of 2013 were included in the systematic review. For studies that occurred from February 2013 through August 2015, we only added a crude update search. Second, we did not assess the non-randomized studies for quality. There is a large risk of confounding bias in the non-randomized studies, and most of them must be viewed as being of low quality. Moreover, even systematic reviews show some limitations, thus hampering their use as a starting point for the selection of scientifically supported methods for evidence-based practice. Inevitably, systematic reviews only summarize data from primary research studies. Therefore, the results of these reviews cannot be markedly more informative than the information taken from the original studies directly. Many of the primary studies, while reaching sufficient internal validity, lack the characteristics necessary for effectiveness or generalizability. For instance, as compared with clinical reality, studies almost never examine combined (“eclectic”) interventions or those that are naturalistically integrated into the flow of clinical routine. In addition, studies and systematic reviews often focus on changes in core ASD symptoms as defined in the *Diagnostic and Statistical Manual of Mental Disorders* or the *International Statistical Classification of Diseases and Related Health Problems*, even though functional adaptation, quality-of-life measures, changes in comorbidity severity, or the perceived stress of the affected individual and his or her relatives may be equally important. It should also be noted that adverse effects are rarely monitored and reported in trials of psychological interventions, precluding risk-benefit analyses (144). Moreover, the quality of the delivery of the respective methods is rarely controlled, although frequently in published trials interventions are not administered by experienced personnel. To somewhat comply with limitations in external validity, in this study, we introduced a bottom-up approach when selecting the methods to be included in the review. We addressed the attitudes of the interest organizations, and we also mapped the clinical practices and opportunities in Sweden; both of these were seen as important prerequisites for the implementation of intervention techniques. This strategy identified the significance of interventions

that involved significant others, which had not been systematically evaluated previously.

We deem our bottom-up approach to be a strength of this study as compared with previous systematic reviews: it enhanced communication with stakeholders and policy makers, who frequently feel that scientific reviews are difficult to comprehend and that they do not take into account anything other than scientific views. We hope to encourage future intervention research to increasingly include societal perspectives and issues of implementation to maximize patient gains and the impact of ASD research on clinical practice.

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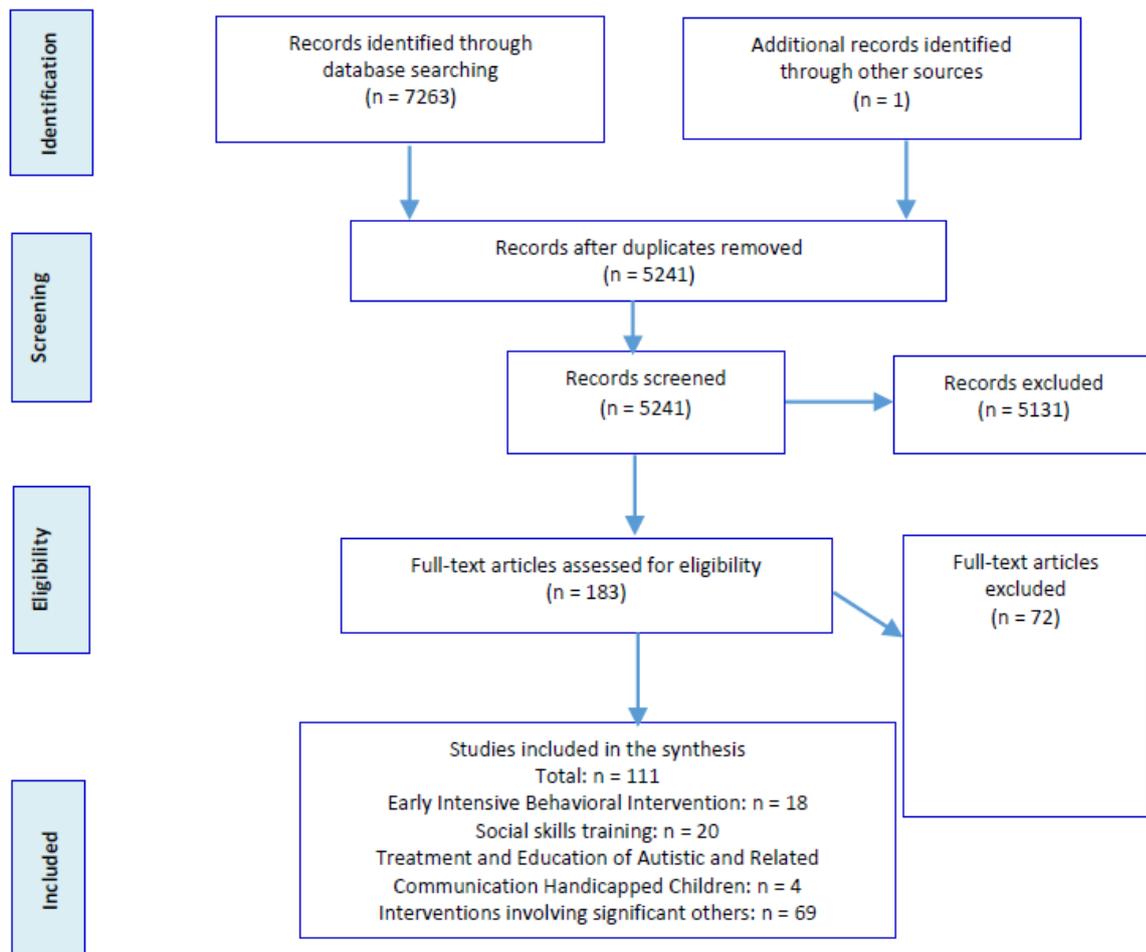
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**FIGURE 1.** Flowchart of the included studies



**Appendix 1.** Search terms**Medline (OVID)***Early Intensive Behavioral Intervention (EIBI)*

1. animals/ not humans/
2. autis\*.tw.
3. exp child development disorders, pervasive/
4. asperger\*.tw.
5. (PDD or PDDs).tw.
6. (ASD or ASDs).tw.
7. "pervasive develop\*".tw.
8. 2 or 3 or 4 or 5 or 6 or 7
9. "eibi".tw.
10. "early intensive behavio\*".tw.
11. exp behavior therapy/
12. Early Intervention/
13. Early Medical Intervention/
14. "early intervention\*".tw.
15. (child\* or infant\* or baby or babies or toddler or girl\* or boy\* or pre\*school\*).tw.
16. exp child/
17. exp infant/
18. adolescent/
19. 15 or 16 or 17 or 18
20. (behavio\* adj1 (analys\* or therap\* or modification or interven\* or lovaas or lovas or communicat\*)).tw.
21. ("applied behavio\*" adj1 (intervention\* or analys\*)).tw.
22. 9 or 10 or 14 or 20 or 21
23. 12 or 13
24. 11 and 23
25. 22 or 24
26. 8 and 19 and 25
27. 26 not 1
28. limit 27 to yr="1990 -Current"
29. limit 28 to ((danish or english or norwegian or swedish) and (case reports or journal article))

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

1. autis\*.tw.
2. exp child development disorders, pervasive/
3. asperger\*.tw.
4. (PDD or PDDs).tw.
5. (ASD or ASDs).tw.
6. "pervasive develop\*".tw.
7. 1 or 2 or 3 or 4 or 5 or 6
8. "Treatment and Education of Autistic".tw.
9. "TEACCH".tw.
10. "university of north carolina".mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]
11. 8 or 9 or 10
12. 7 and 11
13. 12 not (animals/ not humans/)

*Social skills training*

1. autis\*.tw.
2. exp child development disorders, pervasive/
3. asperger\*.tw.

4. (PDD or PDDs).tw.
5. (ASD or ASDs).tw.
6. "pervasive develop\*".tw.
7. 1 or 2 or 3 or 4 or 5 or 6
8. animals/ not humans/
9. "communication skill\*".tw.
10. "human relation\*".tw.
11. exp communication disorders/
12. exp social behavior/
13. "train\*".tw.
14. "treatment\*".tw.
15. "intervention\*".tw.
16. "therap\*".tw.
17. "educat\*".tw.
18. "program\*".tw.
19. exp behavior therapy/
20. communication/
21. language/
22. exp verbal behavior/
23. 20 or 21 or 22
24. socialization/
25. interpersonal relations/
26. social participation/
27. (interpersonal adj1 (behavio\* or communication\* or competenc\* or relation\* or skill\*)).tw.
28. (social adj1 (behavio\* or adjustment\* or interaction\* or communication\* or competenc\* or relation\* or skill\*)).tw.
29. 9 or 10 or 11 or 12 or 23 or 24 or 25 or 26 or 27 or 28
30. 13 or 14 or 15 or 16 or 17 or 18 or 19
31. 7 and 29 and 30
32. 31 not 8
33. 32
34. limit 33 to yr="1990 -Current"
35. limit 34 to ((danish or english or norwegian or swedish) and (case reports or journal article))

*Interventions involving significant others*

1. animals/ not humans/
2. autis\*.tw.
3. exp child development disorders, pervasive/
4. asperger\*.tw.
5. (PDD or PDDs).tw.
6. (ASD or ASDs).tw.
7. "pervasive develop\*".tw.
8. 2 or 3 or 4 or 5 or 6 or 7
9. exp child/
10. exp infant/
11. adolescent/
12. (child\* or infant\* or baby or babies or toddler or girl\* or boy\* or pre\*school\* or adolescent\* or teen\*age\* or school\*).tw.
13. 9 or 10 or 11 or 12
14. exp family/
15. caregivers/
16. (support\* or educat\* or training\* or program\* or psychoeduca\* or knowledge or intervention\* or guidance or supervis\*or promot\*).tw.
17. ((parent\* or care\*giver\* or family or families or mother\* or father\* or maternal\* or paternal\* or network\* or "significant other\*" or sibling\* or group\*) adj3 (support\* or educat\* or training\* or program\* or

psychoeduca\* or knowledge or intervention\* or guidance or supervis\*or promot\*).tw.  
 18. 14 or 15  
 19. 16 and 18  
 20. 17 or 19  
 21. 8 and 13 and 20  
 22. 21 not 1  
 23. limit 22 to (yr="1990 -Current" and (danish or english or norwegian or swedish) and (case reports or journal article))

### PsycInfo (OVID)

#### *Early Intensive Behavioral Intervention (EIBI)*

1. (autis\* or asperger\* or pdd or pdds or asd or asds or "pervasive develop\*").ab,ti.  
 2. exp Pervasive Developmental Disorders/  
 3. exp Early Intervention/  
 4. exp Behavior Therapy/  
 5. (eibi or "early intensive behavio\*" or "Early Intervention").ab,ti.  
 6. "early medical intervention".ab,ti.  
 7. (child\* or infant\* or baby or babies or toddler or girl\* or boy\* or pre\*school\*).ab,ti.  
 8. (behavio\* adj1 (analys\* or therap\* or modification or interven\* or lovaas or lovas or communicat\*)).ab,ti.  
 9. ("applied behavio\*" adj1 (intervention\* or analys\*)).ab,ti.  
 10. 1 or 2  
 11. 3 or 4 or 5 or 6 or 8 or 9  
 12. 7 and 10 and 11  
 13. limit 12 to (journal article and (danish or english or norwegian or swedish) and yr="1990 -Current")

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

1. TEACCH.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]  
 2. "university of north carolina".mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]  
 3. "Treatment and Education of Autistic".mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]  
 4. 1 or 3

#### *Social skills training*

1. (autis\* or asperger\* or pdd or pdds or asd or asds or "pervasive develop\*").ab,ti.  
 2. exp Pervasive Developmental Disorders/  
 3. communication/ or communication skills/ or communication skills training/ or exp communication barriers/ or exp communication disorders/  
 4. ("communication skill\*" or "human relation\*").ab,ti.  
 5. exp Interpersonal Communication/ or exp Interpersonal Relationships/ or exp Interpersonal Interaction/  
 6. social behavior/ or social adjustment/ or exp social interaction/ or exp social skills/  
 7. exp Socialization/  
 8. exp Intervention/  
 9. exp Treatment/  
 10. exp Training/

11. (train\* or treatment\* or intervention\* or therap\* or educat\* or program\*).ab,ti.  
 12. exp Behavior Therapy/  
 13. "social participation\*".ab,ti.  
 14. (interpersonal adj1 (behavio\*r\* or communication\* or competenc\* or relation\* or skill\*)).ab,ti.  
 15. (social adj1 (behavio\*r\* or adjustment\* or interaction\* or communication\* or competenc\* or relation\* or skill\*)).ab,ti.  
 16. 1 or 2  
 17. 3 or 4 or 5 or 6 or 7 or 13 or 14 or 15  
 18. 8 or 9 or 10 or 11 or 12  
 19. 16 and 17 and 18

#### *Interventions involving significant others*

1. (autis\* or asperger\* or pdd or pdds or asd or asds or "pervasive develop\*").ab,ti.  
 2. exp Pervasive Developmental Disorders/  
 3. (child\* or infant\* or baby or babies or toddler or girl\* or boy\* or pre\*school\*).ab,ti.  
 4. (adolescent\* or teen\*age\* or school\*).ab,ti.  
 5. exp Family/  
 6. exp Caregivers/  
 7. ((parent\* or care\*giver\* or family or families or mother\* or father\* or maternal\* or paternal\* or network\* or "significant other\*" or sibling\* or group\*) adj3 (support\* or educat\* or training\* or program\* or psychoeduca\* or knowledge or intervention\* or guidance or supervis\*or promot\*)).ab,ti.  
 8. 1 or 2  
 9. 3 or 4  
 10. 5 or 6 or 7  
 11. 8 and 9 and 10  
 12. limit 11 to (journal article and (danish or english or norwegian or swedish) and yr="1990 -Current")