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Focal Educational and Behavioral Interventions for the Treatment of Autism Spectrum Disorders (ASDs)

**Full In-Depth Health Care Technology Assessment
(CLIN 3002)**

Contract No. H94002-05-D-0003

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Aurora, Colorado

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January 12, 2009

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Re: Contract No. H94002-05-D-0003
Delivery Order No. 28
Task Order No. 28
Full In-Depth Health Technology Assessment Report
Focal Educational and Behavioral Interventions for the Treatment of Autism Spectrum Disorders (ASDs)

Dear Ms. Morrell:

ECRI Institute is pleased to provide the report *Focal Educational and Behavioral Interventions for the Treatment of Autism Spectrum Disorders (ASDs)*, pursuant to the contract and delivery order cited in the subject line of this letter.

We trust you will find that this report conforms to TRICARE's specifications and meets with your satisfaction.

If we can be of further assistance or if you have any questions regarding this report, please contact me at (610) 825-6000, ext. 5337.

Sincerely,



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Enclosure

/ldd

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Summary of Findings

Autism spectrum disorders (ASDs), also known as pervasive developmental disorders, refer to a wide continuum of associated cognitive and neurobehavioral disorders, including, but not limited to, three defining features: impairments in socialization, impairments in verbal and nonverbal communication, and restricted and repetitive patterns of behaviors. Within the *Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (DSM-IV) and Text Revised Edition (DSM-IV-TR)*, ASDs are divided into five specific diagnostic categories—autistic disorder, Asperger disorder, Rett disorder, childhood disintegrative disorder, and pervasive developmental disorder, not otherwise specified (PDD-NOS). Data from a population-based, multisite surveillance study conducted by the Centers for Disease Control and Prevention’s Autism and Developmental Disabilities Monitoring Network (ADDM) indicated that in 2002 the prevalence of ASD in the United States per 1,000 children aged eight years ranged from 3.3 in Alabama to 10.6 in New Jersey.

A number of focal treatments are available for children with autistic spectrum disorders. Unlike comprehensive treatment programs that aim to modify most or all core ASD deficits, focal interventions are narrower in scope, with the goal of addressing one or more symptoms of the disorder.(1) In general, focal treatments use a single or limited number of methods to address specific social, communication or problem behaviors, and tend not to address broader cognitive skills, such as IQ.(2) Some well-known focal interventions include the Picture Exchange Communication System (PECS) and Social Stories™.

This report addresses four Key Questions that pertain to the efficacy and safety of focal educational and behavioral interventions for the treatment of ASD:

1. Does any focal educational or behavioral intervention improve outcomes for children with ASD when compared to no treatment, waitlist control, or standard care (e.g., special education, paramedical services, such as occupational therapy)?
2. Is one focal educational or behavioral intervention more effective than another in improving outcomes for children with ASD?
3. What adverse events and harms have been reported to occur in association with the use of focal educational or behavioral interventions for children with ASD?
4. What is the consensus among experts about the safety and efficacy of single-strategy educational or behavioral interventions for the treatment of children with ASD?

We based the answers to Key Questions 1, 2 and 3 on a systematic review of data from clinical studies, whereas Key Question 4 is based on the expert opinion of professional societies. In answering these questions, we provide two ratings of the evidence, one for the evidence underlying our qualitative conclusions (which answer the question “Does it work?”), and one for the evidence underlying our quantitative conclusions (which answer the question “How well does it work?”). We express the ratings for evidence underlying qualitative conclusions as the strength of the evidence, and the ratings for the evidence underlying quantitative conclusions as the stability of the evidence. The following table presents the ratings we use and the definitions of each relevant term.

Table 1. Definitions of Strength and Stability of Evidence

Strength-of-evidence Rating	Interpretation
Qualitative Conclusion (Direction of Effect)	
Strong Evidence	Evidence supporting the qualitative conclusion is convincing. It is highly unlikely that new evidence will lead to a change in this conclusion.
Moderate Evidence	Evidence supporting the qualitative conclusion is somewhat convincing. There is a small chance that new evidence will overturn or strengthen our conclusion. ECRI Institute recommends regular monitoring of the relevant literature at this time.
Weak Evidence	Although some evidence supports the qualitative conclusion, this evidence is tentative and perishable. There is a reasonable chance that new evidence will overturn or strengthen our conclusions. ECRI Institute recommends frequent monitoring of the relevant literature at this time.
Inconclusive Evidence	The available evidence that exists is not of sufficient strength to warrant drawing an evidence-based conclusion. ECRI Institute recommends frequent monitoring of the relevant literature this time.
Quantitative Conclusion (Magnitude of Effect)	
High Stability	The estimate of the effect size in the conclusion is stable. It is highly unlikely that the magnitude of this estimate will substantially change as a result of the publication of new evidence.
Moderate Stability	The estimate of the effect size in the conclusion is somewhat stable. There is a small chance that the magnitude of this estimate will substantially change as a result of the publication of new evidence. ECRI Institute recommends regular monitoring of the relevant literature at this time.
Low Stability	The estimate of the effect size in the conclusion is likely to be unstable. There is a reasonable chance that the magnitude of this estimate will substantially change as a result of the publication of new evidence. ECRI Institute recommends frequent monitoring of the relevant literature at this time.
Unstable	Estimates of the effect size are too unstable to allow a quantitative conclusion to be drawn at this time. ECRI Institute recommends frequent monitoring of the relevant literature.

A summary of the findings for each of the four questions we addressed are presented below. For Key Question 1 through 3, we considered the following outcomes: language skills, social skills, learning readiness, problem behaviors, higher order functioning, and parental/family well-being. The studies that met the study selection criteria for this report used various instruments to measure these outcomes.

Key Question 1: Does any focal educational or behavioral intervention improve outcomes for children with ASD when compared to no treatment, waitlist control, or standard care (e.g., special education, paramedical services, such as occupational therapy)?

ECRI Institute’s Conclusions for Key Question 1

The evidence was insufficient, due to differences in the interventions used by the included studies, to determine whether focal treatments improve outcomes for children with ASD when compared to no treatment, wait list control, or standard care.

Eleven moderate-quality controlled studies enrolling a total of 360 children with a diagnosis of ASD addressed this question. Two of the 11 studies evaluated the use of imitation as an intervention for teaching children social skills. However, because the data in these studies were not reported in a consistent or complete format, we considered the evidence insufficient to draw any evidence-based conclusions. The nine remaining studies tested the effectiveness of different focal treatments to either no treatment or routine care. Because the interventions evaluated in these studies were different, we considered the evidence insufficient to draw any conclusions.

Key Question 2: Is one focal educational or behavioral intervention more effective than another in improving outcomes for children with ASD?

ECRI Institute’s Conclusions for Key Question 2

Because each of the included studies evaluated a different focal intervention, the evidence was considered insufficient to determine whether one focal treatment is more effective than another in improving outcomes for children with ASD.

Three moderate-quality randomized controlled studies enrolling a total of 66 children with a diagnosis of ASD addressed this question. Because the studies all used different focal interventions we did not draw any conclusions.

Key Question 3: What adverse events and harms have been reported to occur in association with the use of focal educational or behavioral interventions for children with ASD?

ECRI Institute’s Conclusions for Key Question 3

None of the authors of the 13 included trials reported adverse events. Whether this was because there were no adverse events or because the authors of the studies failed to report adverse events was unclear.

Key Question 4: What is the consensus among experts about the safety and efficacy of focal educational or behavioral interventions for the treatment of children with ASD?

Our searches identified four guidelines that included specific recommendations for the use of focal educational and behavioral interventions for children with ASDs. Facilitated Communication (FC) was unanimously considered ineffective and potentially harmful by the

four guidelines that reported on it. By contrast, the use of visual augmentation, such as the use of pictures or objects, to support communication was supported.

ECRI Institute's Overall Conclusions

For Key Question 1, two out of 11 included moderate quality trials that evaluated the same focal intervention. However, because the data were not reported in a consistent or complete format, the evidence was considered insufficient to draw any evidence-based conclusions. The remaining nine trials all evaluated different focal interventions. For Key Question 2, only one moderate-quality trial evaluated each type of intervention, so again we considered the evidence insufficient to draw any conclusions.

For Key Question 3, none of the authors of the 13 included trials reported adverse events. Whether this was because there were no adverse events or because the studies failed to report adverse events was unclear.

For Key Question 4, only four guidelines specifically addressed behavioral or educational focal interventions. Based on these reports, Facilitated Communication was found to be ineffective and potentially harmful, while visual augmentation, or the use of pictures and/or objects to support communication, was supported.

Overall, the evidence evaluated in this review was considered insufficient to determine whether focal interventions are more effective than no treatment or routine care or whether one focal intervention is more effective than another in improving outcomes for children with ASDs. Future research on focal interventions for ASD would greatly benefit from more controlled trials, larger sample sizes, and a concerted effort to replicate the findings of the few existing controlled trials.

Preface

Organization of This Report

There are six major sections in this report: 1) *Overview*, 2) *Key Questions and Outcomes Assessed*, 3) *Methods*, 4) *Synthesis of Results*, 5) *Economic and Regulatory Issues*, and 6) *Conclusions*. In the *Overview* section, we provide background information about the health condition or illness under evaluation, including details about its epidemiology, diagnosis, and treatment. This includes background information on other procedures used for diagnosing the condition or illness, and details about the specific intervention(s) evaluated in this report. The final parts of the *Overview* section address previous systematic reviews and meta-analyses of studies of this technology. This background material supports the *Key Questions and Outcomes Assessed*. The questions were developed in consultation with TRICARE. The section on Key Questions explains the rationale for each question and the type of evidence that can answer it.

The *Methods* section details how we identified and analyzed information for this report. It covers our literature searches, criteria for including studies in our analysis, evaluation of study quality, assessment of the strength of the evidence base for each question, and methods for abstracting and synthesis of clinical study results. The *Methods* section provides a synopsis of these activities. Specific details of literature searches, study quality and evidence strength measurement, and statistical approaches (understanding of which is not necessary for understanding the findings of this technology assessment) are documented in appendices.

The *Synthesis of Results* section of this report is organized by Key Question. For each question, we report the quality and quantity of the studies that provided relevant evidence. Then we summarize the results of the reported clinical studies that met our criteria for analysis. Detailed results from each included study are found in evidence tables in Appendix D. Each subsection closes with our evidence-based conclusions on the Key Question.

In the *Economic and Regulatory Issues* section, we provide information on the cost of treatment, where available. We also include information on health insurance coverage for the treatments under evaluation. This includes a discussion of the coverage policies of Medicare, Medicaid, and other third party payers.

This report ends with a *Conclusions* section that briefly summarizes the answers to the questions addressed in it, and summarizes other important information that was presented in other sections.

Scope

This report evaluates the efficacy of focal educational and behavioral interventions for the treatment of autism spectrum disorders (ASD). Focal interventions are defined as interventions that use a specific strategy to address one or more deficits/symptoms associated with ASD. The use of focal interventions to treat conditions other than ASD is outside the scope of this report, as are other forms of treatment for ASD, such as comprehensive interventions which utilize more than one treatment strategy (for example, Applied Behavior Analysis), pharmacological or dietary interventions, complementary/alternative treatments (i.e., massage therapy, hyperbaric oxygen therapy, neurofeedback) or any other treatment that aims to have a physiological effect, auditory or sensory integration, surgical interventions, or other non-drug therapies (e.g., special education, physical, occupational, or speech therapy). Also excluded from this report are focal

interventions used to treat symptoms other than the core deficits associated with ASDs (i.e., anxiety, anger management).

For information about comprehensive treatment programs, please refer to our recent technology assessment entitled *Comprehensive Programs for the Treatment of Children with Autism*.

Overview

In this section, we provide background information on a range of diagnoses included under the ASD umbrella and provide a description of some of the more commonly used focal educational and behavioral interventions used to treat them.

Autism Spectrum Disorders

Autism spectrum disorders (ASDs), also known as pervasive developmental disorders, refer to a wide continuum of associated cognitive and neurobehavioral disorders, including, but not limited to, three defining features: impairments in socialization, impairments in verbal and nonverbal communication, and restricted and repetitive patterns of behaviors.(3) Within the *Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (DSM-IV) and Text Revised Edition (DSM-IV-TR)*, ASDs are divided into five specific diagnostic categories—autistic disorder, Asperger disorder, Rett disorder, childhood disintegrative disorder, and pervasive developmental disorder, not otherwise specified (PDD-NOS).(4)

While all children with ASDs demonstrate similar core features, the severity of impairments, age of onset, and associations with other disorders (e.g., mental retardation, specific language delay, and epilepsy) vary considerably.(5) Further, manifestations of ASDs vary across children and within a child over time. According to a report published by the National Research Council, despite strong and consistent commonalities, there is no single behavior that is always typical of autistic disorder or of any of the other ASDs and no behavior that would automatically exclude an individual child from diagnosis of autistic spectrum disorder.(6) Below, we briefly describe each of the diagnostic categories of ASD.

Autistic Disorder

The DSM-IV criteria for the diagnosis of autistic disorder (AD) are presented in Table 2. According to the DSM-IV, the essential features of AD are the presence of “markedly abnormal or impaired development in social interaction and communication, and a markedly restricted repertoire of activities and interests.”(4) To meet the criteria for AD, a child must demonstrate at least six of the symptoms listed in Table 2, with at least two coming from criterion 1 and one coming from criterion 2 through 4. Further, at least one symptom must have been present before the child’s third birthday.

Table 2. The DSM-IV Diagnostic Criteria for Autistic Disorder

Criterion	Description of Symptoms
Criterion 1	Qualitative impairment in social interaction, as manifested by at least two of the following:
A	Marked impairment in the use of multiple nonverbal behaviors, such as eye-to-eye contact, facial expression, body postures, and gestures to regulate social interaction.
B	Failure to develop peer relationships appropriate to developmental level.
C	Lack of spontaneous seeking to share enjoyment, interests, or achievements with other people.
D	Lack of social or emotional reciprocity.
Criterion 2	Qualitative impairments in communication as manifested by at least one of the following:
A	Delay in or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime).
B	In individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others.
C	Stereotyped and repetitive use of language or idiosyncratic language.
D	Lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level.
Criterion 3	Restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
A	Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.
B	Apparently inflexible adherence to specific, nonfunctional routines or rituals.
C	Stereotyped and repetitive motor mannerisms.
D	Persistent preoccupation with parts of objects.
Criterion 4	The delays in normal functioning must have been manifest in at least one of the following areas with onset prior to age 3 years:
A	Social interaction.
B	Language as used in social communication.
C	Persistent preoccupation with parts of objects.
Criterion 5	The disturbance cannot be better accounted for by any other disorder.

Adapted from the *DSM-IV*.(4)

According to the DSM-IV, impairment in reciprocal social interaction is “gross” and “sustained.”(4) Children with AD might display marked impairments in the use of multiple nonverbal behaviors that normally act to regulate social interaction and communication, such as

eye-to-eye contact, facial expression, body postures, and gestures (Criterion 1A). They might fail to develop peer relationships appropriate to their developmental level (Criterion 1B). Children with AD might lack the normal behavior of spontaneously seeking to share enjoyment, interests, or achievements with others (Criterion 1C). For example, normal children will usually show or point out an object that they find interesting to other people, whereas a child with autistic disorder might not. Children with AD may also lack social or emotional reciprocity (Criterion 1D). For example, a child with autistic disorder might not actively participate in simple social play or games, preferring solitary activities only involving others as tools or mechanical aids to their own play.

Impairments in communication are also “gross” and “sustained” with both verbal and nonverbal skills being affected.(4) Children with AD may demonstrate a delay or a total lack of development of the spoken language (Criterion 2A). In children who are not mute, there may be an impairment in their ability to initiate or sustain a conversation with others (Criterion 2B), or they might engage in stereotyped and repetitive use of language (Criterion 2C). Children with AD may also lack varied, spontaneous make-believe play or social imitation appropriate to their developmental level (Criterion 2D).

Children with autistic disorder typically demonstrate restricted repetitive and stereotyped patterns of behavior, interests, and activities. This may manifest itself in one (or more) of four ways. There may be an all-encompassing preoccupation with one or more stereotyped and restricted patterns of interest (Criterion 3A). For example, a child with autistic disorder may appear to be preoccupied with one very narrow interest, such as collecting information about bus schedules. The child may also demonstrate an apparently inflexible adherence to a specific, nonfunctional routine or ritual (Criterion 3B) that might, for example, result in catastrophic consequences when the bus schedule is changed. Children with AD may demonstrate stereotyped and repetitive motor mannerisms, which might include clapping the hands or rocking the body back and forth (Criterion 3C). Finally, a child with AD may demonstrate a persistent preoccupation with particular parts of objects such as a button or parts of their own body (Criterion 3D).

Asperger Disorder

The DSM-IV diagnostic criteria for Asperger disorder are presented in Table 3. A diagnosis of Asperger disorder applies to those children who demonstrate at least three autistic-like deficits without demonstrating a delay in language development or an important cognitive deficit.(4) Two of these deficits must manifest as impairments in sociability and one must present as impairment in the range of the individuals' interests and activities. In contrast to AD, individuals with Asperger disorder do not demonstrate delays in cognitive or language development, but are socially awkward, pedantic, and preoccupied with narrow interests, such as memorization of lists.

Table 3. The DSM-IV Diagnostic Criteria for Asperger Disorder

Criterion	Description of Symptoms
Criterion 1	Qualitative impairment in social interaction, as manifested by at least two of the following:
A	Marked impairment in the use of multiple nonverbal behaviors, such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction.
B	Failure to develop peer relationships that are appropriate to developmental level.
C	A lack of spontaneously seeking to share enjoyment, interests, or achievements with other people.
D	Lack of social or emotional reciprocity.
Criterion 2	Restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
A	Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.
B	Apparently inflexible adherence to specific, nonfunctional routines or rituals.
C	Stereotyped and repetitive motor mannerisms.
D	Persistent preoccupation with parts of objects.
Criterion 3	The disturbance causes clinically significant impairment in social, occupational, or other areas of functioning.
Criterion 4	There is no clinically significant general delay in language.
Criterion 5	There is no clinically significant delay in cognitive development or in the development of age-appropriate self-help skills, adaptive behavior, and curiosity about the environment in childhood.
Criterion 6	Criteria are not met for any other disorder.

Adapted from the *DSM-IV*.(4)

The validity of Asperger disorder as a discrete diagnostic entity distinct from high-functioning (verbal) autistic disorder remains controversial.(3) Many clinicians have used the term Asperger disorder loosely to refer to all children with autistic disorder who show normal to high intelligence. While a consensus is beginning to emerge that the two conditions are more similar than different, the DSM-IV, as currently written, indicates that if criteria for autistic disorder are met, a diagnosis of Asperger disorder is precluded.

Rett's Disorder

The DSM-IV criteria for Rett's disorder are presented in Table 4. Rett's disorder occurs primarily in girls.(4) Children with Rett's disorder develop normally until approximately six months of age, when developmental delays and regression occur. Affected children typically exhibit reduced muscle tone, autistic-like behavior, stereotyped hand movements consisting mainly of wringing and waving, loss of purposeful use of the hands, a lag in brain and head growth, gait abnormalities, and seizures. Recently, a gene was isolated on the X chromosome, MECP2, which appears responsible for most cases of Rett's disorder.(5)

Table 4. The DSM-IV Diagnostic Criteria for Rett's Disorder

Criterion	Description of Symptoms
Criterion 1	All of the following:
A	Apparently normal prenatal and perinatal development.
B	Apparently normal psychomotor development through the first 5 months after birth.
C	Normal head circumference at birth.
Criterion 2	Onset of all the following after a period of normal development:
A	Deceleration of head growth between ages 5 and 48 months.
B	Loss of previously acquired purposeful hand skills between ages 5 and 30 months with the subsequent development of stereotyped hand movements.
C	Loss of social engagement early in the course of development.
D	Appearance of poorly coordinated gait or trunk movements.
E	Severely impaired expressive and receptive language development with severe psychomotor retardation.

Adapted from the *DSM-IV*.(4)

Childhood Disintegrative Disorder

The DSM-IV diagnostic criteria for childhood disintegrative disorder (CDD) are presented in Table 5. The diagnosis of disintegrative disorder applies to children who demonstrate normal early development, including the development of language for at least the first two years of life. Then, between the ages of two and ten years, they undergo behavioral and cognitive regression that results in severe autism and mental retardation. The period of regression typically lasts four to eight weeks and is marked by agitation and panic on the part of the child. Childhood disintegrative disorder can occur in either boys or girls, but is much more common in boys. Unlike typical autistic disorder, children with CDD display very little developmental growth after treatment and the condition continues as a chronic, severe developmental disability. Many researchers suspect that CDD is a distinct neurodegenerative disorder with a very different etiology from autistic disorder.(5)

Table 5. The DSM-IV Diagnostic Criteria for Childhood Disintegrative Disorder

Criterion	Description of Symptoms
Criterion 1	Apparently normal development for at least 2 years after birth as manifested by age appropriate verbal and nonverbal communication, social relationships, play, and adaptive behavior.
Criterion 2	Clinically significant loss of previously acquired skills (before the age of 10 years) in at least two of the following areas:
A	Expressive and receptive language.
B	Social skills and adaptive behavior.
C	Bowel and bladder control.
D	Play.
E	Motor skills.
Criterion 3	Abnormalities of functioning in at least two of the following:
A	Quantitative impairment in social interactions.
B	Quantitative impairments in communication.
C	Restricted, repetitive, and stereotyped patterns of behavior, interests, and activities, including motor stereotypies and mannerisms.
Criterion 4	The disturbance is not better accounted for by any other disorder.

Adapted from the *DSM-IV*.(4)

PDD-NOS

A DSM-IV diagnosis of PDD-NOS is applied to those children who demonstrate severe impairments in sociability, language, and range of activities and who do not meet the DSM-IV diagnostic criteria for any of the other ASDs, schizophrenia, schizotypal personality disorder, or avoidant personality disorder. PDD-NOS is a diagnosis by exclusion of the other autistic spectrum disorders. For example, a diagnosis of PDD-NOS would be given to a child who does not meet the six of possible 12 criteria for the diagnosis of autistic disorder, or who had symptom onset after the age 36 months.(3) Also, children whose symptoms are atypical or not as severe, or who appear to have Asperger's but exhibit cognitive or language delays, might be coded under this diagnosis.

Associated Disorders

In addition to the behavioral deficits described by the DSM-IV (and the ICD-10), children with autism spectrum disorders often present with a variety of other developmental disorders, medical conditions, and behavioral problems. The most commonly co-occurring developmental disorder is mental retardation. Approximately 75% of children diagnosed with ASD have an associated diagnosis of mental retardation (IQ <70), with roughly half of this group functioning at the range of mild to moderate mental retardation and half in the severe to profound range.(5,7) The degree of mental retardation appears to be highly correlated with the severity of autistic symptoms.

Children with ASD are also at risk for developing seizure disorders throughout the developmental period.(6) The incidence of seizures in children with ASD has been estimated to be three to 28 times higher than that found in the general population, with the prevalence being highest among those with mental retardation or motor deficits.(8,9) Seizure disorders in ASDs are of various types and may sometimes present in unusual ways, such as staring spells, cessation of activity, or aggressive escalations.(3) The most prevalent type of seizure appears to be partial complex seizures, with electrophysiological testing showing abnormalities occurring most often over the temporal lobes.(3) Other medical conditions that may co-occur with ASDs include metabolic disorders, Angelman syndrome, fragile X syndrome, and tuberous sclerosis.(3,5,6,8,9)

Other comorbid behavioral problems associated with autistic spectrum disorders include fear/phobias, sleeping and eating disturbances, Tourette syndrome and other tic disorders, hyperactivity, inattentiveness, aggressiveness, self-injurious behavior, and obsessive-compulsive behavior.(3,5,6) Abnormal responses to sensory stimuli such as loud sounds, oversensitivity to light touch, fascination with certain visual stimuli, and insensitivity to pain are also often seen in children with ASD. Additionally, disorders of mood and affect may be present, manifesting as laughing or crying for no apparent reason, lack of, or excessive fearfulness, generalized anxiety, temper tantrums, and decreased or absent emotional reaction.(5)

Diagnostic Strategies

The diagnosis of autistic spectrum disorders can be challenging. According to the National Research Council, complexities in diagnosis and evaluation relate to the range of syndrome expression in these conditions along various dimensions such as language abilities and associated mental handicap.(6) Other factors such as differential diagnosis, concerns with labeling, diagnostic terminology, and lack of expertise in assessment and diagnosis can add to the challenge. Generally, the diagnosis of ASD is carried out by a multidisciplinary team of experts, which may include pediatricians, psychologists, psychiatrists, neurologists, speech pathologists, occupational and physical therapists, and special and general educators. Diagnosis should be based on a careful and comprehensive assessment that includes specific evaluations of language and communication skills, cognitive and adaptive functioning, sensorimotor functions, behavioral deficits, and family functioning and resources.(3) The evaluation should include measures of parental report, child observation and interactions, and clinical judgment. An expanded medical and neurological evaluation should also be conducted to assess for possible comorbid conditions. Because there is evidence that ASDs have a genetic basis, at least in some cases, details of other family members with ASDs or other mental illnesses, such as bipolar disorder, should also be recorded.(3)

A number of instruments have been developed to aid in the diagnosis of ASD. The most widely recognized diagnostic instruments include the parent-interview Autism Diagnostic Interview-Revised (ADI-R)(10), the performance-based Autism Diagnostic Observation Schedule-Generic (ADOS-G).(11) and the Gilliam Rating Scale (GARS).(6) While not stand-alone diagnostic instruments, they are useful aids to a DSM-IV and ICD-10 diagnosis within the autism spectrum, with definitive threshold scores for the diagnosis of autistic disorder.(3) Other diagnostic instruments include the Childhood Autism Rating Scale (CARS), Autism Behavior Checklist, Aberrant Behavior Checklist, Parent Interview for Autism (PIA), Social Communication Questionnaire (SCQ), and the Diagnostic Interview of Social and Communication Disorders (DISCO).(3,6,12)

The symptoms of ASD are often measurable by 18 months of age.(6) While there is still some concern about the reliability and validity of early diagnosis (prior to age three), most clinicians now recognize the potential benefits of early diagnosis.(13) According to Rogers (2001), early recognition helps answer parents' questions about the nature of their child's developmental delay and the implications of this delay in the future, allows for the most appropriate treatment to be selected and delivered, and has been associated with the possibility of better outcomes.(14) Recently, several standardized tests and checklists have been developed to help assist in the early recognition and identification of children with ASD. Such instruments include the Checklist for Autism in Toddlers (CHAT) and modified version (M-CHAT), the Pervasive Developmental Screening Test-II (PDDST-II), the Screening Tool for Autism in Toddlers (STAT), and the Early Screening for Autism questionnaire. Other screening instruments have been developed for undiagnosed older verbal children, including the Australian Scale for Asperger's Disorder, the Autism Spectrum Screening Questionnaire (ASSQ), and the Gilliam Asperger Disorder Scale (GADS).(3,6)

Course and Prognosis

The onset of ASD typically occurs before age three, with the majority of children displaying developmental abnormalities within the first two years of life.(5) Although they are not always recognized at the time, a careful retrospective interview with the parents typically reveals evidence of abnormalities in social responsiveness and early communication behaviors (e.g., baby games and communication gestures). According to Ozonoff and Rogers (2003), a smaller group of children with autistic disorder display a period of normal or mostly normal development, followed by a loss of communication and social skills and onset of autism.(5) The regression generally occurs between 12 and 24 months, thus distinguishing it from childhood disintegrative disorder, in which severe regression occurs after at least two years of normal development.(5) The causes of the regression are not yet understood. Some believe that it is influenced by environmental factors, while others contend that it is genetically influenced.

Most individuals continue to meet the criteria for ASD as teenagers and adults. Studies of adolescents and adults with autistic disorder have found that some of the symptoms that are associated with autism, such as hyperactivity, self-injurious behavior, compulsivity, and stereotypies, are exacerbated in about 35% of individuals during puberty.(15) In later adolescence and adulthood, abnormalities such as stereotyped motor movements, flat affect, generalized anxiety, and social improprieties are frequently observed, even in high-functioning individuals. In such individuals, social ineptitude and employment can also become acute problems.(15) Adults with severe autistic disorder may develop complex obsessive-compulsive rituals and abnormal speech behaviors, such as idiosyncratic usage, preservation, excessive concreteness, monotonous tone, repetitive questioning, and talking to oneself.(15)

The long-term prognosis for patients with autism, as defined by measures of social adjustment, the ability to work, and the ability to function independently, is poor.(15,16) Based on an assessment of the few available long term follow-up studies, Gillberg and Nordin found that 60% to 70% of children with autistic disorder will have “a poor” or “very poor” outcome with regard to social adjustment, and only 5% to 15% of children with autism will experience a “good” outcome.(15) The best single predictor of outcome is IQ,(17-19) with an IQ of <50 at the age of five to six being a strong predictor of a poor prognosis.(15) Another predictor of a poor outcome is the lack of communicative speech at the age of five to six.(15)

Epidemiology

Data from a population-based, multisite surveillance study conducted by the Centers for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring Network (ADDM) indicated that in 2002 the prevalence of ASD in the United States per 1,000 children aged eight years ranged from 3.3 (95% confidence interval [CI] 2.7 to 3.9) in Alabama to 10.6 (CI 9.5 to 11.5) in New Jersey. The overall mean prevalence was 6.6 (CI 6.3 to 6.8).⁽²⁰⁾ To determine the prevalence of ASD, the ADDM collected data on 407,578 children from 14 different states. Children were identified as having ASD through screening and abstraction of evaluation records at health facilities and through psychoeducational evaluations for special education services. Children whose records documented behaviors consistent with the DSM-IV-TR criteria for autistic disorder, pervasive developmental disorder, not otherwise specified, or Asperger disorder were classified as having ASD. Among the 407,578 children for which data were collected, 2,685 (0.66%) were identified as having ASD. Table 6 lists each state that was surveyed, total number of children identified as having ASD within each state, and individual state prevalence rates. To date, the ADDM's study represents the largest and most complete study on the prevalence of ASD in the United States.

Table 6. Prevalence Surveillance States and Rates of ASD in 2002

State	Total Number of Children	Total Children with ASD	Overall Rate (95% CI)
Alabama	35,472	116	3.3 (2.7 to 3.9)
Arizona	45,113	280	6.2 (5.5 to 7.0)
Arkansas	36,472	251	6.9 (6.1 to 7.8)
Colorado	11,020	65	5.9 (4.6 to 7.5)
Georgia	44,299	337	7.6 (5.5 to 8.5)
Maryland	29,722	199	6.7 (5.8 to 7.7)
Missouri	28,049	205	7.3 (6.4 to 8.4)
New Jersey	29,748	316	10.6 (9.5 to 11.9)
North Carolina	20,725	135	6.5 (5.5 to 7.7)
Pennsylvania	21,051	111	5.3 (4.4 to 6.4)
South Carolina	23,191	140	6.0 (5.1 to 7.1)
Utah	26,108	196	7.5 (6.5 to 8.6)
West Virginia	21,472	153	7.1 (6.1 to 8.4)
Wisconsin	35,126	181	5.2 (4.5 to 6.0)

Note: Data for this table were abstracted from the Centers for Disease Control and Prevention's (CDC) Web site (<http://www.cdc.gov/mmwr/preview/mmwrhtml.htm>).

In addition to overall prevalence rates, the ADDM study also provided information on demographic characteristics of children with ASD. Prevalence of ASD varied to a certain extent by race and ethnicity across states. In ten states, prevalence was higher among non-Hispanic white children than among non-Hispanic black children, but this difference was only statistically significant ($p < 0.05$) for five states.(20) In all states the prevalence was lower for Hispanic children than for non-Hispanic white and non-Hispanic black children. A consistent finding across all states was a significantly ($p < 0.001$) higher prevalence of ASDs among males than among females. Prevalence for males ranged from 5.0 per 1,000 children to 16.8 per 1,000 children, and for females the prevalence ranged from 1.4 to 4.0 per 1,000 children. The male-to-female ratio across the various states ranged from 3.4 to 6.5 boys to 1 girl. Finally, the median age of earliest documented ASD ranged from 49 to 66 months.

One of the limitations of the ADDM study is that prevalence rates were not provided for specific diagnostic categories of ASD. However, limited data from smaller studies indicates that the prevalence of Asperger's disorder is relatively high at around 7 per 1,000.(21,22) The prevalence of Rett's disorder is estimated to fall within the range of one in 12,000 to one in 22,800(23,24) The prevalence of childhood disintegrative disorder is estimated to be the rarest of the ASDs at one in 100,000.(25) The prevalence of PDD-NOS is estimated to be 1.6 per 1,000.(26)

The data reported by the ADDM reflects a substantial increase in prevalence of ASD from 1/1000 in the early 1990s to 1/152 in 2002.(5) However, there is no clear explanation for this apparent increase. The increase most likely reflects changes in the clinical definition of autism, and a greater awareness of autistic behaviors by clinicians, teachers, and parents.(5) Recent surveillance studies, such as the one conducted by the ADDM, now include children that were unlikely to have been previously considered to have autism, such as children with less severe forms of autistic disorder and children with Asperger's disorder. Similarly, children with coexisting mental retardation and autism may now have a primary diagnosis of autism rather than mental retardation. Finally, greater awareness of autism has led to more screening and availability of treatment services in schools and the community, which may also partly explain the increase in prevalence.

Pathology and Etiology

At present, the exact etiology of ASD remains unclear for most affected children. Given the range of symptoms associated with ASD and the heterogeneity of the children affected by the disorder, it is very unlikely that one single etiology will turn out to be responsible. Currently, the most widely accepted belief is that ASD is a biologically-based neurodevelopmental disorder with a strong genetic basis.(27) Evidence for a genetic basis comes from twin studies that show a high concordance for ASD in monozygotic twins and relatively small concordance in dizygotic twins.(5) The most recent studies of twins, which used standardized diagnostic measures and total population screening, found a monozygotic concordance rate of 60% for AD and 93% for the broader spectrum of social and communication deficits with stereotypies.(27) The rates for dizygotic twins were shown to be 0.0% to 5.0% for AD and 10% to 30% for the broader spectrum.

This strong decrease in risk from monozygotic twins to dizygotic twins suggests a polygenic model of inheritance.(27) Recent statistical modeling of the genetics of ASD indicates that at least three (perhaps as many as 20) gene loci contribute to the wide spectrum of symptoms.

According to McPherson et al. (2007), preliminary linkage studies have identified gene markers on chromosomes 1p, 7q, 16p, and 17p, with the highest log of odds score across studies for chromosome 7.(27) Other factors associated with an increased risk of autism are single gene defects or deletions, such as those that cause tuberous sclerosis,(28,29) phenylketonuria, fragile X, Angelman's, and Cornelia de Lange's syndromes; intrauterine exposure to rubella, thalidomide, or valproate; and herpes encephalitis.(5,27)

The common association of ASD with seizures and mental retardation suggests a neurological basis.(5,27) Neuroimaging and autopsy studies have revealed a variety of developmental brain abnormalities. According to Ozonoff et al.(2001), the findings of recent neuroimaging studies have shown deviations from normal in the volume of the hippocampus and amygdala, cerebellum, brainstem, neocortex (particularly the frontal and temporal lobes), and the cerebellar vermis (particularly lobules VI and VII).(27) Postmortem studies of a limited number of individuals with ASD most of whom also had significant mental retardation revealed increased neuronal density in the hippocampus, olivary dysplasia, scattered areas of cortical and white matter dysplasia, and other nonspecific developmental abnormalities in the brainstem and cerebellum.(27) In addition to anatomic abnormalities, quantitative abnormalities have also been found in serotonin, dopamine, opioid, and most recently, γ -aminobutyric acid neurotransmitter transport systems.

Given the phenotypic variability of ASD, even among monozygotic twins (e.g., one twin displays more severe symptoms than the other), it is unlikely that ASD is purely a genetic disorder. A number of environmental factors have been hypothesized to play a role in modulating the autism phenotype.(27) The list of factors include, but is not limited to, the following—pesticides and other environmental toxins, diet and nutrition, and vaccines containing the preservative called thimerosal, which is 50% mercury.(6) Research, however, assessing the association of environmental factors with ASD has been largely inconsistent.

Focal Educational and Behavioral Interventions

A number of focal treatments are available for children with autistic spectrum disorders. Focal or targeted interventions aim to modify one or more ASD specific behaviors or deficits and are often components of comprehensive treatment programs. Focal treatments can be distinguished from comprehensive treatment programs which seek to simultaneously address most or all of the symptoms of ASDs by using a combination of interventions which collectively:

- target education and skill development as well as problematic behavior(6)
- emphasize early intervention (treatment beginning between one and six years of age) and the importance of individualizing interventions
- include specific curriculum content, highly supportive teaching environments and generalization strategies, highly trained staff, predictable routines, and active family involvement
- involve intensive hours of treatment (usually more than 15 hours per week) delivered over a long period of time (one or more years)(30)

In the section below, we briefly describe some of the more widely recognized focal treatments that aim to improve social, communication and the stereotypic/problem behaviors common to ASD. This section is not intended to serve as an exhaustive list of all available focal

interventions. The reader should be made aware that there is a great deal of overlap in definitions of social skills and communication interventions.(31)

Focal Treatments for Improving Social Skills

A variety of different interventions fall under the broad heading of “social skills training”. These interventions can be subdivided into five categories: reinforcement/modeling, peer-mediated interventions, reinforcement schedules and activities, scripts and stories, and miscellaneous.(31) All of these interventions focus primarily on addressing the social impairments that are characteristic of children with ASD, such as poor eye contact and failure to initiate social interactions. A description of the five subcategories follows.

Video Modeling, a type of reinforcement/modeling, is an intervention based on the belief that children with ASD, generally, process visual stimuli well. In this intervention a teacher, other instructor (i.e., peer, parent) or even the child him/herself demonstrates expected, or targeted, behaviors and skills on videotape. These videos often focus on teaching important social cues, specific communication behaviors or sequences for task completion. The affected child watches the video as often as needed until the desired behavior is learned.(32) Social or food reinforcements may be used with this technique.(31) Video Modeling is used by both ABA and positive behavioral support programs.(32)

Peer-mediated interventions are based on the notion that individuals will learn to generalize any newly acquired skills faster and to a wider range of new situations if they are presented to them by peers rather than non-peers. Like video modeling, in this intervention the peer “trainers” model or prompt appropriate social behaviors for the child with autism.(31)

Reinforcement Schedules and Activities, which are frequently used in comprehensive teaching approaches, have also been used as focal interventions by some. When used as a focal intervention, Reinforcement Schedules and Activities involve the use of reinforcements and prompts (stimuli that increase the probability of the desired behavior) or time delays (expectant posture) between prompts and reinforcement to get children, particularly young children, to engage in social interactions and be more accepting of physical contact.(31,33)

Social Stories is another commonly used method for teaching children with ASDs how to respond in a socially acceptable manner in a variety of situations. A particular story may aim to improve social skills or communication (i.e., provide instructions on greeting others, talking with friends), reduce undesirable behaviors (i.e., shouting) or even teach academic curriculum (i.e., math lessons). In its original form, Social Stories were stories made up of short, direct sentences that described a social situation, with an emphasis on the relevant social cues (descriptive sentences); directed the reader in how to respond in a socially acceptable manner (directive sentences); and described the readers and/or stories’ characters’ feelings (perspective sentences).(34)

In its updated form, Social Stories may also contain illustrations that provide the reader with visual supports of the story’s content; affirmative statements, which express shared values within a given culture; control sentences, or statements written by those with ASD to help identify personal strategies that can be used to help with recall; cooperative sentences, to identify how others can help the reader learn the lesson being taught in the story; and consequence statements, or a description of what is likely to happen following a given response to a social dilemma.

These stories may be read to or by an individual with ASD, presented on a computer, or be accompanied by music.(34)

Other methods, including such interventions as social-skills curriculums, Pivotal Response Training (PRT), Picture Exchange Communication System (PECS), inclusion in classrooms with typically developing, same-age peers and even self-management also fall under the broad umbrella of social skills training.(31) While the two better known strategies from this category, PECS and PRT, both encourage ASD children to be more social, they go about doing so in different ways. The PECS requires the child to exchange a picture of a desired item for the actual item.(35) Pivotal Response Training aims to change pivotal (central to wide areas of functioning) social behavioral deficits, such as a lack of self-initiated social interactions, by placing a desired object in an opaque bag and prompting the child to ask “What’s that?” before he/she gets to play with the item.(36) Both PECS and PRT are also used to improve communication skills.(35,36)

Focal Treatments for Improving Communication Skills

The acquisition of basic language skills can occur through three treatment approaches: discrete trial training (DTT) interventions, naturalistic behavioral interventions and developmental-pragmatic interventions.(33,37) Discrete trial training, a component of Lovaas and other ABA programs, attempts to teach children with ASD basic language skills in a very formal manner. A teacher gives an instruction or discriminative stimulus to the child (e.g., asking the child to name an object), the child is expected to respond, a consequence follows, and then the sequence is repeated until the instructor feels confident the child has mastered the desired skill. The DTT method is often criticized for its lack of generalizability to other situations.(33,37)

As the name implies, naturalistic behavioral interventions occur in the child’s natural environment (e.g., at home or in school) and are initiated by the child himself, rather than an instructor. Other differences between this method and DTT include the use of intrinsic rather than extrinsic rewards, lack of repetitiveness of the interaction, and a lack of a predetermined communication curriculum. Examples of naturalistic behavioral interventions include, but are not limited to, PRT and incidental teaching. When used to improve language skills, PRT may focus on pivotal communication behaviors, like requesting, while incidental teaching methods manipulate the child’s environment, by incorporating highly desirable toys for example, to promote child-initiated communications.(33,37) Naturalistic teaching is purported to produce communication abilities that are more generalizable to other settings than those learned through DTT.(37)

A similar approach, developmental-pragmatic interventions, also take place in the child’s natural environment and are child-directed, but the emphasis is on making the child understand that communicating with others is a satisfying and enjoyable experience and often the learning takes place while the child is engaged in play behavior. This method is often incorporated into the Developmental Individual-difference Relationship-based (DIR) comprehensive treatment program.(37)

Several methods have been developed to teach more complex language skills. For instance, Augmentative and Alternative Communication (AAC) interventions are used to facilitate language in those who have significant speech impairments, bypassing the motor and cognitive demands of speech production. AAC strategies attempt to teach the individual with ASD other ways of communicating until he/she is able to effectively communicate with the spoken word. Some examples of AAC interventions include:

- teaching the individual with ASD sign language
- presenting a picture along with the spoken word so that the child can use the picture in future exchanges to express his desires
- PECS, in which the child initiates the picture request and persists with the communication until their partner in the exchange responds
- nonelectronic-aided systems and electronic-aided systems with or without voice output.(37,38)

In some cases, the attempts of the individual with ASD to use AAC are followed by a reinforcer to increase the behavior. The fear that AAC interventions will actually delay or inhibit speech production altogether is a common criticism of this approach. Some fear that the recipients of this technology will prefer it to natural speech.(37,38)

One AAC that has received considerable attention over the years is Facilitated Communication (FC). Proponents of FC believe that ASD children can possess, understand and utilize language just like their non-ASD counterparts, but merely have a problem expressing themselves. Facilitated Communication, which involves a trained person guiding the child's hand on a computer keyboard, is simply an aid to self-expression.(39) Opponents of FC have been highly critical of this method, however, asserting that what is being communicated is the facilitator's rather than the child's thoughts. Opponents have also noted the disproportionate rate of accusations of sexual abuse that have resulted while using this technology.(40)

Focal Treatments for Improving Stereotyped/Problem Behaviors

There are two basic approaches underlying focal treatments to reduce stereotyped/problem behaviors. One is functional behavior analysis and the other is self-management approaches. Functional behavior analysis assumes that the child is gaining something by acting in a stereotypic manner, either getting a desired object or avoiding engagement in some unpleasant activity. This theory emphasizes that these behaviors will not go away on their own and, instead, must be replaced by more socially acceptable behaviors. In recent years, proponents of functional behavior analysis have adopted positive behavioral supports as opposed to punishment as a way of getting the child with ASD to replace the stereotypic behavior for a socially desirable one.(41,42) A variation of this method, functional communication training (FCT), assumes the problem behavior is the ASD individual's only method of communicating and that once a new way of communicating is learned, the unacceptable behavior will disappear.(43)

Self management approaches, by contrast, require the ASD individual to monitor the frequency of their socially acceptable and socially unacceptable actions and the child is given a reward based on how well they replace one behavior for another.(41)

Care Setting

Focal interventions can be carried out in the child's home, school/daycare or an office setting. It has been reported that pivotal response training (PRT) was designed to be used by anyone who works or lives with an individual with an ASD and may be applied in school, home or a community setting.(44)

Staff Training for Focal Interventions

Very little information is available on specific training techniques or the number of hours needed to be qualified to implement a focal intervention. One article did note that University teaching credentialing programs often include only one course on functional behavioral assessment and intervention, although some teachers receive additional behavior training from their Local Education Agency (LEA).(45) In a RCT of PECS versus no treatment, teachers, parents, teaching support staff and speech language therapists received 13 hours of training in this teaching technique and were provided with six half day maintenance sessions over the course of the next five months.(46) In another trial, graduate students majoring in psychology and related fields received 60 hours of training in a group-delivered social skills intervention.(47)

Competing/Complementary Treatment

A number of treatment options other than focal interventions are currently available for children with ASDs. These include comprehensive treatment programs; pharmacotherapy and complementary or alternative treatments, such as chiropractic manipulation, sensory and auditory integration, hyperbaric oxygen therapy, dietary interventions; exercise; and surgical procedures. In addition, most children with ASDs are eligible to receive special education, physical, occupational, and/or speech therapy. This list, however, is not exhaustive of all the competing/complementary treatments available for children with ASD.

Comprehensive Treatment Programs

A number of comprehensive treatment programs are available for children with ASDs. Unlike the focal or targeted interventions previously described, comprehensive programs seek to simultaneously address most or all of the symptoms of ASDs. Most comprehensive programs emphasize early intervention (treatment beginning between one and six years of age) and the importance of individualizing interventions in a manner that meets the needs of each child and family.(30) Comprehensive programs also often include specific curriculum content, highly supportive teaching environments and generalization strategies, highly trained staff, predictable routines, and active family involvement.(30) Further, most comprehensive programs involve intensive hours of treatment (usually more than 15 hours per week) delivered over a long period of time (one or more years).

What distinguishes one comprehensive treatment program from another is its theoretical orientation, with some being behaviorally oriented and others being developmentally oriented. In brief, behavioral approaches, such as Applied Behavior Analysis (ABA), use certain techniques in a systematic manner to produce observable and socially significant changes in a child's behavior and skills.(48) Some of the techniques include chaining, or breaking a task down to its smallest parts; prompting, to encourage the child to respond appropriately; fading, or using the least intrusive prompts to bring about a desired result until prompting is no longer needed; shaping, or gradually modifying inappropriate behaviors; and, finally, providing various levels of positive or negative reinforcement depending on the difficulty of the task.

Unlike behaviorally-oriented programs, most developmental approaches do not rely on a specific set of strategies or techniques to modify behaviors or teach new skills.(6) Instead, developmental programs, such as the DIR model and the Denver Model, organize a child's environment to encourage or facilitate communicative and social interactions.(49) Developmental programs are child-directed in that the child initiates interaction and the adult responds. In most

developmentally oriented programs, play is a primary vehicle for learning social, emotional, communicative, and cognitive skills. Other comprehensive programs, such as TEACCH and the SCERTs model, are considered “eclectic” or mixed because they incorporate both developmental and behavioral procedures.(6,50) For information about comprehensive treatment programs, refer to our recent technology assessment *Comprehensive Programs for the Treatment of Children with Autism*.

Pharmacotherapy

The three major classes of psychotropic agents that have demonstrated efficacy in ASD in open label or placebo controlled trials and are widely used today include atypical neuroleptics (antipsychotics), antidepressants, and psychostimulants/alpha-adrenergic agonists.(5) Of these, the psychostimulants appear to be the most commonly used, in approximately 12% of children aged seven through 13 with ASDs.(51)

Atypical neuroleptics, including clozapine, risperidone, quetiapine, olanzapine and ziprasidone, are increasingly being used to treat the symptoms of ASD because they generally do not produce serious side effects, especially extrapyramidal effects like tardive dyskinesia. One exception is clozapine, which does carry a risk of seizure and agranulocytosis, and requires frequent monitoring with blood tests. Of the medications in this category, risperidone has shown the most promise in reducing repetitive behavior, aggression, anxiety, depression, and irritability in individuals with ASDs in clinical trials.(5)

Among the antidepressants, selective serotonin reuptake inhibitors (SSRIs) are the preferred medication in this class, given their superior safety profile compared to tricyclics. There is some evidence that fluvoxamine and sertraline are effective at reducing repetitive and/or maladaptive behaviors and aggression but further studies are needed.(5)

Finally, the psychostimulant methylphenidate appears to be effective in about half of ASD children who are also hyperactive or have Attention Deficit Hyperactivity Disorder (ADHD) symptoms. Other medications in this class, including Concerta, Adderall XR, Ritalin LA, Metadate CD, and Methylin ER, have been found to be efficacious in treating children with ADHD, although they have yet to be studied in children with ASD and ADHD. Clonidine and guanfacine, two alpha-adrenergic agonists, have demonstrated some efficacy in autism. In particular, for children with Fragile X and autism, clonidine appears effective in reducing tantrums and aggression.(5)

While the three medication classes listed above show efficacy in treating some symptoms often associated with ASD, other medications which were touted to alleviate the core deficits of autism (social skills, language, and cognitive function) but have since been discredited include naltrexone, haloperidol, propranolol, and fluvoxamine for increasing communicative language and improvements in socialization.(5,51) There is disagreement in the literature on lamotrigine’s effect on ASD core deficits(5,51) Newer medications that look promising for treating the core deficits of autism but need more research include olanzapine as well as agents designed to increase glutamatergic transmissions.(5)

Complementary and Alternative Medicine (CAM)

The National Center for Complementary and Alternative Medicine (NCCAM) recognizes five domains of complementary and alternative medicine: alternative medicine systems (e.g., Chinese medicine), mind-body interventions (e.g., meditation), body-based medicine (e.g., sensory

integration therapy), biologically-based therapies (e.g., mega-vitamin therapy), and energy therapies (e.g., magnet therapy). Among individuals with ASD, it is estimated that 50%-95% have been treated with one or more of these therapies despite a lack of empirical support for these treatments.(40)

In the body-based medicine category, chiropractic manipulation is the most commonly used method, but sensory integration therapy, to compensate for brain deficits in processing sensory input, is also popular.(40) Sensory integration therapy is typically administered by occupational therapists with an emphasis on manipulation of the child's environment. Specific treatment approaches include but are not limited to trampoline jumping, wearing weighted vests, "smooshing" a child between pads or pillows, or playing with textured toys. Auditory integration training, or playing acoustically modified music, is believed to reduce the volume of frequencies to which the child is hypersensitive. Finally, hyperbaric oxygen therapy to decrease blood perfusion to several areas of the brain believed to be affected in ASD is another example of body-based treatments.(40)

Among the biologically-based therapies, there is a popular belief that dietary manipulation may eliminate some or all of the symptoms associated with ASDs. In particular, reduced sugar intake (Feingold diet) has been purported to reduce hyperactivity and impulsivity in children with ASD.(40) The use of secretin, a hormone involved in the control of digestion that stimulates the secretion of pancreatic fluid, has gained significant attention.(5,40) Proponents of secretin therapy, which is usually delivered in a single dose, allege improved behavioral outcomes. However, the authors of a recent Cochrane review on secretin therapy for autism concluded that the available evidence does not show that it is effective in treating the core features of autism.(52)

Other supplementary dietary therapies include large doses of omega-3 fatty acid, ketogenic diets, and the addition of vitamin B6-magnesium complex.(40) Vitamin B6-magnesium is believed to be beneficial by many because of its role in neurotransmitter production. Further, the elimination of casein and gluten (milk and wheat proteins) from the child's diet is believed by some to prevent the manifestation of autism altogether, by altering cerebral neurotransmitter metabolism. Other highly publicized strategies in this category include chelation therapy to rid the body of excess mercury and not vaccinating children with the MMR vaccine.(5,40) Chelation therapy, however, may produce serious adverse events, including kidney damage, irregular heartbeat, and swelling of the veins.(53) It may also cause nausea, vomiting, diarrhea, and temporary lowering of blood pressure. Further, research assessing the association of vaccinations with ASD has been largely inconsistent.

Exercise

Some programs emphasize the importance of physical exercise. Proponents of this method believe that stimulation of muscle activity may bring about a rewiring of the brain's neural network. Two examples of interventions that incorporate exercise as the main component of treatment are the Doman-Delacato Program and Daily Life Therapy (Higashi).(54)

Surgical

Surgery is not a treatment typically used to treat ASDs. However, because children with ASD have a higher frequency of seizure (3% to 30%) and other neurological symptoms than normal children, neurosurgery and vagal nerve stimulation to reduce or eliminate seizures has been used to treat children with comorbid seizure disorder and ASD.(55)

Special Education, Occupational, Speech and Physical Therapy

Per the United States Government Accountability Office, in 2002, 120,000 individuals aged six to 21 were diagnosed with ASD and received services under the Individual with Disabilities Act (IDEA). These services entail an individualized education program (IEP) which utilizes one or more of the following: special education teachers, counselors/psychologists, and speech, occupational, behavioral, and physical therapists based on the child's unique deficits.(56)

Economic and Regulatory Issues

The Individuals with Disabilities Education Act (IDEA)

The education of children with autism is governed by the Individuals with Disabilities Education Act (IDEA). IDEA is made up of both statutory laws enacted by Congress and the regulation of those laws by the Department of Education. IDEA incorporates six guiding principles. The first of which is a zero rejection policy that prohibits the exclusion of a student with a disability from free appropriate education.(57) This includes provisions governing how a child with a disability may be disciplined, limiting schools to a ten-day suspension for any violation of the school's code of conduct and up to a 45-day removal to an interim alternative education setting for serious safety threats to the child or another person. In addition, schools are not permitted to institute a change of placement if the behavior leading up to the change is a manifestation of the child's disability, unless the parent consents. When a change of placement is initiated, a behavioral intervention plan must be developed to address the problem behavior and positive behavioral interventions and supports (PBS) must be considered to remedy the situation. To insure that the cost of some of these needed related services are covered for children with disabilities, IDEA specifies that public agencies, including state Medicaid agencies, must assume financial responsibility for services to these children.(57)

Under IDEA, a child is entitled to a nondiscriminatory evaluation (NDE), which insures that socioeconomic status, language or other such factors do not bias the evaluation, and education in the least restrictive environment (LRE), which means that if the child can benefit from an education alongside his/her typically developing peers, that is the setting in which the child should be taught. Other IDEA principles include a policy of due process, or the rights of parents to contest any school decisions regarding the education plan of their child, and an emphasis on parent and student participation in the decision-making process. Finally, under IDEA, each child is entitled to appropriate education, or education that benefits the student and is appropriate to their individual needs. However, a free appropriate public education (FAPE) does not entitle the child to other interventions (e.g., Lovaas method, TEACCH, etc.) unless it can be shown that denial of these other interventions would constitute a denial of FAPE. As IDEA routinely uses Positive Behavioral Interventions and Supports, the burden of proof falls on parents to try to show that PBS is not beneficial to their child and that one of these other interventions would be more beneficial.(57)

Charges and Fees

Our searches of both the published and gray literature (e.g., intervention-specific Web sites) identified very little reliable information on the cost of specific behavioral interventions for the treatment of ASDs. However, some data were available for applied behavioral analysis (ABA) and parent-directed discrete trial training (DTT). In terms of healthcare utilization, based on data from 1997-2000 from three national surveys, families of children with an ASD were more likely than families of children with mental retardation to have private insurance and were found to average \$2,239 on home healthcare expenditures per year, of which \$179 was for ABA.(58)

Chasson et al. conducted a projected cost comparison study of children receiving three years of discrete trial training as compared to if those same children received a full 18 years of special education in Texas. The authors incorporated special education costs (\$20,000 annually), early intensive behavioral intervention (EIBI) costs (assumed to be \$22,500 annually with the parent-directed model of DTT), EIBI ineffectiveness (assuming a proportion of 0.28 of children who receive EIBI but fail to mainstream into regular education), population estimates of children with autism in Texas, and the expected number of years required for each type of service into the model. They found that the state of Texas could save \$84,300 per child over the child's total school years. Assuming 10,000 children in Texas have autism, that is a savings of \$843 million in state budgeted funds and \$2.09 billion in actual funds (state funds plus local, federal and private funds).(59)

Words and Concepts®, another focal treatment used to treat individuals with ASD, is a computer software program that aims to improve oral language skills. Three versions of the Words and Concepts software are available with increasing level of difficulty. Each level costs approximately \$230 for a copy of the software program plus \$1,150 for a network license. As a package, the three levels cost \$517 plus a network license rate of \$2,585.(60)

More generally, some investigators have attempted to compare the health care costs of children with ASDs versus other children. In one such study, the average annual total Medicaid expenditures for children with ASD versus those diagnosed with either mental retardation or other developmental/psychiatric disorders for the years 1994-1999 for one Pennsylvania county was found to be 3.5 times higher, or about \$10,000, for the ASD children, but no breakdown by behavioral service was provided.(61) In a similar study which examined total 1993-2003 medical expenditures for a national sample of children with ASDs covered under employer-based private health insurance plans, average medical expenses for these children were between 4.1 and 6.2 times higher than for children without a diagnosis of ASD.(62) When compared with children with another mental disorder, for the year 2004, children with ASDs cost private healthcare insurers approximately \$6,700 a year in total autism expenditures, surpassed only by those with a diagnosis of mental retardation (at about \$10,000 per year).(63) Again, no breakdown for behavioral interventions was presented in these studies.

As the costs of programs like the Lovaas method are not routinely covered under IDEA, recently some states have taken action to remedy this coverage gap. The Nevada Autism Task Force found that less than 6.0% of ASD individuals in the state receive funding from state programs to assist with the costs of ABA and that most insurance companies, including Medicaid and Nevada Check-Up, do not cover it. The task force is currently pressuring the Nevada Legislature to require health insurance policies and medical assistance programs to cover these costs for individuals under 21 years of age.(64) Other states are also in the processes of passing insurance reform, while some others have already done so. Table 7 below lists the insurance reform status by state.(65)

Table 7. Insurance Reform Status by State

Insurance Reform Status	States
The state has a law in place that requires private insurance to cover autism services, including ABA	Arizona, Florida, Indiana, Louisiana, Minnesota, Pennsylvania, South Carolina, Texas
The state currently has a bill seeking autism insurance reform that has been endorsed by Autism Speaks	Michigan, New Jersey, Virginia
The state is currently in the process of working on autism insurance reform, but does not yet have a bill endorsed by Autism Speaks	Kansas, Maryland, Massachusetts, Mississippi, Missouri, Nevada, New York, North Carolina, Ohio, Oklahoma, Washington, Wisconsin
The state is either in the very early stages of working on a bill or is not working on an autism insurance reform bill at all	Alabama, Alaska, Arkansas, Connecticut, Delaware, Idaho, Kentucky, Maine, Montana, Nebraska, New Hampshire, New Mexico, North Dakota, Oregon, Rhode Island, South Dakota, Tennessee, Utah, Vermont, West Virginia, Wyoming

Centers for Medicare and Medicaid Services Coverage Policy

The U.S. Centers for Medicare and Medicaid Services (CMS) does not have a national coverage policy for the use of educational or behavioral interventions for individuals with ASDs. Coverage decisions are left to the discretion of local Medicaid carriers. According to the 2008 Easter Seals Web site, only the following 16 states had a Medicaid coverage policy applicable to individuals less than 21 years of age: Arkansas, Colorado, Florida, Georgia, Illinois, Indiana, Kansas, Massachusetts, Maryland, Montana, Nebraska, South Carolina, Tennessee, Utah, Wisconsin, and Wyoming. Only 11 of the 16 states had coverage policies that specified behavioral interventions for individuals with ASDs. Table 8 below presents the behavioral services covered in the policies of the 11 states that specified some type of behavioral intervention.

Table 8. State Medicaid Coverage Policies

State	Behavioral Service Covered
Arkansas	Waiver for intensive early intervention individualized therapy, such a behavioral therapies, for children 3 to 10 years of age with a diagnosis of PDD, covering services up to \$50,000 per year.
Colorado	Behavioral therapy services are covered at a maximum of \$25,000 per year for three years or until the child's sixth birthday.
Florida	Individual with autism three and older requiring intermediate care facility for the developmentally disabled may seek services under a waiver for behavioral analysis and behavior assistant services. Massage therapy, IQ testing and psychological assessments are not covered.
Georgia	Waiver in effect covers behavioral support consultation.
Illinois	Home-based support services for children 3 to 21 years of age, with a monthly allocation not to exceed 200% of the monthly federal SSI payment. Participants may select from a range of services including behavior intervention and treatment. For those requiring residential care, behavior interventions to an annual maximum of 66 hours are covered.
Indiana	Waiver covers Applied Behavioral Analysis and behavioral support.
Kansas	Waiver covers early intensive intervention treatment through 5 years of age for a maximum of four years.
Montana	In process of developing a waiver for autistic children between 2 to 5 years of age for a maximum of three years of treatment with 20 to 25 hours per week of early intensive rehabilitation in the home by a qualified provider.
Nebraska	Waiver in process that would cover children up to nine years of age for intensive early intervention services.
South Carolina	Waiver for children 3 to 10 years of age for early intensive behavioral intervention.
Wisconsin	Waiver program covers intensive in-home treatment (although no specific behavioral intervention is listed) for children birth to 21 years of age.

More detailed information about local coverage decisions (LCD) can be found by searching the following Web site: http://www.easterseals.com/site/PageServer?pagename=ntlc8_autism_state_profiles.(66)

Third Party Payer Coverage

Table 9 below shows the current state-by-state private health insurance mandated coverage status for ASDs based on the 2008 Easter Seals Web site. This coverage may or may not include behavioral interventions. For more specific information on each state's health insurance policies visit the following Web site:

http://www.easterseals.com/site/PageServer?pagename=ntlc8_autism_state_profiles.

Table 9. State Insurance Coverage

State Insurance Coverage	States
Mental health parity law only; no specific health insurance mandate for coverage for ASDs	Alabama, Arkansas, California, Louisiana, Maine, Massachusetts, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, Rhode Island, Utah, Vermont, Virginia, Washington
State insurance coverage mandate in effect	Arizona, Colorado, Connecticut, District of Columbia, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kentucky, Maryland, New York, Oregon, Pennsylvania, South Carolina, Texas, Tennessee
No specific policy reported that covers ASDs	Alaska, Delaware, Idaho, Kansas, Michigan, Mississippi, Ohio, Oklahoma, Puerto Rico, South Dakota, West Virginia, Wisconsin, Wyoming

In addition to the above, we searched the Web sites of 15 private third-party payers for coverage policies of focal interventions for children with ASD (See the *Literature Search Methods* in Appendix A for a list of sites searched).

Three providers, Aetna, Premera BlueCross, and Regence Blue Cross/Blue Shield specifically indicated that alternative/augmentative communication devices are covered. Another payer, Cigna, considers these devices to be experimental and does not cover them. Facilitated communication was mentioned as an excluded therapy by three payers, Aetna, Blue Cross/Blue Shield of Massachusetts, and Cigna. See Table 38 in Appendix I for more information about the coverage policies of the third party payers.

Key Questions and Outcomes Assessed

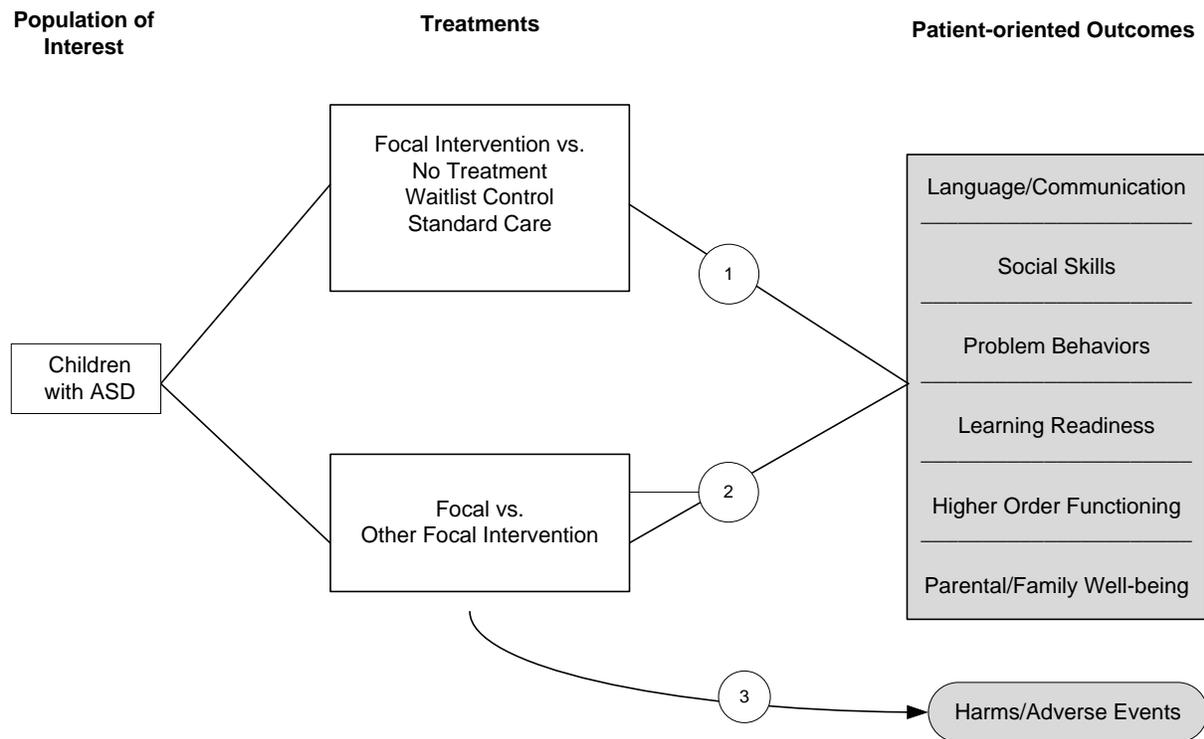
For this report, we addressed the following four Key Questions:

Key Questions:

1. Does any focal educational or behavioral intervention improve outcomes for children with ASD when compared to no treatment, waitlist control, or standard care (e.g., special education, paramedical services, such as occupational therapy)?
1. Is one focal educational or behavioral intervention more effective than another in improving outcomes for children with ASD?
2. What adverse events and harms have been reported to occur in association with the use of focal educational or behavioral interventions for children with ASD?
3. What is the consensus among experts about the safety and efficacy of single-strategy educational or behavioral interventions for the treatment of children with ASD?

These questions, along with the treatments and outcomes we evaluated to address these questions, are illustrated in Figure 1 below. This figure portrays the pathway of events that participants experience, starting from the relevant patient population (the far left of the figure), to the treatments they receive, and to participant-oriented outcomes. As such, participants in the population of interest are identified and “enter” the pathway at the left of the figure. The outcomes we address are shown to the right side of the figure. Key Question 4 is not depicted in the figure because this question deals with current expert opinion on treatment for ASD and does not address participant-oriented outcomes. We address this question by summarizing pertinent information from clinical practice guidelines and consensus or position statements.

Figure 1. Analytic Framework



Note: Circled numbers, e.g., 1 denote Key Questions.

Definition of Outcomes Assessed

Below, we briefly describe the outcomes assessed in this review. The outcomes represent those that are most commonly measured in studies evaluating comprehensive interventions for children with ASD.(1) Numerous standardized instruments are available to measure these outcomes. The instruments used in the studies that met the study selection criteria for this report are listed in Table 11 and further described in Table 17 in Appendix C.

- **Language/Communication skills**—typically measured as child’s ability for verbal expression, receptive skills, and pragmatic communication (e.g., body language, turn taking, and understanding intention and interest of others). Language and communication skills are generally measured using various standardized language and non-verbal communication tests. Subscales of IQ tests may also be used.
- **Social Skills**—often measured in terms of joint attention, play behavior, initiating social interactions. There is some overlap between this and communication skills.
- **Problem Behaviors**—this outcome encompasses a wide range of behaviors associated with ASD, including severe difficulty in initiating and maintaining social interactions and relationships, aggression, self-injury, and the use of restrictive and repetitive behaviors (repetitive non-functional movement or self-stimulatory behavior, also known as stereotypical behaviors). For the most part, problem behavior is measured using various validated instruments and checklists.(67)
- **Learning Readiness**—includes such measures as the Assessment of Basic Language and Learning Skills; to assess such things as how well an individual learns new information in a group setting.
- **Higher Order Functioning**—includes Theory of the Mind (or the recognition that others’ thoughts and beliefs are distinct from one’s own, the ability to make inferences about what others are thinking and feeling and to predict another person’s behavior) and Executive Function (the ability to follow through on tasks to achieve a goal). Both of these are speculated to be fundamental deficits in ASD, which could explain deficits in other domains.
- **Parental/Family Well-being** (e.g., family stress, quality of life)—often parents are highly involved in their child’s care, so many studies include measures assessing family outcomes.
- **Harms/Adverse Events**—Matson (2005) suggests that children, particularly young children, who are expected to comply to structured tasks over extensive periods of time on a daily basis may experience unintended adverse events such as tantrums, noncompliance, yelling, etc.(68)

Methods

Identification of Clinical Studies

One characteristic of a good technology assessment is a systematic and comprehensive search for information. Such searches distinguish ECRI Institute's assessments from traditional literature reviews. Traditional reviews use a less rigorous approach to identifying and obtaining literature and allow a reviewer to include only articles that agree with a particular perspective, and to ignore articles that do not. Our approach precludes this potential reviewer bias because we obtained and included articles according to explicitly determined *a priori* criteria. The criteria used for this report is explained in detail below under *Study Selection*.

Electronic Database Searches

We searched 16 external and internal databases, including PubMed, EMBASE, and Pilots, for clinical trials on the use of comprehensive interventions to treat ASD. To supplement the electronic searches, we examined the bibliographies of included studies, scanned the content of new issues of selected journals, and reviewed relevant gray literature for potential additional relevant articles. Gray literature includes reports and studies produced by local government agencies, private organizations, educational facilities, and corporations that do not appear in the peer-reviewed literature. Although we examined gray literature sources to identify relevant information, we only evaluate published literature in this report. All of the databases and the detailed search strategies used in this report are presented in Appendix A.

Study Selection

We selected the studies that we considered in this report using *a priori* inclusion criteria. As mentioned above, arriving at these criteria before beginning the analysis is one way of reducing bias.

We used the following criteria to determine which studies would be included in our analysis.

Population

1. At least 85% of children included in a study must have a primary diagnosis of ASD based on the diagnostic criteria established by the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders -IV or Text Revised edition (DSM-IV or DSM-IV-TR) or the World Health Organization's International Statistical Classification of Diseases-10th edition (ICD-10). *If less than 85% then the study must have reported outcomes separately for children who met a primary diagnosis of ASD. Studies that included children with co-morbid psychological conditions such as depression, attention deficit/hyperactivity disorder (ADHD), obsessive compulsive disorder (OCD) were not excluded as long as these conditions were secondary to a diagnosis of ASD.*
2. Studies of children through 18 years of age will be included in this report. Also, the children with ASD are the primary subjects being evaluated. Parent/provider outcomes will be assessed but only if they are reported in a publication in which the main goal is to assess ASD children.

Intervention

3. Studies must have assessed the efficacy of a focal educational or behavioral intervention defined as an intervention that utilizes one technique designed to address one or more deficits/symptoms associated with ASD (language/communication, social skills, cognition, adaptive behavior, etc). *Studies that focused on interventions which involved multiple treatment strategies (“comprehensive interventions”) were excluded from this review.*

Study Design

4. Each study must have been a prospective randomized or prospective non-randomized controlled trial. *Studies that employed a non-randomized design must have used matching procedures to insure some equivalence among study groups or had groups that were comparable at baseline on key factors such as age, IQ, and spontaneous speech production.*
5. Studies must have included five or more children in both the treatment and control conditions. *The results of studies with very small patient groups are often not applicable to the general population.*
6. Data from the second half of cross-over studies was excluded. *As there may be a lingering treatment effect from the first treatment applied, we have excluded the results from the second half of these trials. Studies that did not report data from the two different periods separately were excluded.*

Outcomes

7. All relevant outcomes must have been measured using an instrument(s) for which the properties of reliability and validity have been verified in the published literature. *However, if a study did not use a validated instrument, then the entire study was not necessarily excluded—only its data from instruments in which the psychometric properties were not reported in the published literature. Observational data were included if two independent raters assessed the behavior of interest.*
8. Study must have reported on at least one of the outcomes of interest for one or more of the Key Questions.
9. For all outcomes, we only considered time points for which at least 50% of the enrolled participants contributed data.

Publication Type

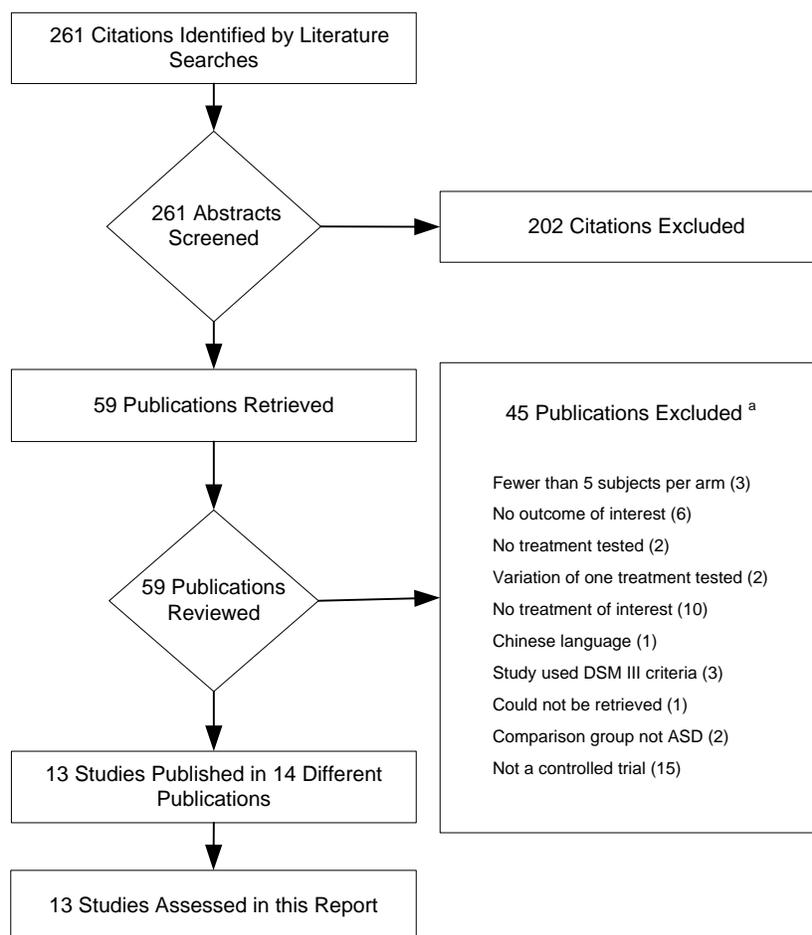
10. Study must have been published in English. *Moher et al. have demonstrated that exclusion of non-English language studies from meta-analyses has little impact on the conclusions drawn.(69) Juni et al. found that non-English studies typically were of lower methodological quality and that excluding them had little effect on effect size estimates in the majority of meta-analyses they examined.(70) Although we recognize that in some situations exclusion of non-English studies could lead to bias, we believe that the few instances in which this may occur do not justify the time and cost typically necessary for translation of studies to identify those of acceptable quality for inclusion in our reviews.*

11. Study was a published full-length peer-reviewed article rather than an abstract or letter. *Published abstracts and letters do not include sufficient details about experimental methods to permit verification and evaluation of study design.(71,72) However, we included data from any abstract that reported additional outcomes from a study and patient group that had been reported in a peer-reviewed full-length article that met all inclusion criteria.(73)*
12. When several reports from the same center were available, only outcome data from the report with the largest number of patients was included. *This is to avoid double-counting of patients. If a smaller report had provided data on an outcome that was not provided by the largest report, we included the data.*
13. Study was published between 2000 and present. *This was to avoid inclusion of outdated treatment approaches.*

Our searches identified 261 potentially relevant articles. Of those, 202 were excluded at the abstract level because they were not clinical studies or did not address any of the Key Questions. Out of the remaining 59 articles retrieved in full-length, 45 were excluded from consideration. Studies were excluded for the following reasons: the study design was not a controlled trial (15 studies), a controlled trial enrolled fewer than five subjects per arm (three studies), the study did not report on an outcome of interest (i.e., anger management or anxiety) (six studies), no treatment was tested (two studies), study compared a variation of one treatment without establishing the effectiveness of the original treatment (one study reported on in two publications), the study did not report a treatment of interest (i.e., massage therapy) (ten studies), publication was prior to 2000 and used DSM III criteria (three studies), Chinese language (one study), comparison group was not made up of children with ASD (two studies), and article could not be retrieved by our library (one study). Table 15 in Appendix A lists the reasons for exclusion. Figure 2, below, provides a diagram of our study selection process.

A total of 13 studies published in 14 different publications made up the evidence base for this review. Of the 13 studies, 11 addressed Key Question 1, three addressed Key Question 2, and no studies addressed Key Question 3. One of the 13 studies, Fisher and Happé(74), addressed both Key Question 1 and 2. Table 10 lists the studies included in this review and the Key Questions and outcomes addressed in each of the studies.

Figure 2. Study Attrition Diagram



^a Table 15. Excluded Studies

Table 10. Key Questions Addressed by Included Studies

Study	Study Design	Interventions	Number of Children	Key Question 1 Focal treatment vs. No Treatment or Standard Care	Key Question 2 Focal Treatment vs. Focal Treatment	Key Question 3 Adverse Events
Beaumont and Sofronoff 2008(75)	RCT	Junior Detective Program	26	✓		
		Wait list control	23			
Solomon et al. 2008(76)	RCT	Parent-Child Interaction Therapy (PCIT)	10	✓		
		Waitlist Control	9			
Howlin et al. 2007(46)	RCT	PECS – immediate delivery	26	✓		
		PECS – delayed delivery	29			
		SC	28			
Kroeger et al. 2007(47)	CT	Group delivered social skills intervention and edible reinforcers	13	✓		
		Unstructured play groups	12			
Rogers et al. 2006(77)	RCT	The communication curriculum of the Denver Model	5		✓	
		PROMPT	5			
Yoder and Stone 2006(78)	RCT	Responsive education and prelinguistic milieu teaching (RPMT)	17		✓	
		PECS	19			

Study	Study Design	Interventions	Number of Children	Key Question 1 Focal treatment vs. No Treatment or Standard Care	Key Question 2 Focal Treatment vs. Focal Treatment	Key Question 3 Adverse Events
Fisher and Happé 2005(74)	RCT	Theory of the mind	10	✓	✓	
		Executive function training	10			
		No treatment	7			
Aldred et al. 2004(79)	RCT	Parent training in a social communication intervention plus routine care	14	✓		
		Routine care	14			
Sofronoff et al. 2004 and 2002(80,81)	RCT	1 day parent training workshop (psychoeducation; Comic Strip Conversations; Social Stories; and management of problem behaviors, rigid behaviors and anxiety)	18	✓		
		6 individual one-hour parent training sessions (psychoeducation; Comic Strip Conversations; Social Stories; and management of problem behaviors, rigid behaviors and anxiety)	18			
		Wait list control	15			
Solomon et al. 2004(82)	RCT	Social adjustment enhancement curriculum including a parent training component	9	✓		
		Wait list control	9			

Study	Study Design	Interventions	Number of Children	Key Question 1 Focal treatment vs. No Treatment or Standard Care	Key Question 2 Focal Treatment vs. Focal Treatment	Key Question 3 Adverse Events
Drew et al. 2002(83)	RCT	Parent training curriculum in joint attention skills and joint activities	12	✓		
		Local services	12			
Escalona et al. 2002(84)	RCT	Imitation	10	✓		
		Contingent responsivity	10			
Field et al. 2001(85)	RCT	Imitation	10	✓		
		Contingent responsivity	10			
Total				11	3	0

CT Non-randomized controlled trial
PECS Picture Exchange Communication System
RCT Randomized controlled trial
SC Standard care

Table 11. Outcomes Assessed and Instruments Used in Included Studies

Instrument Name	Key Question 1										Key Question 2			
	Beaumont and Sofronoff 2008(75)	Solomon et al. 2008(76)	Howlin et al. .2007(46)	Kroeger et al. 2007(47)	Aldred et al. 2004(79)	Sofronoff et al. 2004, 2002(80,81)	Solomon et al. 2004(82)	Fisher and Happé 2005(74)	Drew et al. 2002(83)	Escalona et al. 2002(84)	Field et al. 2001(85)	Rogers et al. 2006(77)	Yoder and Stone 2006(78)	Fisher and Happé 2005(74)
Social														
Social Interaction Observation Code				✓										
Social Skills Questionnaire	✓					✓								
Diagnostic Analysis of Nonverbal Accuracy 2 – adult and child facial expressions							✓							
Griffiths Scale of Social Development									✓					
ADI- Revised									✓*					
Observation of object play, distal social behavior, proximal social behavior										✓	✓			
Observation of time spent in motor activity vs. time in a social interaction										✓				
Emotion Recognition test by Spence 1995	✓													
James and the Math test	✓													
Dylan is being teased	✓													

Instrument Name	Key Question 1											Key Question 2		
	Beaumont and Sofronoff 2008(75)	Solomon et al. 2008(76)	Howlin et al. .2007(46)	Kroeger et al. 2007(47)	Aldred et al. 2004(79)	Sofronoff et al. 2004, 2002(80,81)	Solomon et al. 2004(82)	Fisher and Happé 2005(74)	Drew et al. 2002(83)	Escalona et al. 2002(84)	Field et al. 2001(85)	Rogers et al. 2006(77)	Yoder and Stone 2006(78)	Fisher and Happé 2005(74)
Language														
Mullen Scales of Early Learning												✓		
Social Communication Questionnaire												✓		
Expressive one word picture vocabulary test			✓											
British picture vocabulary scale			✓											
Autism Diagnostic Observation Schedule			✓		✓							✓		
Observation of turn taking behavior (object exchange), an early form of intentional communication													✓	
Observation of nonimitative spoken communications or nonword vocalizations			✓					✓				✓	✓	
MacArthur Communicative Developmental Inventory					✓				✓			✓		
Developmental play assessment – adapted														
Vineland Adaptive Behavior Scale(VABS)					✓							✓		

Instrument Name	Key Question 1										Key Question 2			
	Beaumont and Sofronoff 2008(75)	Solomon et al. 2008(76)	Howlin et al. .2007(46)	Kroeger et al. 2007(47)	Aldred et al. 2004(79)	Sofronoff et al. 2004, 2002(80,81)	Solomon et al. 2004(82)	Fisher and Happé 2005(74)	Drew et al. 2002(83)	Escalona et al. 2002(84)	Field et al. 2001(85)	Rogers et al. 2006(77)	Yoder and Stone 2006(78)	Fisher and Happé 2005(74)
Problem behaviors and Family Well-being														
Parent-child interactions					✓									
Eyberg Child Behavior Inventory		✓				✓								
Parent stress index		✓			✓			✓						
Behavior Assessment System for Children Parent Rating Scales (BASC)		✓												
Observation of stereotypes, inactivity and playing alone									✓	✓				
Executive Functioning														
Test of Problem Solving (TOPS) – Elementary Revised							✓							
Modified Wisconsin card sort task								✓						
Trails Task														
Learning Readiness														
Assessment of Basic Language and Learning Skills (ABLLS)				✓										

Instrument Name	Key Question 1										Key Question 2			
	Beaumont and Sofronoff 2008(75)	Solomon et al. 2008(76)	Howlin et al. .2007(46)	Kroeger et al. 2007(47)	Aldred et al. 2004(79)	Sofronoff et al. 2004, 2002(80,81)	Solomon et al. 2004(82)	Fisher and Happé 2005(74)	Drew et al. 2002(83)	Escalona et al. 2002(84)	Field et al. 2001(85)	Rogers et al. 2006(77)	Yoder and Stone 2006(78)	Fisher and Happé 2005(74)
Theory of the Mind Tasks														
False belief standard deceptive box – self and other								✓						
Penny hiding deception task								✓						
Seeing lead to knowing/knowing self and other								✓						
Teacher questionnaire of everyday behaviors (ToM and EF)								✓						
Strange Stories Task							✓							
Faux Pas Stories Task							✓							

Note: Only validated instruments were assessed; for observations of child behavior, a method was considered valid if two coders independently rated the behaviors.
 * ADI – Revised is a measure that assesses language, social skills and repetitive/problem behaviors and was used to measure all three by this study.

Rating the Stability and Strength of Evidence

We used the ECRI Institute strength-of-evidence system to evaluate the stability and strength of a body of literature (shown in Appendix B).(86) ECRI Institute’s system employs 14 decision points that collectively yield an overall category that describes the stability of our quantitative estimates of treatment effect and the strength of the evidence supporting our qualitative conclusions. Qualitative conclusions address the question, “Does it work?” Quantitative estimates addresses the question, “How well does it work?” This distinction allows an evidence base to be considered unstable in terms of the quantitative estimate of effect (e.g., if estimates vary widely among studies) yet provide strong or moderate qualitative conclusions (e.g., if all studies nevertheless demonstrate the same direction of effect). Interpretations of the terms that define the strength of evidence (strong evidence, moderate evidence, weak evidence, and inconclusive evidence) and stability ratings (high stability, moderate stability, low stability or unstable) are presented in the *Summary* section of this report in Table 1.

The 14 decision points that comprise the ECRI Institute strength-of-evidence system address five general aspects of the evidence (domains): quality, quantity, consistency, robustness, and magnitude of treatment effect. Quality refers to the degree of potential bias in the design or conduct of studies. Quantity refers to the number of studies and the number of patients enrolled in the studies. Consistency addresses the degree of agreement among the results of available studies. Robustness is the insensitivity of conclusions to minor alterations in the data. Magnitude of treatment effect concerns the quantitative amount of benefit (or harm) that patients experience after treatment. These concepts are described in greater detail in Appendix D.

Quality of Evidence

To aid in assessing the quality of each of the studies included in this assessment, we used the quality assessment instrument developed by ECRI Institute for controlled trials, shown in Appendix C. This instrument examines different factors of study design that have the potential to reduce the validity of the conclusions that can be drawn from a trial. In brief, the tools were designed so that a study attribute that, in theory, protects a study from bias receives a “Yes” response. If the study clearly does not contain that attribute it receives a “No” response. If poor reporting precludes assigning a “Yes” or “No” response for an attribute, then “NR” is recorded (NR = not reported).

To estimate the quality of an individual study, we computed a normalized score so that a perfect study received a score of 10, a study for which the answers to all items was “No” received a score of 0, and a study for which the answers to all questions was “NR” was 5.0. We then classified the overall quality of the evidence base by taking the median quality score. Quality scores were converted to categories as shown in the table below. The definitions for what constitutes low or moderate quality evidence were determined *a priori* by a committee of four ECRI Institute methodologists, and are presented in Table 12 below.

Table 12. Study Quality Categories

	Overall Quality of Evidence Base		
	Low	Moderate	High
Median Overall quality score of the evidence base	≤6.0	>6.0 but <8.5	≥8.5

Data Synthesis

Where possible, we have converted the results reported by the studies to a standardized measure of treatment efficacy, an effect size. We usually pool the results of different studies together using meta-analysis, but the studies included in this assessment were too heterogeneous in the treatments assessed to allow us to do so.

For continuous outcomes, we used Hedges' g (standardized mean difference adjusted for small sample size), which represents the difference between groups on a standardized scale.¹(87) When baseline measures were reported for corresponding outcome data, we computed baseline-adjusted Hedges' g values using a pre-post correlation of 0.5.(88) Odds ratio (OR) was used as the measure of effect size for all analyses of dichotomous data. The OR formula gives a relative measure of chance of the event of interest in the form of the ratio of the odds of an event in two groups; values greater than one favored the experimental group, and values less than one favored the control group.

¹ The formula for Hedges' g is $g = \left(\frac{M_1 - M_2}{s} \right) * \left(1 - \frac{3}{(4 * (N - 2)) - 1} \right)$ where M_1 is the mean for one group, M_2 is the mean for the other group, s is the pooled standard deviation, and N is the total number of patients in both groups. Hedges' g adds a correction factor to adjust for small samples.(87)

Synthesis of Results

Key Question 1: Does any focal educational or behavioral intervention improve outcomes for children with ASD when compared to no treatment, waitlist control, or standard care (e.g., special education, paramedical services, such as occupational therapy)?

Two of the 11 included moderate quality studies compared the same focal intervention. Both studies evaluated the use of imitation to teach children social skills. However, the data from these two trials were not reported in a consistent or complete format, thus we considered the evidence insufficient to draw any evidence-based conclusions. All of the remaining included studies compared different focal interventions.

Evidence Base

Eleven controlled studies enrolling a total of 360 children with a diagnosis of ASD addressed this question. Eight studies compared the efficacy of a focal treatment intervention to no treatment and three compared the focal treatment of interest to routine care, local services or an unstructured play group. See Appendix G for more detail.

The median quality assessment score for the studies was moderate (8.0, range: 6.8 to 8.4). The trials received a moderate quality assessment rating because, with the exception of the Kroeger et al. study, all were RCTs. In addition, most of the trials received funding from a source without a financial or proprietary interest in the research findings, had groups that were comparable on important patient characteristics (e.g., age, I.Q.) at baseline, and had study completion rates of 85% or greater. However, nine of the studies either did not blind outcome assessors for all reported outcomes or failed to report that they had done so; no trials reported that there was concealment of subject allocation to study group; and the outcomes assessed by each report were subjective.

Patient Baseline Characteristics

Overall, children in these trials tended to be on the less severe side of the autism spectrum, with 134/360 (or 37.2%) children being categorized as having either Asperger's syndrome or high-functioning autism.

Three of the 11 controlled trials reported whether or not their subjects were verbal. Howlin et al. and Drew et al. included either all or a majority of children who were nonverbal, while Kroeger et al.'s sample was only 16% nonverbal.(46,47,83)The other eight studies did not report this patient characteristic.

Children in the 11 included studies ranged in age from a mean of 21.4 (2.7) months in the Drew et al. trial to a mean of 130 months (or 10.8 years, range 111-146 months) in the older child social skills group of the Solomon et al. trial.(74,82) Of the studies that did report gender, only 37/237 subjects (or 15.6%) were female. Three studies, Beaumont et al., Fisher and Happé, and Sofronoff et al. did not report the gender of their participants.(74,80,81)

Four studies reported on concurrent treatments their study subjects were receiving throughout the trial.(46,74,79,83) Overall, study participants in these four trials were receiving special education, often including speech/language therapy. Three children in the Drew et al. trial received concurrent ABA therapy. In the Aldred et al. study, two children were involved in ABA therapy and 14 were enrolled in Treatment and Education of Autistic and Communication Handicapped Children (TEACCH). Table 23 in Appendix E provides further information about the children who participated in the studies.

Treatment Characteristics

Two of the 11 included studies tested the effects of imitation versus contingent responsiveness on the social skills of children with autism. Unfortunately, no meta-analysis was possible as the two studies reported their results in different ways. Fields et al. did not provide baseline data. Instead, they reported the effects of treatment after one, two or three sessions.(85) By contrast, Escalona reported how subjects' social skills were affected after one session of imitation compared to baseline.(84)

The nine remaining included studies tested the effectiveness of different focal treatments. Beaumont et al. tested the effectiveness of a new, multi-component intervention known as the Junior Detective Program versus no treatment.(75) The Junior Detective Program has four components: a computer game to teach emotion recognition, emotion regulation and social interaction; small group therapy sessions gave subjects an opportunity to practice skills learned on the computer and provided additional step-by-step guidance on how to solve social problems; parent training sessions to guide parents in how to reward their child for using their newly learned skills; and teacher handouts, also used to encourage the use of newly acquired skills. It was delivered in eight sessions over a seven-week period.

Solomon et al. tested Parent-Child Interaction Therapy (PCIT), a highly structured training program which relies on behavioral principles to help parents change their child's problem behaviors, compared to no treatment. PCIT has two phases. In Phase 1, the child-directed interaction phase, therapists coached parents in how to respond to their children using a "bug in the ear" microphone behind a one-way mirror. Parents were taught to be attuned to their children by giving positive attention; ignoring negative behaviors; avoiding criticism, discipline, making requests, giving commands and asking questions. In phase 2, the parent-directed interaction phase, therapists coached parents in how to give clear direct, concise, age-appropriate, simple commands and to consistently reinforce their child's compliance. The training program was attended for 12.7 sessions, on average.

Although both Kroeger et al. and Solomon et al. labeled the intervention they tested "a group-delivered social skill intervention", several factors caused us not to attempt a meta-analysis. In the Kroeger et al. trial the treatment regimen was 15 hours per week/5 weeks, while in Solomon it was 1.5 hours per week/20 weeks. In addition, the targeted behaviors (play and socialization vs. emotion recognition), outcomes assessed (social interaction and learning readiness vs. recognition of facial expressions, EF and ToM), and comparison groups (unstructured play group vs. wait list control group) studied by each investigator were different.(47,82)

Howlin et al. compared PECS to a no-treatment control group. In this study, PECS was administered for an unspecified number of hours in a classroom setting by teachers, therapists, support staff or parents, all of whom received 13 hours of training in this teaching technique and were provided with six half-day maintenance sessions over the course of the next five months. Treatment duration was 20 weeks.(46)

Kroeger et al. studied the effects of a 15-hour per week group-delivered social skills intervention which utilized video modeling to provide study participants with direct instructions in how to play and socialize. Following the video, facilitators encouraged subjects to use the skills they just learned and generalize them to other situations. This treatment was compared to an unstructured play group. The training lasted a total of five weeks.(47)

Like Kroeger et al, Solomon et al. investigated the effects of a group-delivered social skills intervention, but Solomon's intervention, administered for only 1.5 hours per week in group sessions and supported by parent implementation in the home, targeted emotion recognition in self and others, ToM, and EF, with a special emphasis on individual and group problem solving. This treatment lasted for 20 weeks and was compared with a wait list control group.(82)

Fisher and Happé compared two treatments, both of which aim to improve what are speculated to be the fundamental deficit in ASD, capable of explaining deficits in other domains, to a no-treatment control group. The two active treatments aimed to reduce deficits in executive functioning (EF) and theory of the mind (ToM). Executive functioning refers to the ability to maintain a mentally specified goal and implement that goal despite distracting alternatives. Executive functioning includes inhibition, planning, coordination and control of action sequences. In this study, EF training was implemented using a card sort task as the training task. The children were then taught a strategy designed to help them shift between sets (to improve inhibitory control and flexibility). Theory of the Mind (ToM) refers to the recognition that others' thoughts and beliefs are distinct from one's own, and includes the ability to make inferences about what others are thinking and feeling and to predict another person's behavior. In this study, ToM training consisted of training children to think about beliefs as "photos in the head," using such props as dolls and illustrative stories.

Children in both treatment groups of the Fisher and Happé study received 25-minute long individual sessions for five to ten consecutive days. The children were not allowed to advance to the next stage in the treatment program until they reached the preset goal for the previous one, which is why treatment duration may vary. Children were tested pre-treatment, immediately after treatment and two months post-treatment. At the start of each new session, the trainer and student reviewed what had been learned the day before.(74)

Aldred et al. compared a self-developed social communication intervention aimed at improving the quality of parent-child communications. This treatment was administered in a clinic and lasted for one year, although the training schedule was reduced after the first six months. The outcomes of children receiving this social communication intervention were compared with children receiving routine care.(79)

Drew et al. evaluated a parent training program intended to increase joint attention and joint action routines. They also provided parents with behavioral management techniques that could be used to reduce unwanted behaviors, like interrupting, in an attempt to keep children compliant with study curriculum. Treatment lasted one year and outcomes were compared to those in children taking part in local services only.(83)

Finally, Sofronoff et al. tested the efficacy of a parent training program to reduce problem behaviors in children with Asperger's syndrome to a wait list control condition. Parents in the active treatment group received six hours of training for a total of four weeks.(80,81)

A detailed description of the patient characteristics of each study's subjects and the treatments tested is available in Appendices F and G. The table below is a summary of the individual study results. More information about individual study results, including conclusions presented by the authors, can be found in Appendix G.

Table 13. Key Question 1 Individual Study Results

Study	Design	Intervention	Outcomes Reported and Effect Sizes at Final Followup
Beaumont and Sofronoff 2008(75)	RCT	Junior Detective Program vs. wait list control group	Social Skills Questionnaire parent report: Hedge's g 1.22 (0.619 to 1.824) Emotion Regulation Social Skills questionnaire: Hedge's g 1.41 (0.792 to 2.029) Emotion Recognition from facial expression: Hedge's g 0.389 (-0.169 to 0.946) Emotion Recognition from body posture: Hedges' g 0.332 (-0.224 to 0.888) Dylan is being teased: hedges' g 1.244 (0.639 to 1.848) James and the Math test: Hedges' g 1.408 (0.790 to 2.207)
Solomon et al. 2008(76)	RCT	Parent-Child Interaction Therapy vs. waitlist control group	Eyberg Child Behavior Inventory problems: Hedge's g 0.492 (-0.383 to 1.366) Eyberg Child Behavior Inventory parent perceptions: Hedge's g: 0.946 (0.034 to 1.857) Behavior Assessment System for Children Parent Rating Scale atypicality: 0.631 (-0.253 to 1.514) Behavior Assessment System for Children Parent Rating Scale adaptability: 0.999 (0.082 to 1.916) Behavior Assessment System for Children Parent Rating Scale social skills: 0.632 (-0.251 to 1.516) Behavior Assessment System for Children Parent Rating Scale leadership: 0.310 (-0.556 to 1.175) Parenting Stress Index: could not be calculated.
Howlin et al. 2007(46)	RCT	PECS vs. no treatment	Frequency of child communication initiations, speech, and PECS use; expressive one word picture vocabulary test; British picture vocabulary scale; ADOS-G communication and reciprocal social interaction domains: no effect sizes could be calculated.
Kroeger et al. 2007(47)	CT	Group delivered social skills intervention vs. unstructured play group	ABLIS; frequency of prosocial behaviors: no effect sizes could be calculated.

Study	Design	Intervention	Outcomes Reported and Effect Sizes at Final Followup
Fisher and Happé 2005(74)	RCT	ToM training vs. EF training vs. no treatment	<p>Proportion of ToM tasks passed; penny hiding task; seeing leads to knowing task; know/guess self task; deceptive box self and other tasks; Wisconsin card sort tasks; teacher rating questionnaire; and trails task: no effect sizes could be calculated.</p> <p>Percent of children who improved on ToM tasks passed: Odds Ratio 6.00 (0.52 to 69.75)</p> <p>Children's "reading in the mind's eye" task: Odds Ratio 14.00 (1.135 to 172.642)</p> <p>Wisconsin card sort task – aggregate score: Hedges' g 0.101 (0.82 to 1.02)</p>
Aldred et al. 2004(79)	RCT	Self-developed social communication interventions. Routine care	<p>ADOS communication and stereotyped and restricted behavior Domains; parental stress index: no effect size could be calculated.</p> <p>MacArthur CDI – language comprehension: Hedges' g = 0.003 (-0.72 to 0.72)</p> <p>MacArthur CDI – expressive language: Hedges' g = 0.009 (-0.71 to 0.73)</p> <p>Parent-child communicative acts: Hedges' g = 0.719 (-0.02 to 1.46)</p> <p>Parent-child shared attention: Hedges' g = 0.219 (-0.50 to 0.94)</p> <p>Vineland Adaptive Behavior Scale – communication domain: Hedges' g = 0.326 (-0.40 to 1.05)</p> <p>ADOS reciprocal social interaction: Hedges' g = 0.965 (0.20 to 1.73)</p>
Solomon et al. 2004(82)	RCT	Group delivered social skills intervention vs. wait list control group	<p>Diagnostic Analysis of nonverbal accuracy adult facial expressions: Hedges' g young children 1.041 (-0.17 to 2.25) older children 1.092 (-0.23 to 2.4)</p> <p>Diagnostic Analysis of nonverbal accuracy child facial expressions: Hedges' g young children 1.063 (-0.150 to 2.275) older children 0.435 (-0.79 to 1.66)</p> <p>Strange Stories task: Hedges' g young children 0.131 (-0.99 to 1.25) older children 0.438 (-0.78 to 1.66)</p> <p>Faux Pas Stories task: Hedges' g young children 0.902 (-0.285 to 2.089) older children 0.246 (-0.966 to 1.457)</p> <p>TOPS: Hedges' g young children 1.135 (-0.09 to 2.36) older children 0.000 (-1.21 to 1.21)</p>
Sofronoff et al. 2004 and 2002(80,81)	RCT	Parent training to reduce problem behaviors vs. wait list control group	<p>Social skills questionnaire: Hedges' g 1.379 (0.66 to 2.13)</p> <p>Eyberg child behavior inventory number of problem behaviors: Hedges' g 1.446 (0.69 to 2.20)</p> <p>Eyberg child behavior inventory intensity of problem behaviors: Hedges' g 1.262 (0.53 to 2.00)</p>

Study	Design	Intervention	Outcomes Reported and Effect Sizes at Final Followup
Drew et al. 2002(83)	RCT	Parent training in joint attention/joint action routines vs. local services	<p>MacArthur CDI – words understood: Hedges' g = 0.799 (-0.04 to 1.64)</p> <p>MacArthur CDI – words said: Hedges' g = 0.580 (-0.25 to 1.41)</p> <p>MacArthur CDI – total gestures produced: Hedges' g = 0.661 (-0.17 to 1.49)</p> <p>Griffith Scale of Infant development nonverbal IQ and subscales D and E: Hedges' g 0.655 (-0.14 to 1.45)</p> <p>ADI-R nonverbal communication: Hedges' g 0.713 (-0.09 to 1.51)</p> <p>ADI-R overall language rating: Odds Ratio 7.875 (1.11 to 56.12)</p> <p>ADI-R reciprocal social interaction: Hedges' g 0.245 (-0.53 to 1.02)</p> <p>ADI-R repetitive and stereotyped behavior: Hedges' g 0.113 (-0.89 to 0.66)</p> <p>Parent stress inventory total score: Hedges' g 0.477 (-0.38 to 1.33)</p>
Escalona et al. 2002(84)	RCT	Imitation vs. contingent responsivity	<p>Time spent in motor activity vs. focused on social interaction: could not be calculated</p> <p>Time spent showing motor stereotypies: could not be calculated</p> <p>Time spent in silence: could not be calculated</p> <p>Time spent looking at an adult: could not be calculated</p> <p>Time spent distant from an adult: could not be calculated</p> <p>Time spent touching an adult: could not be calculated</p>

Study	Design	Intervention	Outcomes Reported and Effect Sizes at Final Followup
Field et al. 2001(85)	RCT	Imitation vs. contingent responsivity	<p>Frequency of stereotypies: could not be calculated</p> <p>Frequency of inactivity: could not be calculated</p> <p>Frequency of playing alone: could not be calculated</p> <p>Frequency of accepting an object: could not be calculated</p> <p>Frequency of playing with an object: could not be calculated</p> <p>Frequency of mirror play: could not be calculated</p> <p>Frequency of looking at an adult: could not be calculated</p> <p>Frequency of smiling/laughing: could not be calculated</p> <p>Frequency of vocalizing: could not be calculated</p> <p>Frequency of being proximal to an adult: could not be calculated</p> <p>Frequency of sitting next to an adult: could not be calculated</p> <p>Frequency of touching an adult: could not be calculated</p> <p>Frequency of imitation recognition: could not be calculated</p> <p>Frequency of reciprocal play: could not be calculated</p>

Key Question 2: Is one focal educational or behavioral intervention more effective than another in improving outcomes for children with ASD?

All of the included studies evaluated different focal interventions. As only one moderate-quality, single-center trial addressed each comparison, we consider the evidence insufficient to determine if one focal treatment is more effective than another in improving outcomes for children with ASD.

Evidence Base

Three randomized controlled studies enrolling a total of 66 children with a diagnosis of ASD addressed this question.(74,77,78) In one study, the authors compared two prelinguistic communication interventions, Responsive Education and Prelinguistic Milieu (RPMT) to PECS.(78) The second trial compared the communication component of the Denver Model to PROMPT, and the third trial compared training in Executive Function to Theory of the Mind training, respectively.(74,77)

The median quality assessment score for the studies was moderate (7.65, range: 6.6 – 8.0). Although all three included studies were RCTs and were sponsored by sources without a financial or proprietary interest in the study's findings, two of the three did not have groups who were similar on important patient characteristics at baseline and one did not have an 85% study completion rate.

Patient Baseline Characteristics

All children in these trials had a primary diagnosis of AD, ASD or PDD-NOS, with the exception of one child with Asperger's Syndrome. None of the three included RCTs reported whether or not their study subjects were nonverbal. Children in the three included studies ranged in age from a mean of 128.16 (32.16) months in the Executive Function arm of the Fisher and Happé trial to a mean of 33.6 (8.4) months, in the Yoder trial.(74,77) Only the Fisher and Happé study failed to report the gender of its participants.(74) In the other two studies, 5/46 (10.9%) were female. In terms of concurrent treatments received, children in all three studies were receiving some type of special education, often including a speech language therapy component. Table 23 in Appendix E provides further information about the children who participated in the studies.

Treatment Characteristics

The three included RCTs compared RPMT to PECS, the communication component of the Denver Model to Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT), and training in Executive Function to Theory of the Mind training.

Yoder and Stone compared the effectiveness of RPMT to PECS. Both treatments were administered in a university clinic setting by treatment teams composed of master's and bachelor's level instructors trained by either those who developed the treatment method or one of their representatives. All children participate in three 20-minute individual therapy sessions per week for six months (a maximum of 24 hours of treatment), which their parents observed. In addition, the parents were offered 15 hours of therapy designed to complement the treatment their children were receiving.

RPMT is a two-pronged treatment approach in which both parents and children are taught new skills. Parents receive training in responsive education, or advice on how to play with and talk to their children in a manner that is believed to promote the child's communication and language development. This includes responding to the child's early communication attempts, like gesturing for an object, by putting the child's desire into words or, for children who have mastered prelinguistic communication, prompting them to use the spoken word, by asking questions, for example. Simultaneously, the child with ASD is engaged in a child-led, play-based incidental teaching program that focuses on eliciting gestures, nonword vocalizations, gaze use, and ultimately, the spoken word.

In PECS, children are taught to use pictures to communicate their desires for a specific object as a form of intentional communication. If the child attempts to grab the desired item rather than use a picture, he is to be redirected to the picture by a participating adult. Like in RPMT, parents are supposed to use linguistic mapping, or verbalizing the child's unspoken desires, at every opportunity. PECS has six phases ranging in difficulty from the actual physical exchange of a picture to a sentence strip exchange ("What do you see? I see..."). Two adults per child are required for phases I, II and IV.(78)

Rogers et al. compared the effectiveness of one part of the Denver Model, the communication curriculum, to PROMPT. The Denver Model is a comprehensive treatment program that, when administered in its entirety, addresses the cognitive, language and social deficits of ASD. It is grounded in the developmental approach, which combines both discrete trial and naturalistic teaching methods with an emphasis on interpersonal relationships delivered in a curriculum that is individualized for each child based on their current developmental abilities and goals. In this study, both the communication component of the Denver Model and PROMPT were delivered through a combination of once weekly 50-minute therapy sessions and daily home review by parents for 12 weeks.

The communication portion of the Denver Model uses naturalistic teaching strategies to turn nonverbal communications (turn taking, eliciting natural gestures) into intentional conventional gestures (requesting, initiation) to teach receptive understanding through simple instructions like sit down or come here, and attempted to increase verbal approximations through modeling and shaping with intrinsic reinforcement strategies; taught imitation of oral-facial movements and speech sounds through the use of both mass trial and naturalistic teaching strategies; and conveyed object association skills by having children group similar objects together or match a picture to the object it portrays. Parents participated in all therapy sessions and were expected to practice newly learned techniques at home for 45 minutes per day.

As a comparison, Rogers et al. also studied the effectiveness of PROMPT. The PROMPT intervention assumes that children with autism may suffer from some impairment in oral-motor control, limiting their ability to imitate sounds. PROMPT relies heavily on the use of touch to establish speech-motor control; developing a core vocabulary by setting goals, and repetition of motor-sound practice using prompts to achieve accuracy of sound production. Like the Denver Model, PROMPT is a developmentally-based approach that is conducted in a naturalistic environment. PROMPT's main difference from the Denver Model is its use of tactile prompts. As an example, the child is encouraged to make an utterance in order to get a desired object and the therapist then correctly pronounces the intended word and manipulates the child's jaw and lips so that the child can repeat the target word himself. In this model, parents observed all

therapy sessions by way of video and were expected to practice newly learned techniques at home for 30 minutes per day without the tactile cues.(77)

As described under Key Question 1, Fisher and Happé compared EF and ToM. EF training was implemented using a card sort task as the training task. The children were then taught a strategy designed to help them shift between sets (to improve inhibitory control and flexibility). Theory of the Mind training used props such as dolls and illustrative stories to teach children to think of beliefs as “photos in the head.”

Children in both treatment groups received 25-minute long individual sessions for five to ten consecutive days. The children were not allowed to advance to the next stage in the treatment program until they reached the preset goal for the previous one, which is why treatment duration may vary. Children were tested pre-treatment, immediately after treatment and two months post-treatment. At the start of each new session, the trainer and student reviewed what had been learned the day before.(74)

The table below presents a summary of the individual study results. More detailed information about individual study results, including conclusions presented by the authors, can be found in Appendix G.

Table 14. Key Question 2 Individual Study Results

Study	Design	Intervention	Outcomes Reported and Effect Sizes at Final Followup
Rogers et al. 2006(77)	RCT	Communication component of the Denver Model vs. PROMPT	Vineland Adaptive Behavior Scale; average words used per hour; ADOS; SCQ: no effect sizes could be calculated. Mullen Scales of Early Learning – expressive language: Hedges’ g 0.087 (-1.03 to 1.21) Mullen Scales of Early Learning – receptive language: Hedges’ g 0.178 (-0.95 to 1.30) MacArthur CDI: Hedges’ g 0.124 (0.99 to 1.25)
Yoder and Stone 2006(78)	RCT	RPMT vs. PECS	Frequency of nonimitative spoken acts; number of different nonimitative words; number of object exchange turns: no effect sizes could be calculated.
Fisher and Happé 2005(74)	RCT	ToM training vs. EF training	Proportion of ToM tasks passed; penny hiding task; seeing leads to knowing task; know/guess self task; deceptive box self and other tasks; Wisconsin card sort tasks, individual and aggregate; teacher rating questionnaire; and trails task: no effect sizes could be calculated. Percent of children who improved on ToM tasks passed: Odds Ratio 1.00 (0.17 to 5.77) Children’s “reading in the mind’s eye” task: Odds Ratio 2.33 (0.37 to 14.61) Wisconsin card sort task – aggregate score: Hedges’ g 0.101 (0.82 to 1.02)

Key Question 3: What adverse events and harms have been reported to occur in association with the use of focal educational or behavioral interventions for children with ASD?

None of the authors of the 13 included trials reported adverse events. Whether this was because there were no adverse events or because the studies failed to report adverse events was unclear.

Key Question 4: What is the consensus among experts about the safety and efficacy of comprehensive educational or behavioral interventions for the treatment of children with ASD?

ECRI Institute's searches of the National Guideline Clearinghouse™ (NGC) and the Healthcare Standards database identified a total of 14 unique treatment guidelines published between the years 1998 to present that included recommendations for the use of interventions for children with ASDs. The guidelines were published by the following organizations:

- Burns Indiana Statutes Annotated 2008(89)
- New York Department of Health Early Intervention Program 2008(90)
- Agence D'évaluation Des Technologies Et Des Modes D'intervention En Santé (AETMIS) 2007(91)
- Scottish Intercollegiate Network (SIGN) 2007(92)
- American Speech-Language Hearing Association 2006(93-95)
- British Psychological Society Position Paper 2006(96)
- American Occupational Therapy Association, Inc. 2005(97)
- Canadian Pediatric Society 2004 (reaffirmed 2008)(98,99)
- Alberta Heritage Foundation for Medical Research 2001(100)
- Canadian Coordinating Office for Health Technology Assessment (CCOHTA) 2001(101)
- British Columbia Office of Health Technology Assessment 2000(102)
- British Columbia Office of Health Technology Assessment 2000(103)
- American Academy of Child and Adolescent Psychiatry 1999(104)
- American Academy of Pediatrics, Committee on Children with Disabilities 1998(105)

The topics covered included insurance regulations for individuals with a PPD (one guideline); a review of hyperbaric oxygen therapy (one guideline); a position statement on the role of speech-language pathologists in the treatment of ASD (one guideline); a position statement on the treatment of occupational therapists in treating ASD (one guideline); a set of guidelines to insure that psychologists are appropriately trained to identify and treat ASD (one guideline); review of both comprehensive and focal treatment approaches (two guidelines); a review of one

or more comprehensive treatment approaches (five guidelines); and guidelines that covered only focal treatments (two guidelines).

Although this report limited itself to an analysis of focal educational or behavioral interventions only, the summary below provides the reader with a broader range of ASD treatment recommendations.

Four guidelines made recommendations regarding auditory integration training (AIT). One concluded that AIT may help some children with ASDs, but noted that more research is needed.(105) The other three stated that this treatment is not recommended.(90,92,104)

Facilitated Communication (FC) was unanimously considered ineffective and potentially harmful by the four guidelines that reported on it.(90,92,104,105)

The one guideline that addressed the efficacy of hyperbaric oxygen therapy concluded that this treatment should be considered experimental at the present time, but that the results of several ongoing studies are much anticipated.(91)

Music therapy, mega vitamins and nutritional supplements, elimination diets, “realignment” of the brain and nerves, the injection of sheep brain extract, patterning, secretin, and the Options method were not recommended by the single guideline that addressed each of these topics.(90,104) Likewise, touch therapy and sensory integration was found to have little or no empirical evidence.(90,104) However, the use of visual augmentation, such as the use of pictures or objects, to support communication was supported.(92)

Applied Behavioral Analysis, a comprehensive treatment program, was recommended by several guidelines groups,(90,101) although one cautioned against presenting the Lovaas program as an intervention that will lead to normal functioning(92) and others specifically stated that although this treatment did demonstrate a trend towards positive outcomes, there was not enough evidence available to support adopting a single autism treatment program as the gold standard.(98-100,102) Another publication which analyzed existing cost-effectiveness of Lovaas concluded that these types of assessments are meaningless, when or until evidence for one intervention program that results in normally functioning children can be established.(103)

Developmental, Individual-differences, Relationship model (DIR model) was not supported by the single publication that addressed this treatment.(90) However, some other non-ABA comprehensive intensive intervention programs showed promise, but the lack of high-quality research made drawing conclusions difficult.(98-100,102)

Information on guidelines identified through other sources, as well as state-specific practice parameters, can also be found in Appendix I, in Tables 36 and 37.

Findings of Other Systematic Reviews

We identified a total of 16 systematic reviews that covered focal behavioral or educational interventions for children with ASD that were published between 1998 and present. These reviews covered a wide range of topics including social skills training (four reviews); LEGO® to improve social skills (one review); Social Stories™ (two reviews); Picture Exchange Communication System (one review); reading comprehension instruction (one review); video modeling to improve a wide range of behaviors (two reviews); augmentative and alternative communication interventions (one review); Facilitated Communication (one review); interventions for problem behaviors (one review); discrete trial versus normalized behavioral language interventions (one review); and comprehensive treatment programs and a variety of focal treatment interventions (one review). In all cases, the reviews included a broad range of study design types, did not set a minimum for the number of subjects per treatment and, in some cases, included trials published prior to 2000. Because of the broad inclusion criteria, the conclusions reached by the authors of these systematic reviews should be considered with caution. Many of the studies included in the systematic reviews did not have control groups or failed to insure comparability of patients enrolled in different arms of the studies. Other studies included in the systematic reviews enrolled very few patients and thus their results may not be applicable to the general population of children with ASD. For more detailed information about these reviews, see Appendix B.

Of the four systematic reviews that covered social skill interventions, one was specific to children with either high-functioning autism (HFA) or Asperger's syndrome (AS), while the other three covered children anywhere on the autism spectrum. These reviews included a wide variety of study designs and did not limit inclusion by number of study subjects. On the whole, the authors of these reviews found a broad range of social skill training interventions to have a positive effect on study participants.(67,106-108)

One systematic review evaluated a specific social skills intervention, LEGO®, on children with ASD, Asperger's syndrome or PDD-NOS. Again, this review included all study designs, including what the author described as a controlled trial but was actually a pre-post study design, and did not set a minimum number of subjects for study inclusion. The reviewer found that after 12 weeks of therapy with LEGO® subjects demonstrated an increase in self-initiated social contacts and the duration of social interactions, while aloofness and rigid behaviors decreased. These positive results were increased after an additional 12 weeks of therapy.(109)

The two reviews of Social Stories™ included studies of children with autism, ASD or AS. As with the previously discussed reviews, all study designs were included without a set minimum number of subjects per included study. One review reported positive effects of Social Stories™ on reducing unwanted behaviors and increasing social communication.(110) However, the other review reported more mixed results, with some studies even finding an increase in disruptive behaviors following this intervention.(34)

The single review assessing the effectiveness of PECS on children with ASD or PDD-NOS found some evidence of an increase in speech production, but improvement was highly dependent upon the child's pre-treatment speech imitation skill level.(111)

One study evaluated ten different reading comprehension instruction interventions on children with ASD, MR or HFA, but given the diversity of treatments used and the absence of comparative trials, the authors were unable to draw a conclusion about the effectiveness of this type of intervention.(112)

Two systematic reviews that included studies of all design types evaluated the efficacy of video modeling and found that children with ASD improved in social communication and experienced a reduction in problem behaviors. Self-modeling compared favorably to peer- and teacher-modeling. A minority of studies reported mixed results with this intervention.(32,113)

Augmentative and alternative communication interventions in children with ASD or MR and significant speech impairments were reported to have increased speech in 82% of study participants. Given a lack of controlled trials, the authors of this systematic review based their conclusions on the six higher quality included studies, of which five evaluated manual sign language.(38)

One systematic review reported that facilitated communication increased speech production in studies without a control condition but showed no effect once a control condition was introduced. The authors suggest future studies of FC should focus on the facilitators' beliefs and motivations.(39)

Children with autism who exhibited problem behaviors, in particular tantrums and aggression, were found to improve following interventions aimed specifically at reducing problem behaviors. The authors of the systematic review concluded that the most effective methods for reducing unwanted behaviors were stimulation-based and instruction-based methods.(114)

The single review that compared discrete trial training to normalized language interventions in children meeting one criterion for autism based on the DSM or National Society for Autistic Children found the normalized training method to be superior to DTT at improving language.(115)

Comprehensive programs and a variety of focal treatments for children with autism and related disorders were assessed by one review. The authors of this review concluded that comprehensive treatments improved clinical outcomes but, given the designs of the included studies, alternative explanations for these observed improvements could not be ruled out. Some focal interventions, by contrast, appeared to be effective, including functional communication training, a subset of Applied Behavioral Analysis, and a caregiver -based intervention.(116)

Ongoing Clinical Trials

To locate recently conducted and ongoing clinical trials of comprehensive intervention programs for children with ASDs, we searched two databases: <http://clinicaltrials.gov> and <http://www.controlled-trials.com>. We also searched the gray literature for possible ongoing studies. Our searches identified one focal ASD intervention study that is currently enrolling participants, the Joint Attention Intervention and Young Children with Autism study. This trial is an open-label, randomized trial designed to investigate the effectiveness of a joint attention intervention in two- to four-year-old children with autism. The study will enroll 60 children from mainstream preschools in Norway. All children will continue in their mainstream preschool classes. The active treatment group will also receive 80 joint attention sessions (20 minutes each) for eight weeks. Children will be assessed at baseline, at ten weeks and six months of followup, and at one year after the intervention ends. This study is sponsored by Ullevaal University Hospital, clinical trial identifier = NCT00378157), and is expected to be completed by December 2010.

Overall Conclusions and Discussion

This review addressed four Key Questions pertaining to the efficacy and safety of educational and behavioral focal interventions for children with autism spectrum disorder (ASD). In the first question, we considered evidence from clinical studies that compared focal interventions to no treatment, a wait list control, or to what we considered standard care (less intensive care provided in an educational/clinical setting). In the second question, we considered evidence from studies that compared one focal intervention to another. The third question, for which we found no information, was intended to assess the possible harms of focal treatments. Finally, the fourth question involved reviewing and summarizing the recommendations of recent clinical practice guidelines and consensus statements regarding focal interventions for children with ASD. Below, we briefly discuss the main findings of our review from the clinical studies that met the study selection criteria and discuss what type of research is needed in the future.

For Key Question 1, 11 controlled trials that compared focal interventions for children with ASD to either no treatment or routine care were reviewed. Because of the differences in the focal interventions assessed in each study, we considered the evidence insufficient to determine whether focal treatments improve outcomes for children with ASD when compared to no treatment or routine care.

For Key Question 2, the evidence from three randomized controlled trials comparing one focal intervention to another was assessed. Again, because of differences in the treatments studied by each trial, we considered the evidence insufficient to determine whether one focal intervention is more effective than another in improving outcomes for children with ASD.

For Key Question 3, none of the authors of the 13 included trials reported adverse events. Whether this was because there were no adverse events or because the studies failed to report adverse events was unclear.

For Key Question 4, four guidelines included specific recommendations for the use of focal educational and behavioral interventions for children with ASDs. Facilitated Communication (FC) was unanimously considered ineffective and potentially harmful by the four guidelines that reported on it.(90,92,104,105) By contrast, the use of visual augmentation, such as the use of pictures or objects, to support communication was supported.(92)

Overall, the evidence evaluated in this review was considered insufficient to determine whether focal interventions are more effective than no treatment or routine care or whether one focal intervention is more effective than another in improving outcomes for children with ASDs. Future research on focal interventions for ASD would greatly benefit from more controlled trials, larger sample sizes, and a concerted effort to replicate the findings of the few existing controlled trials.

The conclusions drawn in this evidence report differ from those in some of the previous systematic reviews on this topic, which have tended to conclude that focal interventions provide some benefit to children with ASDs. The overall conclusions drawn from other reviews are presented in the *Previous Systematic Reviews* section of this report. Unlike ECRI Institute's review, the previous reviews included a broad range of study design types, did not set a minimum for the number of subjects per treatment and, in some cases, included trials published

prior to 2000. Because of the broad inclusion criteria, the conclusions reached by the authors of these reviews should be considered with caution. Many of the studies included in the systematic reviews did not have control groups or failed to insure comparability of patients enrolled in different arms of the studies. Other studies included in the previous reviews enrolled very few patients and thus their results may not be applicable to the general population of children with ASD.

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Appendix A. Literature Search Methods

Electronic Database Searches

The following databases have been searched for relevant information:

Name	Date Limits	Platform/Provider
CINAHL (Cumulative Index to Nursing and Allied Health Literature)	2000 through July 17, 2008	EBSCOhost
The Cochrane Central Register of Controlled Trials (CENTRAL)	Through 2008, Issue 3	www.thecochranelibrary.com
The Cochrane Database of Methodology Reviews (Methodology Reviews)	Through 2008, Issue 3	www.thecochranelibrary.com
The Cochrane Database of Systematic Reviews (Cochrane Reviews)	Through 2008, Issue 3	www.thecochranelibrary.com
Database of Abstracts of Reviews of Effects (DARE)	Through 2008, Issue 3	www.thecochranelibrary.com
EMBASE (Excerpta Medica)	2000 through October 24, 2008	OVID
ERIC (Education Resources Information Center)	2000 through August 29, 2008	http://eric.ed.gov/
Health Technology Assessment Database (HTA)	Through 2008, Issue 3	www.thecochranelibrary.com
Healthcare Standards	July 30, 2008	ECRI Institute
International Health Technology Assessment (IHTA)	July 30, 2008	ECRI Institute
MEDLINE	2000 through October 24, 2008	OVID
PreMEDLINE	Searched October 24, 2008	OVID
Psychology & Behavioral Sciences Collection	1998 – 2008	EBSCOhost
PsycINFO	2000 through July 31, 2008	Dialog
U.K. National Health Service Economic Evaluation Database (NHS EED)	Through 2008, Issue 3	www.thecochranelibrary.com
U.S. National Guideline Clearinghouse™ (NGC)	July 30, 2008	www.ngc.gov

Hand Searches of Journal and Nonjournal Literature

Journals and supplements maintained in ECRI's collections were routinely reviewed. Nonjournal publications and conference proceedings from professional organizations, private agencies, and government agencies were also screened. Other mechanisms used to retrieve additional relevant information included review of bibliographies/reference lists from peer-reviewed and gray literature. (Gray literature consists of reports, studies, articles, and monographs produced by federal and local government agencies, private organizations, educational facilities, consulting firms, and corporations. These documents do not appear in the peer-reviewed journal literature.)

The search strategies employed combinations of free text keywords as well as controlled vocabulary terms including (but not limited to) the following concepts. The strategy below is presented in OVID syntax; the search was simultaneously conducted across EMBASE, MEDLINE, and PsycINFO. A parallel strategy was used to search the databases comprising the Cochrane Library.

Medical Subject Headings (MeSH), Emtree, PsycINFO and Keywords

Conventions:

OVID

- \$ = truncation character (wildcard)
- exp = "explodes" controlled vocabulary term (e.g., expands search to all more specific related terms in the vocabulary's hierarchy)
- .de. = limit controlled vocabulary heading
- .fs. = floating subheading
- .hw. = limit to heading word
- .md. = type of methodology (PsycINFO)
- .mp. = combined search fields (default if no fields are specified)
- .pt. = publication type
- .ti. = limit to title
- .tw. = limit to title and abstract fields

Dialog

- ? = truncation character (wildcard)
- ! = "explodes" controlled vocabulary term (e.g., expands search to all more specific related terms in the vocabulary's hierarchy.)
- /de = limit controlled vocabulary heading
- pt = publication type
- /ti = limit to title
- /ti,ab = limit to title and abstract fields

Topic-specific Search Terms

Concept	Controlled Vocabulary	Keywords
Pervasive developmental disorders	autism Exp autism Autistic disorder Exp child development disorders, pervasive Exp pervasive developmental disorders	Asperger\$ Autis\$ Disintegrative disorder\$ pdd\$ rett
Therapy	Exp behavior therapy/ Exp therapy/	

EMBASE/MEDLINE
English language, human
2000 – 2008
OVID syntax

Set Number	Concept	Search Statement
1	Autism (controlled vocabulary)	Exp Child development disorders, pervasive/ or exp pervasive developmental disorders/ or exp autism/ or autism.de. or autistic disorder.de.
2	Autism (text words)	Autis\$ or pdd or asperger\$.tw. or rett.tw. or disintegrative disorder\$
3	Combine sets	1 or 2
4		3 and exp behavior therapy/
5		3 and exp therapy/ or th.fs.
6	Combine sets	4 or 5
7	Eliminate overlap	Remove duplicates from 6
8	Limit by publication type	7 not ((letter or editorial or news or comment or note or conference paper).de. or (letter or editorial or news or comment).pt.)
9	Limit by publication type	8 and ((Randomized controlled trials or random allocation or double-blind method or single-blind method or placebos or cross-over studies or crossover procedure or cross over studies or double blind procedure or single blind procedure or placebo or latin square design or crossover design or double-blind studies or single-blind studies or triple-blind studies or random assignment or exp controlled study/ or exp clinical trial/ or exp comparative study/ or cohort analysis or follow-up studies.de. or intermethod comparison or parallel design or control group or prospective study or retrospective study or case control study or major clinical study or evaluation studies or follow-up studies).de. or random\$.hw. or random\$.ti. or placebo\$ or ((singl\$ or doubl\$ or tripl\$ or trebl\$) and (dummy or blind or sham)) or latin square or ISRCTN\$ or ACTRN\$ or (NCT\$ not NCT))

PsycINFO
English language, human
2000 – 2008
Dialog Syntax

Set Number	Concept	Search Statement
1	Autism	s child development disorders, pervasive! or autistic disorder/de or (autis? or pdd or asperger? or disintegrative())disorder)/ti,ab
2	Therapy (controlled vocabulary)	s behavior therapy! or early intervention (education)/de
3	Therapy	s therapy! and (communication or social())skills or motor or perceptual or sensory or integrative or interpersonal or modeling)
4		Limit 1 to 3312 (behavior therapy & behavior modification)
5	Combine sets	s s1 and (s2 or s3 or s4)
6	Limit by publication type	s s5 not pt=(book or letter or dissert?)

Reimbursement

The following Web sites were searched for reimbursement policies:

- Aetna US Healthcare
(http://www.aetnaushc.com/cpb/cpb_alpha.html)
- American Medical Association
(<http://coverageandpayment.medicare.gov>)
- Athens Area Health Plan Select, Inc.
(<http://www.aahps.com/pdfs/EOCamend012006.pdf>)
- Blue Cross/Blue Shield of Alabama
(<http://www.bcbsal.org/providers/policies/>)
- Blue Cross/Blue Shield of Massachusetts
(http://www.bcbsma.com/common/en_US/hresource/medcat.jsp)
- Blue Cross/Blue Shield of Tennessee
(<http://www.bcbst.com/providers/mpm.shtm>)
- Cigna
(http://www.cigna.com/health/provider/medical/procedural/coverage_positions/medical/index.html)
- Health Partners
(<http://www.healthpartners.com/policies/>)
- Humana
(<https://providers.humana.com/ciinter/cihome.asp>)
- Kaiser Permanente Northern California Region
(www.kaiserpermanente.org)
- MAMSI Life and Health Insurance Company State of Maryland
(www.mamsiunitedhealthcare.com/s/g/md/0726299-0105MD.pdf)
- Medica
(<http://provider.medica.com/C9/MedicalPolicies/default.aspx>)
- Premera Blue Cross
(<http://www.ashya.org/about/legislation-advocacy/2008/PremeraBlueCross.htm>)
- Regence Blue Cross/Blue Shield
(<http://www.regence.com/trgmedpol/>)
- Wellmark Blue Cross/Blue Shield
(http://www.wellmark.com/e_business/provider/medical_policies/medical_policies.asp)

We also used the Google and Vivisimo internet search engines to locate reimbursement information, using a combination of topic-specific keywords and the following search terms: (reimburs* OR coverage OR “medical policy”).

Table 15. Excluded Studies

Reference	Year	Reason for Exclusion
Corbett et al.(117)	2008	No treatment of interest (Tomatis Sound Therapy)
Lopata et al.(118)	2008	No Key Question addressed Compared a variation of one treatment without establishing effectiveness of original treatment
Ludlow et al.(119)	2008	No treatment of interest No comparable comparison group
Pineda et al.(120)	2008	No treatment of interest (Neurofeedback)
Tien(121)	2008	Cancelled by library
Chalfant et al.(122)	2007	No outcome of interest
Coben and Padolsky(123)	2007	No treatment of interest (Neurofeedback)
Nikopoulos and Keenan(124)	2007	Not a controlled trial
Rossignol et al.(125)	2007	No treatment of interest (Hyperbaric Oxygen Therapy)
Silva et al.(126)	2007	No treatment of interest (Massage Therapy)
Smith and Bennetto(127)	2007	No treatment was tested
Sofronoff et al.(128)	2007	No outcome of interest
Yucel and Cavkaytar(129)	2007	No outcomes of interest
Rickards et al.(130)	2007	No treatment of interest/not a focal treatment
Mackay et al.(131)	2007	Not a controlled trial
Ingersoll and Schreiber(132)	2006	Not a controlled trial
Jones et al.(133)	2006	Not a controlled trial
Lopata et al.(134)	2006	No Key Question addressed Compared a variation of one treatment without establishing effectiveness of original treatment
Massaro and Bosseler(135)	2006	Not a controlled trial
McDuffie et al.(136)	2006	No treatment tested
Seung-Hyunson et al.(137)	2006	Not a controlled trial
Tonge et al.(138)	2006	No outcome of interest; parent well-being was focus of study, no child outcomes
Kasari et al.(139)	2006	No treatment of interest; study assessed effect of focal intervention added to a comprehensive treatment program.
Sofronoff et al.(140)	2005	No outcome of interest
Weiskop et al.(141)	2005	No outcome of interest

Reference	Year	Reason for Exclusion
Bernard-Opitz et al.(142)	2004	Fewer than five subjects per treatment arm
Hetzroni and Tannous(143)	2004	Not a controlled trial
O'Connor and Klein(144)	2004	Fewer than five subjects per treatment arm
LeGoff(145)	2004	Not a controlled trial
Kuoch and Mirenda(146)	2003	Not a controlled trial
Nikopoulos and Keenan(147)	2003	Not a controlled trial
Whalen and Schreibman(148)	2003	Not a controlled trial; no comparable comparison group
Yang et al.(149)	2003	Fewer than five subjects per treatment arm
Eikeseth et al.(150)	2002	No treatment of interest /not a focal treatment
Li et al.(151)	2002	Chinese language article
Escalona et al.(152)	2001	No treatment of interest (Massage Therapy)
Sherer et al.(153)	2001	Not a controlled trial
Charlop-Christy et al.(154)	2000	Not a controlled trial
Koegel et al.(155)	1999	Not a controlled trial
Edelson et al.(156)	1998	Not a controlled trial
Koegel et al.(157)	1998	Not a controlled trial
Jocelyn et al.(158)	1998	DSM IIIR used to diagnose subjects/published before 2000
Koegel and Schreibman(159)	1996	DSM IIIR used to diagnose subjects/published before 2000
Stahmer(160)	1995	No comparable comparison group
Schreibman et al.(161)	1991	DSM IIIR used to diagnose subjects/published before 2000

Appendix B. Previous Systematic Reviews

Table 16. Previous Systematic Reviews

Citation	Search Strategy	Key Inclusion/Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
Rao et al. 2008(106) <i>Social Skills Interventions for Children with Asperger's syndrome or High-Functioning Autism: A Review and Recommendations</i>	A February 2007 search of PsycINFO, PsychARTICLES, ERIC, Psychology & Behavioral Sciences, and Academic Search Primer databases and "online first" database of the <i>Journal of Autism and Developmental Disorders</i>	Included studies implemented social skills training (SST) interventions directly targeting children with AS/HFA; research designs including an intervention and comparison or control or a single case design or a open clinical trial using validated psychometric assessment measures; and outcomes including a direct measure of social skills	This review examined social skills training (SST) programs in 10 studies (1 RCT)	Children aged 18 or younger diagnosed with Asperger's syndrome(AS) or high functioning autism (HFA)	Maintaining interactions, sharing, skill generalization, and social competence and problem behavior	NR	Qualitative	Solomon et al. 2004(162) All others were either not controlled trials or were published prior to 1998.	A majority of the studies reported positive treatment effects although sometimes limited to specific outcomes or only in a subset of study participants. Six studies implemented traditional SST programs. One study implemented a classroom-wide SST intervention throughout the academic year and measured increases in frequency, duration and time engaged in social interactions. Four studies also incorporated generalization studies with two studies reporting no treatment efficacy. The authors state the need for further research on social skills deficits specific to children with autism and the utilization of group designs and larger sample sizes.

Citation	Search Strategy	Key Inclusion/ Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
<p>Schlosser and Wendt 2008(111)</p> <p><i>Effects of Augmentative and Alternative Communication Intervention on Speech Production in Children With Autism: A Systematic Review</i></p>	<p>Search of CINAHL, ERIC, LLBA, Medline, PsycINFO, and ProQuest Digital Dissertations; reference lists of previously cited published and unpublished reviews related to AAC and autism; publisher-related databases; and submissions by active researchers in AAC and autism. Search was limited to studies written between 1975 and May 2007</p>	<p>Studies within the scope of augmentative and alternative communication (AAC) as defined by the American Speech-Language-Hearing Association (2002); dated between 1975 and May 2007 that did not involve functional communication training (FCT); whose participants were not functional speakers prior to AAC interventions; speech production was monitored as a dependent variable. Studies with pre-experimental designs or group equivalents were excluded.</p>	<p>Nine single-subject studies mainly evaluating effectiveness of Picture Exchange Communication System (n = 27; 23 males) and one RCT (n = 38)</p>	<p>Children diagnosed with autism or pervasive developmental disorder not otherwise specified (PDD-NOS) and ages ranging from 37 months to 144 months (single-subject studies) or a mean age of 33 months (RCT). Children included in the RCT presented with higher levels of speech compared to single subject design participants.</p>	<p>Word approximations/vocalizations/elicitations and mean length of utterance</p>	<p>Based on a taxonomy developed by Simeonsson and Bailey (1991)</p>	<p>Quantitative</p>	<p>Yoder and Stone 2006(78)</p> <p>Other studies did not have a comparison group; for the remaining comparison trial, was published prior to 1998.</p>	<p>Although based on small study samples, most studies reported some gains in speech production for most participants. The well-documented heterogeneity of the autistic population may be the cause of range of speech outcomes. In an early comparison derived from one RCT the Picture Exchange Communication System yielded more non-imitative communicative spoken acts and number of different non-imitative words compared to Responsive Education and Prelinguistic Milieu Teaching however this difference disappeared in a later comparison.</p> <p>The analysis confirmed that pre-treatment speech imitation skills are a very strong predictor of subsequent speech production. The authors stress the importance to report and assess individual characteristics to allow subsequent use in identifying potential predictors of speech production.</p>

Citation	Search Strategy	Key Inclusion/ Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
Chiang and Lin 2007(112) <i>Reading Comprehension Instruction for Students With Autism Spectrum Disorders: A Review of the Literature</i>	Articles published from 1986 to 2006 in English in peer- reviewed journals in ERIC and PsycINFO databases	Studies including at least one subject with ASD, included relevant data to reading comprehension components and used an experimental design (including single- subject).	11 total studies assessing reading comprehension Studies focused on sight word comprehension (k = 7) Studies focused on text comprehension (k = 4) Elementary age (k = 9) Preschool age (k = 3) Middle school age (k = 3) High school age (k = 2) 107 overall participants (49 autistic)	Subjects aged 3 to 17 years with a diagnosis of ASD, mental retardation, or high- functioning autism	Functional sight- word reading skills to acquisition of academic reading comprehension	NR	Qualitative	None in common with this report; all included studies published prior to 1998 or no comparison group.	The authors evaluated ten instructional methods for teaching reading comprehension. In the absence of comparative trials, they are unable to determine the best strategies to implement to teach reading comprehension to individuals with ASD.

Citation	Search Strategy	Key Inclusion/Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
Delano 2007(113) <i>Video Modeling Interventions for Individuals with Autism</i>	Search of ERIC and PsycINFO from 1985 to March 2005	Studies with a primary focus on a video modeling intervention with participants identified as having autism spectrum disorder (ASD) were included. Studies without a carefully defined experimental design, without quantitative data and those that evaluated the use of commercial videotapes were excluded.	This review examined 19 studies (n = 55) evaluating video modeling interventions. Study settings focused on special education programs (k = 7); integrated preschool or kindergarten (k = 3); private school (k = 3); and home and community (k = 6). 12 studies (2 comparisons) used adults or peers as models; 5 studies evaluated video self-modeling.	Children diagnosed with ASD ranging in age from 3 to 15 years	Outcomes included problem behavior, functional living skills, perspective-taking skills and social-communicative behaviors.	NR	Qualitative	None in common with this report; no comparison trials.	A majority of studies reported positive gains in social-communicative skills, functional skills, perspective-taking skills, and problem behavior. Mixed results were reported in 5 studies. Probable explanations ranged from need for video modeling to be combined with an additional intervention to the heterogeneity of patient characteristics. Positive findings were reported for maintenance data collected regardless of timing (range 2 days to 15 months). In addition, measurements of generalizations reported positive gains including assessment across both two and three condition scenarios. The authors suggest future inclusion of treatment interventions that can effectively support generalization due to the inherent challenges in the autistic population.
McCoy and Hermansen 2007(32) <i>Video Modeling for Individuals with Autism: A Review of Model Types and Effects</i>	Peer reviewed journals and video modeling identified in Academic Search Premier and published from 1987 to 2006	Studies included at least one participant diagnosed with ASD in a research study with a focus on video modeling. Non-data articles were excluded.	34 studies categorized by type of video modeling including adults models (k = 9), peer models (k = 10), self-models (k = 7), point-of-view models (k = 5), and mixed model types (k = 3) N = 92	Subjects aged 3 to 20 years diagnosed with ASD, ADHD, severe mental retardation and pervasive developmental delay	Self-help skills, social skills, functional living skills, disruptive transition behavior, and purchasing skills	NR	Qualitative	None in common with this report; no comparison trials.	All video modeling techniques resulted in positive outcomes for individuals with autism. In a comparison of modeling type, the authors suggest that self-modeling may be a more superior approach than peer modeling which in turn has been found to more effective than teacher modeling. Self-modeling intervention resulted in a reduction in tantrums, increase in positive social interaction and increase in task fluency. Peer modeling approaches, incorporating either peers or siblings as models, demonstrated effectiveness in enhancing and generalizing language skills.

Citation	Search Strategy	Key Inclusion/Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
Williams White et al. 2007(107) <i>Social Skills Development in Children with Autism Spectrum Disorders: A Review of the Intervention Research</i>	PsycINFO and Medline for published research and unpublished dissertation studies identified through August 2006. An ancestral search of reference lists was also conducted.	Included studies implemented a direct SST intervention in a group format	14 studies (4 controlled) of group-based social skills training programs N = 141	School age children or adolescents diagnosed with ASD	Child self-reports of knowledge of social skills, direct behavioral observations and parent-report quantitative measure using the Social Skills Rating System (SSRS)	NR	Qualitative	Solomon et al. 2004(82) All others published before 1998, not a controlled trial, or not a published full-length peer-reviewed article.	Results for qualitative and observational data generally reported a benefit from the SST intervention while efficacy based on quantitative skill-based measures was inconsistent. Differential improvements across skills may be indicative of need for 'higher level' skills requiring diverse teaching strategies. Both parents and children reported a high level of satisfaction with SST programs although skills exhibited in the clinical setting did not generalize to the school or home settings. Recommendations were made for incorporation of appropriate tools (Social Responsiveness Scale, Social Competence Inventory) for ASD population and greater consensus on outcome measures for SST.

Citation	Search Strategy	Key Inclusion/ Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
McCaffery 2006(109) <i>There is preliminary evidence that LEGO® therapy can improve social skills in children with Autism Spectrum Disorder</i>	Databases of EBSCO (CINAHL, ERIC, PsycARTICLES, PsychINFO), PubMed, Google Scholar, ProQuest; Web searches of Autism Spectrum Australia, Autism Journal, UWS Library-Journal articles, and reference lists from journal articles; systematic review sites – Cochrane library, OTseeker and PEDro; and search of clinical guideline sites – National Health and Medical Council, New Zealand Guidelines, National Guidelines Clearinghouse, UK guidelines, and Scottish Intercollegiate Guidelines Network	Studies involving play therapy as an intervention, involved social skills outcome for children diagnosed with ASD, were full-text articles available in English were included. Excluded studies did not involve play therapy, involved children with other conditions and did not target social skills as an outcome.	One non-randomized controlled trial, 6 case-series, 2 literature/narrative reviews, and one evidence-based practice guideline. N = 47	Children diagnosed with ASD, Asperger's syndrome(AS), and PDD-NOS aged 6 to 16 years	Number of self-initiated social contact (SISC) , duration of social interactions (DSI) and aloofness and rigid behavior	Oxford Centre for Evidence-based Medicine (Phillips et al. 1998)	Quantitative	None in common with this report; no comparison trials.	The author discusses results from one study providing the best evidence in a non-randomized controlled trial design (LeGoff 2004). After 12 weeks of LEGO® play statistically significant improvements were found within groups for SISC, DSI and aloofness and rigid behavior as measured by the Social Interaction subscale of the Gilliam Autism Rating Scale (GARS-SI). Improvements were sustained and increased after 24 weeks of therapy. Between-group differences were also statistically significant for all three outcome measures. Clinically significant improvements were reported for SISC (within group and between group) and aloofness and rigid behavior (within group).

Citation	Search Strategy	Key Inclusion/ Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
<p>Millar et al. 2006(38)</p> <p><i>The Impact of Augmentative and Alternative Communication Intervention on the Speech Production of Individuals with Developmental Disabilities: A Research Review</i></p>	<p>Electronic searches of PsycINFO, ERIC, Medline; searches of 46 journals; journals previously included by Schlosser and Lee's 2000 meta-analysis; and ancestral searches</p>	<p>Studies published from 1975 through 2003, involved subjects with developmental disabilities with significant speech impairments, included implementation of AAC and included data documenting progress of intervention, and data on speech production prior, during and after intervention.</p> <p>Studies of subjects whose primary impairment were a hearing impairment, had acquired disabilities, and did not document the subject's acquisition of AAC were excluded.</p>	<p>23 studies;</p> <p>8 descriptive case , 6 single-participant, alternating treatment design, 6 single-participant, multiple baseline, 1 single-participant, alternating treatment design within a multiple baseline, 1 single-participant withdrawal design, 1 group pretest-posttest design</p> <p>N = 67 (40% MR diagnosis, 31% autism)</p>	<p>Subjects aged 2 to 60 years diagnosed with MR or autism</p>	<p>Number of spoken words, two-word phrases, and word approximations</p>	<p>Based on Slavin 1986</p>	<p>Quantitative</p>	<p>None in common with this report; no comparison trials.</p>	<p>Investigators in 23 studies reported a speech increase for 82% of study participants. A majority of these studies did not establish controlled comparisons to measure the relationship between AAC treatment and natural speech production. Therefore, the authors focus the discussion on six rigorously designed studies.</p> <p>The effects of unaided AAC treatment, specifically instruction in manual signs, were studied in five of the six studies. A variety of techniques were implemented (i.e., directed rehearsal alone, directed rehearsal with positive reinforcement, positive practice, and positive practice plus reinforcement) over a mean study length of 42 sessions. Increases in speech production, although modest, were reported in 89% of cases. A majority of gains were reported in as little as 5 treatment sessions.</p>

Citation	Search Strategy	Key Inclusion/Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
Reynhout and Carter 2006(34) <i>Social Stories™ for Children with Disabilities</i>	Searched ABI/INFORM Global, Academic Research Library, Current Contents Connect, ERIC, Expanded Academic ASAP, First Search, Ingenta, Inspec, Kluwer Online, Proquest Education Complete, PsyARTICLES, PsycINFO, Science Direct and ISI Web of Science for studies appearing before December 2003. Issues of <i>Journal of Autism and Developmental Disorders</i> for articles after 1990 and reference sections of all located sources were also reviewed. 11 peer reviewed journal articles and 5 unpublished dissertations were identified and included.	Studies involving use of social scripts, mutual storytelling and narrative therapy were excluded. Studies based on teacher perception and lacking data for descriptive cases were also excluded.	16 studies focusing on Social Stories™. Study designs included single-subject (k = 14) and group (k = 2; 1 comparison). Overall number of subjects not reported.	Children aged 3 to 15 years diagnosed with autism or Asperger's Syndrome. One study included 69 children with only a language delay ≥6 months (Pettigrew 1998)	Disruptive or challenging behaviors, social skills and communicative behaviors.	NR	Quantitative	None in common with this report; not a controlled trial or not a published full-length peer-reviewed article.	Studies demonstrated mixed effectiveness for the implementation of Social Stories™. While appropriate behavioral changes were demonstrated by most investigators, four studies reported no change or increases in disruptive behaviors. Evidence showed a positive impact of incorporating a higher ratio of directive to descriptive sentences, and a higher level of consequence sentences. Study limitations include the confounding of Social Story™ interventions with other strategies, and the degree of variation in story construction and implementation.

Citation	Search Strategy	Key Inclusion/Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
<p>Sansosti et al. 2004(110)</p> <p><i>A research synthesis of social story interventions for children with autism spectrum disorders</i></p>	Search of PsycINFO and ERIC	Studies of the effectiveness of social story interventions were included.	<p>8 studies;</p> <p>2 AB designs,</p> <p>3 ABAB/reversal type design and</p> <p>3 multiple baseline design</p> <p>N = 21</p>	Subjects diagnosed with ASD aged 5 to 15 years	Outcomes included compliance, shouting, delayed echolalia, social communication skills	NR	Qualitative	<p>None in common with this report; no controlled trials.</p>	<p>The authors report on the effectiveness of social story interventions in a small study population of children with ASD.</p> <p>Approaches included implantation of traditional and musical social stories, computer-based social stories and social stories with video feedback.</p> <p>Studies reported improvements in targeted behaviors (i.e., reduction in tantrum behavior, chair tipping, shouting and staring) and increases in social communication skills.</p> <p>Future research should address the significant components involved in developing and implementing social stories.</p>
<p>Chorpita et al. 2002(116)</p> <p><i>Toward Large-Scale Implementation of Empirically Supported Treatments for Children: A Review and Observations by the Hawaii Empirical Basis to Services Task Force</i></p>	PsycINFO, studies previously reviewed by Lonigan and Elbert Task Force on Empirically Supported Psychosocial Interventions for Children, the American Academy of Child and Adolescent Psychiatry Practice Parameters, and personal communication with members of the Lonigan and Albert Task Force and other national scholars in effectiveness research	Studies that examined comprehensive treatments (designed to improve overall functioning, address multiple symptoms, and exist over long term) and focal treatments (designed to eliminate undesirable autistic behaviors) that included a pill or placebo control, an alternative treatment condition, or a wait-list.	<p>Focal treatments (15 controlled single-subject experimental designs) specific to FCT/ABA and Caregiver-Based Intervention Programs.</p> <p>Subjects included in comprehensive treatment studies and overall number of subjects was not reported.</p>	Children aged 2 to 15 diagnosed with autism and related disorders	Primary outcomes included behavioral changes for both children and parents (i.e., termination of self-injury, parent's level of distress, knowledge of autism)	NR	Qualitative	<p>None in common with this report; either not a controlled trial or a controlled trial that used DSM-III criteria for diagnosing autism.</p>	<p>Although clinical improvements were frequently observed in autistic children undergoing comprehensive treatments, research failed to rule out alternative explanations for improvement deemed an essential component for efficacy by study authors. Focal treatments, however, demonstrated both efficacy and effectiveness, including one trial demonstrating that a Caregiver-Based Intervention Program was superior to day care alone. The effectiveness of intensive sessions of FCT/ABA for children aged 2 to 15 were noted in as short as 2 weeks time and were often associated with clinically important changes in behavior, including the termination of self-injury.</p>

Citation	Search Strategy	Key Inclusion/Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
Homer et al. 2002(114) <i>Problem Behavior Interventions for Young Children with Autism: A Research Synthesis</i>	ERIC, EXCEPTIONAL CHILD, and PsycINFO databases from 1996-2000	Included studies focused on children less than 97-months-old with problem behavior, used an experimental design identifying a causal relationship between problem behavior and intervention, provides subject data, and includes 3 data points for pre-intervention and three data points post-intervention.	9 studies evaluated 37 comparisons of the following problem behavior interventions: <ul style="list-style-type: none"> ▪ stimulation-based ▪ instruction ▪ extinction ▪ reinforcement ▪ punishment ▪ systems change N = 24 (5 females)	Children with autism 8 years or younger	Reduction in problem behavior, duration of intervention/maintenance/follow-up phases, duration of non-problem behavior assessment, and alteration in broader lifestyle changes	National Academy of Sciences "Criteria for Assessing Intervention Studies"	Qualitative	None in common with this report; no controlled trials.	Early use of instruction-based and stimulus-based interventions resulted in significant reduction in problem behaviors in young autistic children. In the nine studies reviewed, almost 60% of the comparisons reported a 90% reduction in problem behavior. The most commonly assessed problem behaviors were tantrums and aggression. Future behavioral support of young autistic children should foremost focus on effective prevention of problem behaviors which should include efforts to identify and include individually functional reinforcers.

Citation	Search Strategy	Key Inclusion/ Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
<p>McConnell 2002(67)</p> <p><i>Interventions to Facilitate Social Interaction for Young Children with Autism: Review of Available Research and Recommendations for Educational Intervention and Future Research</i></p>	<p>PsycINFO database through October 2001; references from published articles and online citation indices.</p>	<p>Studies focused on teaching, training, or providing intervention on social functioning were included. Studies in which subjects were more than 8 years of age, reports of case studies or program descriptions, and most studies published before 1979 were excluded.</p>	<p>55 studies evaluating social interaction interventions categorized as:</p> <ol style="list-style-type: none"> (1) ecological variations (k = 11) (2) collateral skills (k = 9) (3) child-specific (k = 15) (4) peer behavior (k = 30) (5) comprehensive (k = 7) <p>Overall study population not reported.</p>	<p>Children aged 3 to 13 years diagnosed as:</p> <ol style="list-style-type: none"> (1) autistic (2) typically developing (3) with disabilities 	<p>Social initiations and responses to increases in sociodramatic behaviors</p>	<p>NR</p>	<p>Qualitative</p>	<p>None in common with this report; many published before 1998, others either not a controlled trial or subjects were children with disabilities (not specific to autism).</p>	<p>Studies based on ecological variations demonstrated weak to moderate effects on social interaction of young children with autism. Authors discuss the likelihood that the social skills and behavior of peers in integrated play groups affects social interactions rates for young autistic children.</p> <p>In 3 studies incorporating collateral skills interventions, results indicated that teaching a structured activity such as socio-dramatic play increases social interaction rates.</p> <p>15 studies based on child-specific interventions demonstrated positive improvements in social interactions however as these interventions focus more on social initiations they may have limited potential in sustaining long-term effectiveness.</p> <p>A majority of the included studies implemented peer-mediated approaches which have historically been as effective as child-specific interventions. Several studies evaluated the influence of characteristics of a peer group on outcomes of young autistic children. Results indicated that both size of play groups and high sociometric status of peers were associated with increased rates of social interactions.</p> <p>Comprehensive social interaction interventions reported positive effects in social interaction on autistic children and typically developing peers in free play situations. Several interventions incorporated teacher-led instructional groups providing didactic presentation and modeling with individual or group reinforcement.</p>

Citation	Search Strategy	Key Inclusion/Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
Delprato 2001(115) <i>Comparisons of Discrete-Trial and Normalized Behavioral Language Intervention for Young Children with Autism</i>	NR	Group design studies were required to use random assignment and single case studies were required to exert experimental control through either reversal or multiple baseline designs. Studies were required to measure one aspect of language performance.	10 controlled studies (2 RCTs) evaluating traditional discrete-trial/direct instruction/artificial interventions or normalized interventions (loosely structured sessions of indirect teaching) N = 63	Children meeting one criterion for autism (DSM or National Society for Autistic Children) and aged 3 to 8 years	Outcomes include imitative responding, and speech production	NR	Qualitative	None in common with this report; either published before 1998 or not a controlled trial.	Normalized language training was more effective than discrete-trial training in measures by eight studies of language criterion responses and in two studies measuring parental effect. More successful acquisition and generalization performance was reported in normalized language interventions. Results of controlled comparison studies support recommendations (Harris 1975) of training young children with autism in everyday settings versus a classroom setting.
Mostert 2001(39) <i>Facilitated Communication Since 1995: A Review of Published Studies</i>	Search of education and psychology databases from 1993, author searches, manual searches of well known special education journals and ancestry searches.	Only published studies from 1995 were included. Studies focusing on facilitators but not clients as study participants were excluded.	29 studies evaluating facilitative communication (FC) and categorized as: <i>CP-</i> Studies providing one or more control procedures but refute FC claims (k = 19) <i>CP+</i> Studies providing one or more control procedures supporting FC claims (k = 6) <i>NCP+</i> Studies with no control procedures but support FC (k = 4)	Subjects aged 6 to 52 years diagnosed with autism, mental retardation (MR) and other diagnoses <i>CP-</i> (n = 160) Autism (n = 101) MR (n = 54) Other (n = 53) <i>CP+</i> (n = 70) Autism (n = 38) MR (n = 25) Other (n = 8) <i>NCP+</i> (n = 20) Autism (n = 13) MR (n = 3) Other (n = 4) Labels may exceed number of subjects due to comorbidity or double labeling.	Production of functional, typed communication, response latency; and accurate responses	NR	Qualitative	None in common with this report; either published before 1998 or not a controlled trial.	In general, a tendency appeared for studies with several control procedures to refute FC claims, those with fewer control procedures to produce mixed results and those with no control procedures to support FC claims. The authors suggest that future research should address motivations and beliefs of facilitators, study settings, level of disability severity and more closely defined populations.

Citation	Search Strategy	Key Inclusion/ Exclusion Criteria	Evidence Base	Participant Characteristics	Outcomes Assessed	Method of Assessing Study Quality	Type of Review	Studies in Common with Those Assessed in this Report	Results and/or Authors' Conclusions
<p>Hwang and Hughes 2000(108)</p> <p><i>The Effects of Social Interactive Training on Early Social Communicative Skills of Children with Autism</i></p>	<p>Searched ERIC, PsycLIT from 1981 through 1997; review of relevant journals from 1981 to 1997; and an ancestral search of reference lists</p>	<p>Studies reporting an intervention-based investigation; measured social and/or communicative skills as a dependent variable; incorporated a naturalistic, social interactive strategy promoting the child as the initiator as a main component of the independent variable; published in a reference journal or relevant text. Excluded studies only focused on decreasing an undesirable behavior.</p>	<p>16 studies focused on early social communicative behaviors (i.e., expressing affection, reciprocal interaction) and use of naturalistic, social interactive interventions (i.e., naturally occurring reinforcement)</p> <p>Preschool (k = 5) Elementary (k = 11) N = 64 (84% males)</p>	<p>Preschool or elementary children aged 2 to 12 years diagnosed with autism. 69% of participants were either verbal or echolalic.</p>	<p>Imitative play, naming pictures, eye gaze, and requesting action/object/information</p>	<p>NR</p>	<p>Qualitative</p>	<p>None in common with this report; all published before 1998.</p>	<p>All 16 studies reported improvement in social and affective behaviors, nonverbal and verbal communication, eye contact, joint attention and motor imitation.</p> <p>Types of social interactive strategies used singly or in combination included contingent imitation (k = 4), naturally occurring reinforcement (k = 8), time delay (k = 9), and environmental arrangement (k = 8).</p> <p>Time delay alone (k = 5) resulted in increases in verbal responses during free play, requesting information and naming pictures. Incorporation of all four strategies (k = 1) resulted in improvements in eye contact, joint attention and motor imitation.</p>

Appendix C. Description of Instruments Used to Measure Outcomes in Included Studies

Table 17. Name and Description of Validated Instruments

Instrument Name	Description of Instrument
Instruments Measuring Communication/Language Skills	
Expressive One Word Picture Vocabulary Test	Standardized measure to assess expressive language.(46)
British Picture Vocabulary Scale	Standardized measure to assess receptive language.(46)
Autism Diagnostic Observation Schedule (ADOS-G) Communication Domain	A diagnostic instrument that is now also used by some researchers to measure outcomes in clinical research. As a measure of communication, it was used as follows: expressive ability (0 = regular, 1 = occasional phrase, 2 = greater than 5 single words only, 3 = less than 5 single words only, 4 = nonverbal).(46) It consists of a play-based standardized protocol which presents the child with a series of structured and semi-structured presses for observing interaction, communication, repetitive behavior and play.(79)
MacArthur Communication Development Inventory (CDI)	To measure understanding and expression of words and gestures. Parents complete a checklist with the assessment team.(79)
Vineland Adaptive Behavior Scale (VABS) – communication domain	The VABS comes in three forms varying in degree of detail and proposed setting. There is the Survey Form, the Expanded Form, and the Classroom Edition. The VABS is administered by interviewing the child's parents, teachers, or care providers. The scales range in age from birth to 19 years. Raw scores from communication, daily living skills, socialization, motor skills, and maladaptive behaviors are converted to standard scores with a population mean of 100 and standard deviation of 15. Higher scores indicate better outcomes or performance of more adaptive behaviors.(163,164)
Griffith Scale of Infant Development – nonverbal IQ subscales D and E	In lieu of a direct, formal language test, to assess communication in nonverbal children.(83)
Autism Diagnostic Interview Revised	A structured child-adult interaction assessment to elicit examples of nonverbal social communication.(83)

Instrument Name	Description of Instrument
Learning Readiness	
Assessment of Basic Language and Learning Skills (ABLLS)	A skill tracking assessment tool designed specifically for children with autism or other language delays. It offers criterion-referenced information regarding a variety of education and life skills.(47)
Social Skills	
Autism Diagnostic Observation Schedule (ADOS-G) Reciprocal Social Interaction Domain	Originally designed as a diagnostic instrument, this test is now used as an outcome measure of social skills.(46) It consists of a play-based standardized protocol which presents the child with a series of structured and semi-structured presses for observing interaction, communication, repetitive behavior and play.(79)
Social Skills Questionnaire	Thirty-item parent rating scale of the child's social skills. This measure has shown good reliability in previous studies of children with autism.(80)
Diagnostic Analysis of Nonverbal Accuracy –facial expressions	Contains 24 photographs of an equal number of men and women making happy, sad, angry, and fearful facial expressions of both low and high intensity. Has been shown to have acceptable internal consistency for school-aged children as well as good test retest reliability. S = subjects receive one point for correctly identifying each facial expression emotion.(82)
Autism Diagnostic Interview Revised	A structured child-adult interaction assessment to elicit examples of nonverbal social communication.(83)
Emotion Regulation Social Skills Questionnaire (ERSSQ)	Parent rating of how often child engaged in each of 27 social behaviors on a 5-point scale. This questionnaire showed good internal consistency, with a Chronbach's alpha of 0.89 for this study population.(75)
Assessment of Perception of Emotion from Facial Expression (Spence 1995)	A 24-item measure of a child's ability to identify facial expressions in black and white photographs of both children and adults. Emotions depicted were happy, sad, angry, afraid, disgusted and nicely surprised.(75)
Assessment of Perception of Emotion from Posture Cues (Spence 1995)	Same format as the Assessment of Perception of Emotion from Facial Expression (Spence 1995) but test stimuli are photographs of body postures rather than facial expressions.(75)
James and the Math test	Subjects listen to a story about a boy who feels anxious about an upcoming math test and offers suggestions for how he can reduce his feelings of anxiety. Appropriate responses were awarded one point. Inter-rater agreement on how to score subject responses were acceptable (kappa = 0.84).(75)
Dylan is being Teased	Subjects listen to a story about a boy who is being bullied and offers suggestions for how he copes with the bullying. Appropriate responses were awarded one point. Inter-rater agreement on how to score subject responses were acceptable (kappa = 0.82).(75)

Instrument Name	Description of Instrument
Problem Behaviors	
Autism Diagnostic Observation Schedule (ADOS-G) stereotyped and restricted behavior domain	Originally designed as a diagnostic instrument, this test is now used as an outcome measure.(46) It consists of a play-based standardized protocol which presents the child with a series of structured and semi-structured presses for observing interaction, communication, repetitive behavior and play.(79)
Eyberg Child Behavior Inventory	A well-validated 36-item parent rating scale with good reliability and internal consistency.(80) T scores at or above 60 on the Intensity and Problem Scales are considered clinically significant.(76)
Autism Diagnostic Interview Revised – repetitive and stereotyped behavior domain	A structured child-adult interaction assessment to elicit examples of nonverbal social communication, reciprocity, social interaction, and affective responsivity.(83)
The Behavioral assessment System for Children Parent Rating Scales	The BASC is a 138-item parent-report measure of behavior and emotion that is well validated and considered reliable. Parents rate each item on a four-point scale of frequency Scales measure problem behaviors, adaptive social behaviors/child well-being. T scores at or above 70 are considered clinically significant.(76)
Parent/Child Well-being	
Parental Stress Index	A parent-rated record which generates scores for total stress, parent distress, dysfunctional parent-child interactions and child difficulty.(79) Scores at or above the 90 th percentile indicate the parent is experiencing clinically significant parenting stress.(76)

Instrument Name	Description of Instrument
Theory of the Mind	
Strange Stories Task	Strange stories (pretend, joke, lie, white lie, and double bluff) are read to subjects. Subjects then answer a series of questions to determine if child understood that a figurative or non-literal statement had been made and if they understood the non-literal statement. One point is awarded for each correct response. Subjects earned between 0 and 11 points on this task.(82)
Faux Pas Stories Task	Faux Pas stories, tape recorded with children and adults reading the stories, were read to subjects. Subjects then answer a series of questions to determine if child knew if a faux pas occurred, what the faux pas was and why it was an inappropriate thing to say in a given situation. If a child answered all questions about a story correctly they received one point.(82)
Penny hiding deception task	Child hides object in one hand behind his/her back and then brings hands forward for researcher to guess which hand object is in without revealing location to researcher. Scoring was pass/fail.(74)
Seeing Leads to Knowing task	One of two individuals sees object hidden in a box while other person only touches outside of box. The child has to correctly identify which individual knows what is in the box. Scoring was pass/fail.(74)
Know/guess self task	Child shown envelope by researcher and told researcher was unaware of what it contained. Child then answers a series of questions regarding who is aware of content of envelope.(74)
Deceptive box task	Standard deceptive box task using a Smarties tube containing a pencil. Children were questioned about another person's false beliefs.(74)
Reading in the Mind's Eyes task	Pictures of people making various expressions with their eyes were shown to subjects. Subjects had to choose one of four words that best matched the expression. Potential scores ranged from 0 to 14.(74)
Executive Function	
Test of Problem Solving (TOPS)	Designed for children 6 to 11 years of age and normal values determined from non-language disordered children. This test has high test-retest reliability and internal consistency reliability for all age levels. It includes 14 stimulus pictures and questions to assess the subject's critical thinking abilities. Questions require subjects to explain what is going on in the picture as well as reasoning and problem solving inquiries. One example is a picture of two children, one of whom is new to the school, working together in class. Questions might include what the new student can do to make friends, how the other student can assist the new student in this, and what the new child could do if he doesn't know which bus to take home from school.(82)

Instrument Name	Description of Instrument
Wisconsin card sort task	Cards of varying color, shape and number are presented to subjects and subjects must identify on which variable they are to match based on feedback from the instructor.(74)
Teacher-rating questionnaire	Teachers completed a 30 item questionnaire assessing the child's ToM and executive function abilities. Theory of the Mind questions included his/her behavior in terms of telling white lies, taking things literally, recognizing surprise or embarrassment and responding to indirect hints, while executive function questions included ability to plan ahead, do mental arithmetic, and follow a series of verbal instructions.(74)
Trails A & B	Two trails were used: one required the child to connect numbers in order while the second used both number and letters and participants had to alternately connect, keeping both sequences in order.(74)

Appendix D. Quality of Literature and Evidence Strength Rating

Determining the Quality of Individual Studies

For Key Questions 1, 2, and 3, we assessed the quality of each of the studies included in this assessment using a quality assessment instrument developed by ECRI Institute. This instrument examines twenty-two different factors of study design that have the potential to reduce the validity of the conclusions that can be drawn from a trial. Each question is answered with “Yes”, “No” or “NR” (not reported).

Quality Checklist Items:

Comparability of Groups at Baseline

1. Were participants randomly assigned to the study’s groups?
2. Did the study employ stochastic randomization?
3. Were any methods other than randomization used to make the participants in the study’s groups comparable?
4. Were participants assigned to groups based on factors other than child or provider preference?
5. Were the characteristics of participants in the different study groups comparable at the time they were assigned to groups?
6. Did participants in the different study groups have similar levels of performance on all of the outcome variables at the time they were assigned to groups?
7. Was the comparison of interest prospectively planned?
8. Did $\geq 85\%$ of the participants complete the study?
9. Was there a $\leq 15\%$ difference in completion rates in the study’s groups?
10. Were all of the study’s groups concurrently treated?
11. Was compliance with treatment $\geq 85\%$ in both of the study’s groups?
12. Was there concealment of allocation?

Blinding

13. Were the outcome assessors blinded to the group to which the participants were assigned?

Measurement/Instrument

14. Was the outcome measure of interest objective and was it objectively measured?
15. Were the same instruments used to measure the outcomes in all of the study’s groups?
16. Was the instrument used to measure the outcome standard?
17. Were the follow-up times in all of the study’s relevant groups approximately equal?

Treatment

18. Was the same treatment given to all participants enrolled in the experimental group?
19. Was the same treatment given to all participants enrolled in the control group?
20. Were all of the study's groups treated at the same center?
21. Was the treatment provider's adherence to the intervention protocol (treatment fidelity) assessed?

Investigator Bias

22. Was the funding for this study derived from a source that does not have a financial or proprietary interest in its results?

We scored the quality for each outcome/timepoint by coding +1 for each Yes, -1 for each No, and 0 for each NR. The numbers were added, and then we transformed the total so that the best possible study would score 10 (i.e., all Yes's), and the worst possible study would score 0 (i.e., all No's). If the resulting combined score was <7 , we categorized the quality as Low; if the score was ≥ 7 , we categorized quality as Moderate. We then used these quality categories to proceed through the Strength of Evidence system, described next.

Strength-of-Evidence System

Ideally, the body of evidence to support a conclusion would be strong. Often, however, the evidence suffers from various limitations concerning the possible risk of bias in available studies, small numbers of studies and patients, and/or inconsistent effects. These limitations often mean that the strength of the evidence is only moderate, weak, or even insufficient to permit any conclusion. In order to gauge the impact of these possible limitations, we applied a formal rating system developed at ECRI Institute.(86)

Our system allows one to separate the question "is the treatment effective" (leading to a yes or no conclusion) from the question "how effective is the treatment" (leading to a quantitative conclusion with an estimate of the magnitude of effect). Thus, even if the evidence for a precise quantitative effect may not be strong, the same evidence may be strong with respect to the direction of the effect. The interpretation of the strength of the evidence for qualitative and quantitative conclusions was presented in Table 18.

Table 18. Interpretation of Different Categories of Strength of Evidence Supporting Conclusion

Strength-of-evidence Rating	Interpretation
Qualitative Conclusion (Direction of Effect)	
Strong Evidence	Evidence supporting the qualitative conclusion is convincing. It is highly unlikely that new evidence will lead to a change in this conclusion.
Moderate Evidence	Evidence supporting the qualitative conclusion is somewhat convincing. There is a small chance that new evidence will overturn or strengthen our conclusion. ECRI Institute recommends regular monitoring of the relevant literature at this time.
Weak Evidence	Although some evidence supports the qualitative conclusion, this evidence is tentative and perishable. There is a reasonable chance that new evidence will overturn or strengthen our conclusions. ECRI Institute recommends frequent monitoring of the relevant literature at this time.
Inconclusive Evidence	The available evidence that exists is not of sufficient strength to warrant drawing an evidence-based conclusion. ECRI Institute recommends frequent monitoring of the relevant literature this time.
Quantitative Conclusion (Magnitude of Effect)	
High Stability	The estimate of the effect size in the conclusion is stable. It is highly unlikely that the magnitude of this estimate will substantially change as a result of the publication of new evidence.
Moderate Stability	The estimate of the effect size in the conclusion is somewhat stable. There is a small chance that the magnitude of this estimate will substantially change as a result of the publication of new evidence. ECRI Institute recommends regular monitoring of the relevant literature at this time.
Low Stability	The estimate of the effect size in the conclusion is likely to be unstable. There is a reasonable chance that the magnitude of this estimate will substantially change as a result of the publication of new evidence. ECRI Institute recommends frequent monitoring of the relevant literature at this time.
Unstable	Estimates of the effect size are too unstable to allow a quantitative conclusion to be drawn at this time. ECRI Institute recommends frequent monitoring of the relevant literature.

The system employs 14 decision points (Table 19). Four of them are listed in the *General* section because they apply to both quantitative conclusions as well as qualitative conclusions. The other ten apply specifically to either quantitative conclusions (Decision Points 5-9) or qualitative conclusions (Decision Points 10-14). The rest of this appendix defines these decision points and describes how we resolved them for this report. After these descriptions, the pathways for the full system appear in Figure 4 through Figure 7.

Note that we applied this system separately for each outcome of interest. This is because many aspects of the evidence (quality, consistency, etc.) can vary by outcome.

Table 19. Decision Points in the ECRI System

Category	Decision Point
General	1) What is the quality of individual studies?
	2) What is the overall quality of evidence?
	3) Could a quantitative estimate be appropriate?
	4) Are data informative?
Quantitative	5) Are data quantitatively consistent?
	6) Are data quantitatively robust?
	7) Are there sufficient data to perform meta-regression?
	8) Does meta-regression explain heterogeneity?
	9) Is the meta-regression model robust?
Qualitative	10) Are data qualitatively robust?
	11) Is meta-analysis possible?
	12) Are data qualitatively consistent?
	13) Was at least one study a multicenter study?
	14) Is the magnitude of effect extremely large?

Decision Point 1: What is the quality of individual studies?

To aid in assessing the quality of each of the studies included in this assessment, we used a quality instrument developed by ECRI Institute for controlled trials. This instrument examines different factors of study design (attributes) that have the potential to reduce the validity of the conclusions that can be drawn from a trial (see *Determining the Quality of Individual Studies* in the above section for the complete instrument). In brief, the scale was designed so that a study attribute that, in theory, protects a study from bias receives a “Yes” response. If the study clearly does not contain that attribute it receives a “No” response. If poor reporting precludes assigning a “Yes” or “No” response for an attribute, then “NR” is recorded (NR = not reported).

To assess the quality of an individual study, we computed a normalized score so that a perfect study received a score of 10, a study for which the answers to all items was “No” received a score of 0, and a study for which the answers to all questions was “NR” was 5. Quality scores were converted to categories as shown in Table 12 (see *Methods* section of main document). The definitions for what constitutes low and moderate quality evidence were determined *a priori* by a committee of four methodologists. Because the quality was determined separately for each outcome, a study that scored as moderate quality for one outcome might score as low quality for another outcome.

Decision Point 2: What is the overall quality of evidence?

We classified the overall quality of the evidence base by taking the median quality score of the individual studies. We used the median because it is the appropriate measure of central tendency

to represent the “typical” quality score, and is less sensitive to outliers than the mean. Depending on the overall quality scores for each outcome, we then followed the high, moderate, or low quality branch of the system.

Decision Point 3: Is a quantitative estimate potentially appropriate?

The answer to Decision Point 3 depends upon the adequacy of reporting in available studies as well as the number of available studies. In order to permit a quantitative estimate of an effect size for a given outcome, the data for that outcome must be reported in at least three studies in a manner that allows the data to be pooled in a meta-analysis. If less than three studies are available, no quantitative estimate is usually appropriate, regardless of reporting. Another situation that does not permit a quantitative estimate is when at least three studies are relevant to the general topic, but fewer than 75% of them reported the outcome and as well as sufficient information for determination of the effect size and its dispersion, either by direct reporting from the trial or calculations based on reported information. If no quantitative estimate would be appropriate, then one moves directly to Decision Point 10 to determine whether the evidence supports a qualitative conclusion.

Decision Point 4: Are data informative?

For this decision point, we determined whether the precision of an evidence base was sufficient to permit a conclusion. Statistically significant results are informative because they mean that a treatment effect may exist. Statistically non-significant results are also potentially informative, but only if they exclude the possibility that a clinically significant treatment effect exists.

When a meta-analysis is performed, a key concern is the confidence interval around the random-effects summary statistic. If this interval is so wide that it includes a clinically significant (or substantial) effect in one direction *and also an effect in the opposite direction*, then the evidence is inconclusive, and therefore uninformative.(165,166)

Thus, when considering the summary effect size from a meta-analysis (or the effect size from a single study), there are three ways in which the effect can be “informative”:

1. The effect size is statistically significantly different from 0. This would be indicated whenever the confidence interval does not overlap 0.
2. The confidence interval is narrow enough to exclude the possibility that a *clinically significant difference* exists.
3. The confidence interval is narrow enough to exclude the possibility that a *substantial difference* exists. This possibility is included to address situations when even a very small effect can be considered “clinically significant” (e.g., a difference in mortality rates), but the effect may not be “substantial”.

The second possibility requires definitions of a minimum “clinically significant difference” for each outcome. For the outcomes in this report, Table 20 lists our definitions of “clinical significance”.

Table 20. Definitions of Clinical Significance

Outcome	<i>Minimum difference between groups at post-treatment to be considered clinically significant</i>
Language/Communication Skills	One half of the standard deviation of the mean for typically developing children, which for most tests of IQ and language skills is a standard deviation of 15. So, the minimum difference to be considered clinically significant for this report is a standard deviation of 7.5. For dichotomous outcomes (e.g., number of children moving into normal range on I.Q. scores, which is a score of 85 or greater), a statistically significant difference is considered to be clinically significant.
Problem Behaviors	A SMD of 0.2, which corresponds to a small effect size, is considered to be clinically significant.
Parent/family Well-being	A SMD of 0.2, which corresponds to a small effect size, is considered to be clinically significant.

Note that when the evidence base consists of one or two studies, and the only usable data from one study consists of a p-value that was calculated using the wrong statistical test, then the data cannot generally be considered “informative.” If, however, the study reported sufficient information for one to perform the correct test, then informativeness can be determined.

Decision Point 5: Are data quantitatively consistent?

Quantitative consistency (also referred to as lack of heterogeneity) refers to the extent to which the effect sizes of studies in an evidence base were statistically similar.(167) To measure quantitative consistency, we used Higgins and Thompson’s I^2 statistic.(168) For this report, we considered an evidence base to be quantitatively consistent when $I^2 < 50\%$.

Decision Point 6: Are data quantitatively robust?

Robustness of findings refers to whether the evidence for a summary estimate is both *precise* and *stable*. A precise estimate is one for which the evidence permits a narrow confidence range for possible values of the parameter. A stable estimate is one that does not change substantially in response to minor alterations in the analysis. In this report, we considered an estimate to be quantitatively robust if all of the following conditions were met:

1. The overall estimate is sufficiently precise
2. The estimate remains sufficiently precise after the removal of any single study

Test #1: Sufficient precision. An important component of the evidence for a summary estimate is the precision of that estimate. Specifically, we refer to the 95% confidence interval (CI) around the estimate as a measure of precision. This is an objective measure of the quantity of evidence that *simultaneously incorporates* 1) the number of studies; 2) the number of patients in those studies; and 3) within-study variability of effect sizes; and 4) between study-variability of effect sizes (because we only perform random-effects meta-analyses). An imprecise estimate is one that could easily change when future evidence becomes available (i.e., a wide confidence interval), whereas a precise estimate is unlikely to change (i.e., a narrow confidence interval).

To assess whether precision is “sufficient”, we refer to the minimum difference that is considered to be clinically significant. Specifically, we defined a “sufficiently precise” estimate as one where the lower and upper confidence bounds were *each within one clinically significant difference* from the summary estimate. If not, then the evidence base is not precise enough to locate the effect within a clinically equivalent range. For example, suppose the summary effect size is 10, with a CI of 8.5 to 11.5. Further suppose that the definition of clinical significance is 2 units. This indicates that data *are* sufficiently precise to provide an estimate that is within 1 clinically significant difference, and so the estimate would pass this test. However, suppose the CI had been 7 to 13. Then the interval suggests that the true effect could be a full three units above or below the estimate of 10. Three units is greater than the minimum clinically significant difference of 2, therefore a 7 to 13 interval would fail this test.

For some variables (e.g., change in diagnosis, classroom placement) any difference at all can be considered clinically significant. For other variables, we defined the magnitude of a “substantial difference”, which corresponds to a “small” effect size as defined by Cohen.(169) Thus, if the effect size metric is SMD or Hedges’ *g*, we defined a “substantial difference” as $d = 0.2$, or if the effect size metric is the log odds ratio, we defined a “substantial difference” as $\ln(\text{OR}) = 0.4$.

Test #2: Removal of one study at a time. The summary estimate should not depend heavily on the inclusion of any particular study in the evidence base. To test this, we perform a series of subsequent analyses, each with one study removed. In order to pass this test, the lower and upper bounds of the 95% CI in all analyses should be within one clinically significant difference from the *all-study* summary estimate. Thus, this test produces a new set of CIs (one CI for each study removal), and each CI is compared to the all-study summary estimate.

Decision Point 7: Are there sufficient data to perform meta-regression?

We required a minimum of five studies before attempting meta-regression.

Decision Point 8: Does meta-regression explain heterogeneity?

This decision point provides decision rules for the conduct of a meta-regression analysis and the interpretation of its results. The project internal review committee must determine *a priori* what methods will be used in performing a meta-regression should one be necessary. In addition, the committee must define the rules that will be used for interpretation of the findings of the meta-regression analysis. We use the permutation test for all meta-regressions. This test was developed by Higgins and Thompson in attempt to control the Type I error rate for meta-regression.(170)

For this topic, we chose the following covariates as potential explanations of heterogeneity:

1. Duration of treatment (defined as less than 1 year or greater than 1 year).
2. Intensity of treatment (only applicable to key question 2, in cases where one comprehensive program was delivered for less hours than another comprehensive program).
3. Training/experience of provider (the definition of this variable may differ depending on the intervention and who is providing it (parents or therapist). If meta-regression is possible, we will need to consider what training is required and establish whether the criteria were met. So, this might be a continuous variable measured in hours or a dichotomous variable measured as provider met established training requirements or not)

4. Fidelity/integrity of treatment-when measured within a study (Yes or No).
5. Quality category of study (High or Moderate or Low)
6. Use of blinded assessors (Blinded or Not blinded)
7. Use of concomitant treatment in experimental group (medication or supplemental services versus none)

In order to determine that a given covariate “explains” the heterogeneity, the resulting I^2 must have been less than 50%, and the beta coefficient for the covariate must have been statistically significant by the permutation test.

Decision Point 9: Is the meta-regression model robust?

The purpose of Decision Point 7 is to test the robustness of any quantitative findings that may emanate from meta-regression analysis. The only necessary robustness test involves removing one study at a time to determine whether this alters the findings of the meta-regression. If removal of one study results in heterogeneity that is greater than or equal to $I^2 = 50%$, or caused the covariate to become statistically non-significant by the permutation test, then the meta-regression model is not robust.

Decision Point 10: Are data qualitatively robust?

If the evidence base for an outcome had three or more studies, we determined whether the qualitative findings could be overturned by sensitivity analyses. We considered findings to be overturned only when a sensitivity analysis altered the conclusion (e.g., a statistically significant finding becomes non-significant as studies are added to the evidence base). The same sensitivity analyses used to test quantitative robustness were used to test qualitative robustness (except for the sufficient precision test, which does not apply to this decision point).

The system allows for several general types of qualitative conclusions:

1. A conclusion that the effect is statistically significant
2. A conclusion that the effect is clinically significant (see definition of clinical significance in Decision Point #4 above).
3. A conclusion that the effect is not clinically significant
4. A conclusion that the effect is not “substantial.” (see definition of “substantial” in Decision Point #4 above)

For each of these types of conclusions, the qualitative robustness test will depend critically on a different threshold. For conclusion **a**, the question is whether the statistical significance of the finding is preserved across all qualitative robustness tests. In practical terms, this means that the lower bound of the 95% confidence interval must not overlap with 0 in any of the robustness tests. For conclusion **b**, the issue is whether the lower bound of the confidence interval stays consistently *above* the level of clinical significance across all robustness tests. For conclusion **c**, the issue is whether the lower bound of the confidence interval stays consistently *below* the level of clinical significance across all robustness tests. Finally, for conclusion **d**, the issue is whether the lower bound of the confidence interval stays consistently *below* the level of a substantial difference across all robustness tests.

Note that more than one qualitative conclusion could apply to the same outcome. For example, a treatment could be both statistically and clinically significantly better than an alternative (conclusions a and b). Or, a treatment could be statistically better than an alternative but clearly not clinically better (conclusions a and c). Conclusions b, c, and d, however, are mutually exclusive. Conclusions b and c are opposites; conclusion d only applies when the notion of “clinical significance” is inappropriate (see Decision Point #4 for further explanation).

Decision Point 11: Is meta-analysis possible?

This Decision Point is used only when the evidence base for an outcome consists of two studies.

A meta-analysis is possible if each study reports an effect size and its standard error, or if each study reports sufficient information for the reader to calculate these values. Note that meta-analysis is never appropriate if two studies have statistically significant effect sizes in opposite directions.

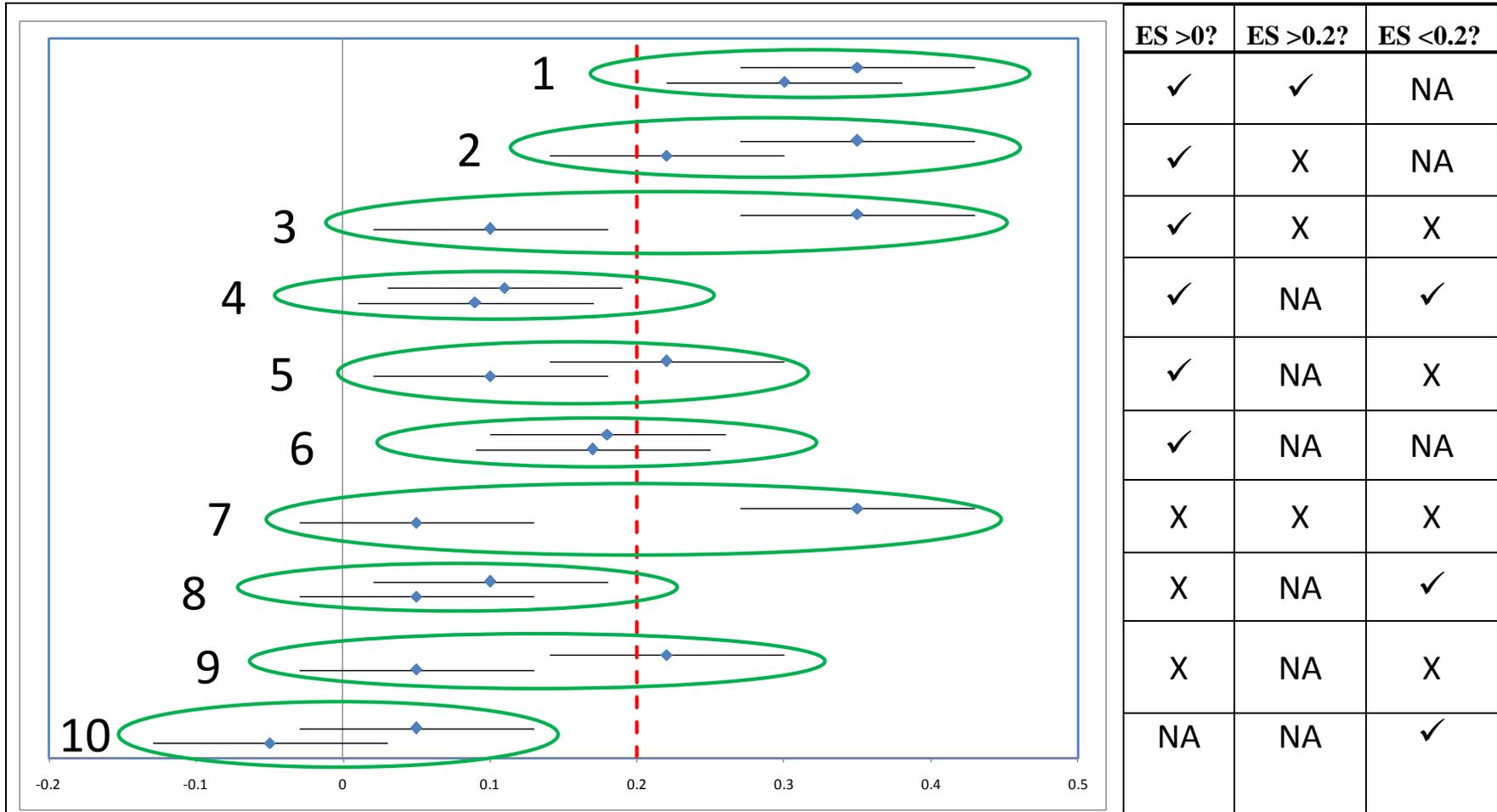
Decision Point 12: Are data qualitatively consistent?

This Decision Point is used only when the evidence base for an outcome consists of two studies. Figure 3 depicts several situations using confidence intervals. For each situation, one can ask three questions:

1. Do the two studies both support the conclusion that the effect size is *greater than 0*?
2. Do the two studies both support the conclusion that the effect size is *greater than the minimum clinically significant effect size* (as defined in the graph by an effect size of 0.2)?
3. Do the two studies both support the conclusion that the effect size is *less than the minimum clinically significant effect size* (as defined in the graph by an effect size of 0.2)?

Qualitative consistency can be judged separately for these three questions; a pair of studies may be qualitatively consistent in some ways but not others. For each of the situations depicted in the figure, the right portion lists the corresponding determinations of qualitative consistency. Some questions are not applicable to a given pair of results because neither study would support that type of conclusion (e.g., in Situation #1, the 3rd question would not be supported by either study and therefore the issues of qualitative consistency in the 3rd sense would not apply).

Figure 3. Qualitative Consistency of Two Studies



NOTES: Each point is the result of a single study with its 95% CI. The dashed line at 0.2 represents the minimum difference considered to be clinically significant. In the right-hand cells, a checkmark ✓ means that the two studies are qualitatively consistent with respect to the question at the top of the column. An X means that the two studies are NOT qualitatively consistent with respect to the question at the top of the column. NA means that the question at the top of the column does not apply because neither study supports that conclusion. ES denotes effect size.

Decision Point 13: Was at least one study a multicenter study?

Multicenter trials may increase the strength of a one or two-study evidence base because they demonstrate partial replication of findings; they have shown that different investigators at different centers can obtain similar results using the same protocol. We defined a multicenter trial as any trial that met the following two conditions: 1) ≥ 3 centers and 2) either ≥ 100 patients or at least 3 centers enrolled ≥ 20 patients/center.

Decision Point 14: Is the magnitude of effect extremely large?

When considering the strength of evidence supporting a qualitative conclusion based on only one or two studies, magnitude of effect becomes very important. If a single study finds a large effect with a narrow confidence interval, then new evidence is unlikely to overturn the qualitative conclusion. To resolve this decision point, we consulted the effect size and the 95% confidence interval around the effect size for the study (with two studies, we consulted the interval around the random effects summary statistic). If this interval was fully above +0.5 (or if it was fully below -0.5) and the effect size was ≥ 0.8 (or ≤ -0.8), we considered the effect to be large. Otherwise, we considered it to be not large. For example, an interval from +0.6 to +1.1 would be considered a large effect, whereas an interval from +0.4 to +1.3 would not be considered a large effect. Another effect that would be considered large is an interval from -1.1 to -0.6 (large in the negative direction). The choice of 0.5 and 0.8 is based on Cohen,(169) who stated that an effect size of 0.5 was “moderate” and 0.8 was “large”; thus the decision rule required that the effect be statistically significantly larger than “moderate”. The use of 0.5 and 0.8 applies to Hedges’ d or Hedges’ g as measures of effect size. These correspond roughly to odds ratios of 2.5 and 4.5, respectively.

Figure 4. General Section of Strength-of-Evidence System

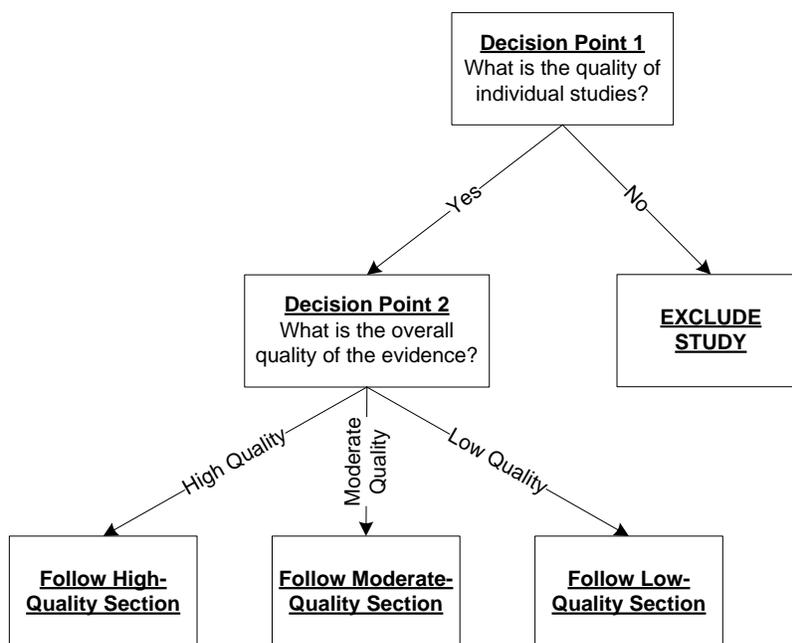


Figure 5. Highest Quality Pathway of Strength-of-Evidence System

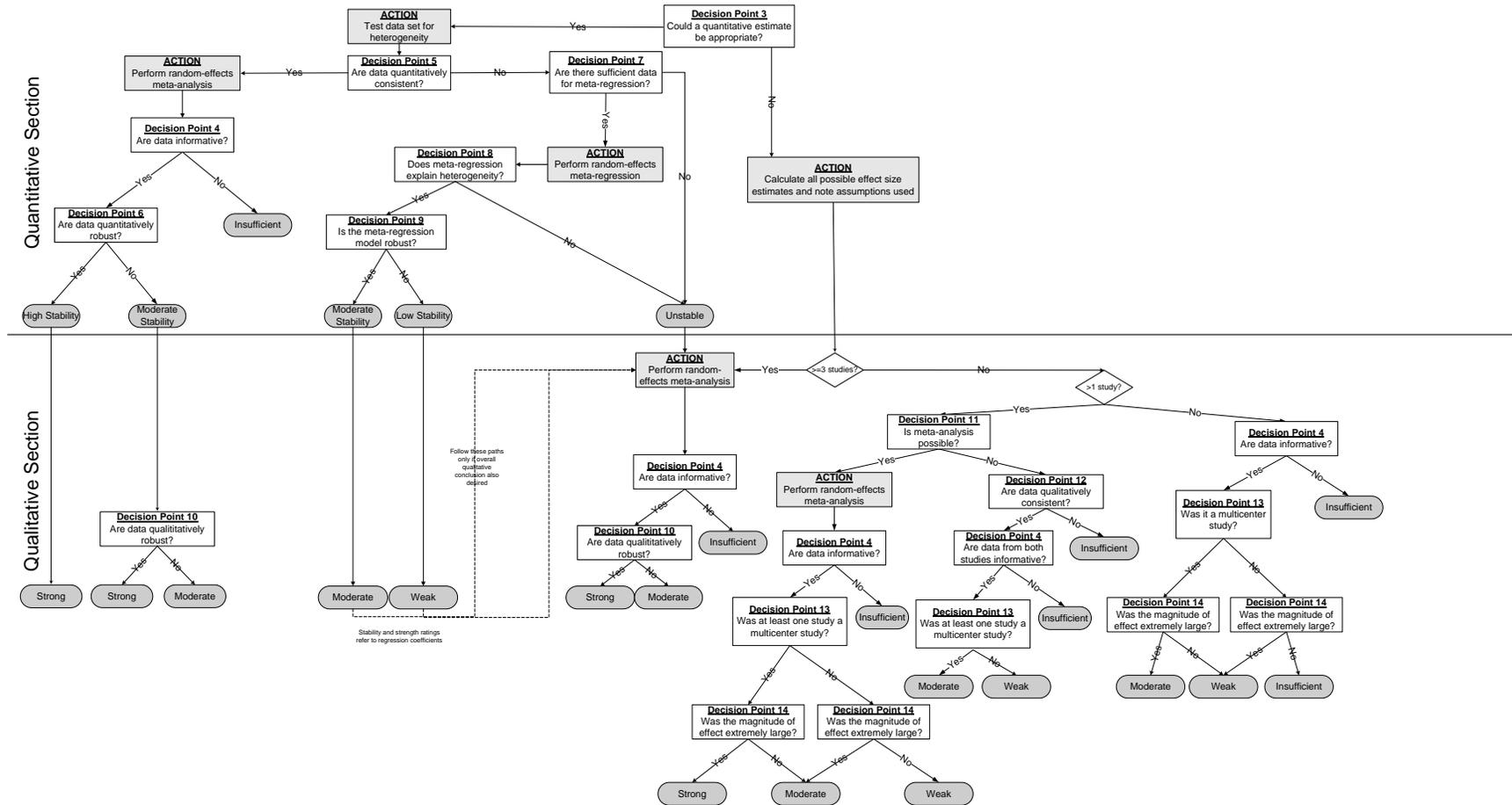


Figure 6. Moderate Quality Pathway of Strength-of-Evidence System

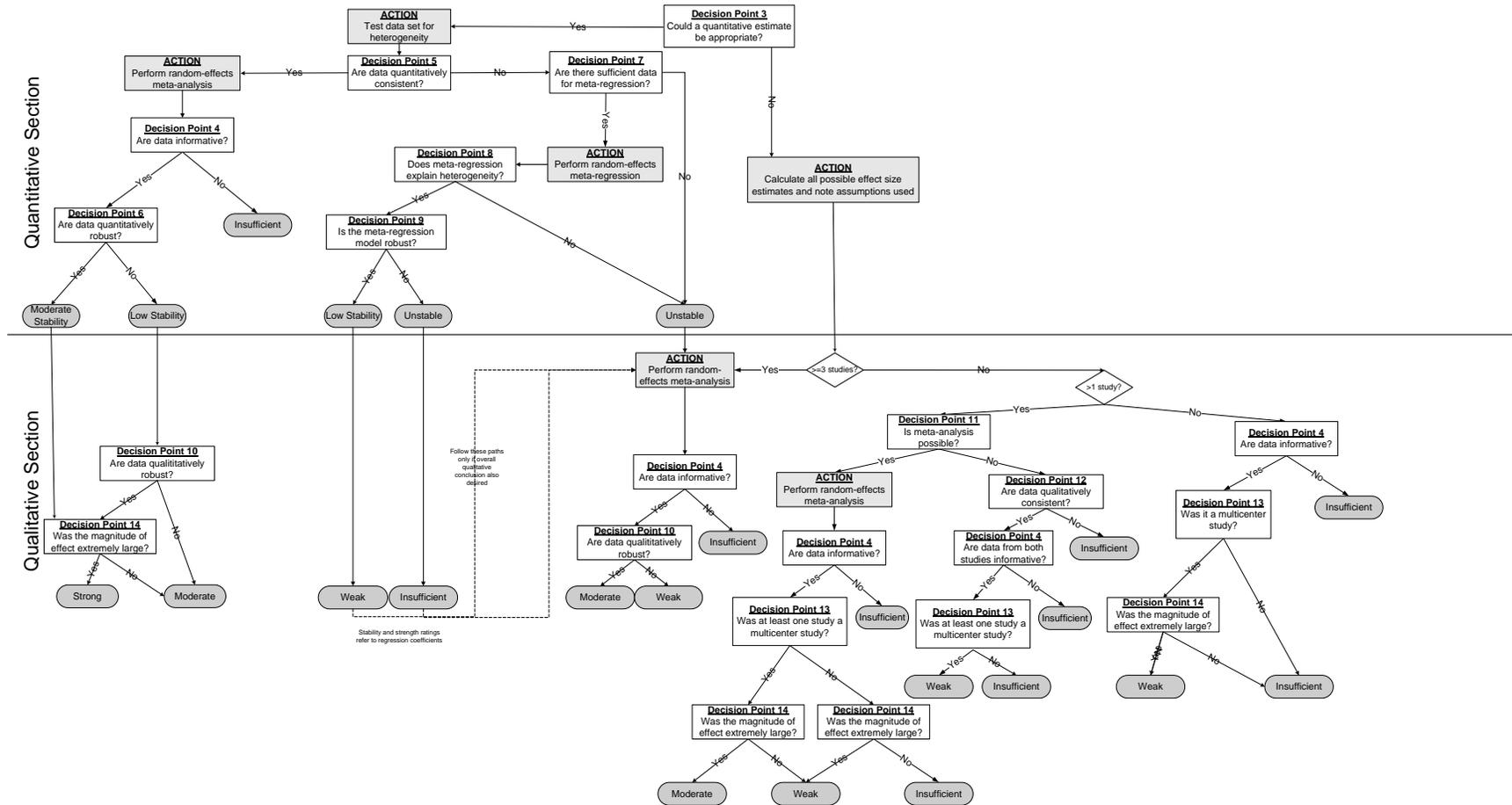
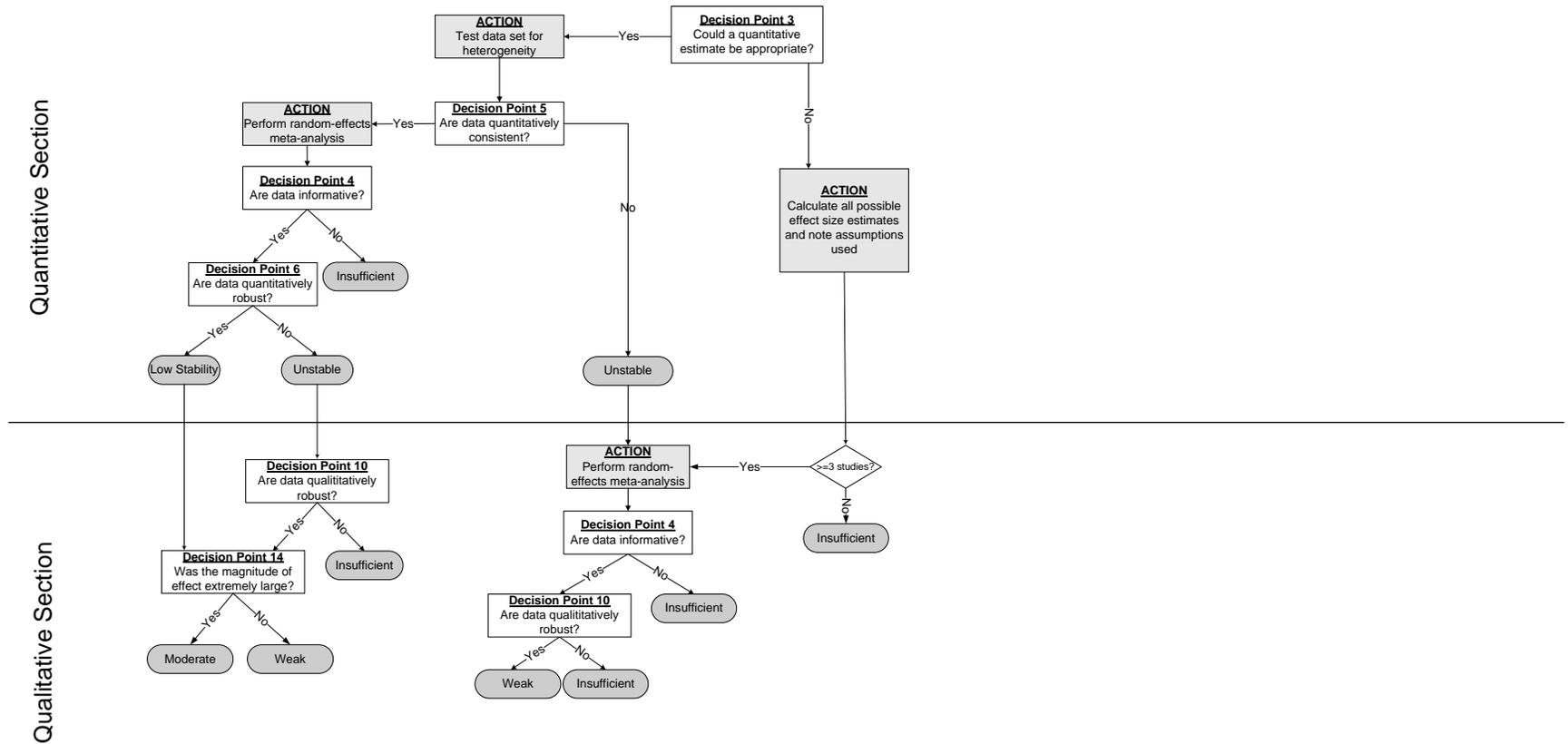


Figure 7. Lowest Quality Pathway of Strength-of-Evidence System



Appendix E. Quality Assessment Scores

Table 21. Quality Assessment Scores

ECRI Institute's Controlled Trial Instrument	Beaumont and Sofronoff 2008(75) nonblinded outcomes	Beaumont and Sofronoff 2008(75)	Solomon et al. 2008(76)	Howlin et al. 2007(46)	Kroger et al. 2007(47)	Rogers et al. 2006(77)	Yoder and Stone 2006(78)	Fisher and Happé 2005(74) KQ1	Fisher and Happé 2005(74) Teacher Questionnaire	Escalona et al. 2002(84)	Field et al. 2001(85)	Fisher and Happé 2005(74) KQ2	Fisher and Happé 2005(74) Teacher Questionnaire	Aldred et al. 2004(79)	Sofronoff et al. 2004, 2002(80,81)	Solomon et al. 2004(82)	Drew et al. 2002(83)
1. Were participants randomly assigned to the study's groups?	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2. Did the study use appropriate randomization methods?	NR	NR	NR	Y	N	Y	Y	N	N	NR	NR	N	N	Y	NR	NR	Y
3. Were methods used to make the participants in the study's groups comparable?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4. Were subjects assigned to groups based on factors other than individual, parent or provider preference?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5. Were characteristics of participants in the different study groups comparable at the time they were assigned to groups?	Y	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
6. Did participants in the different study groups have similar levels of performance on all of the outcome variables at baseline?	Y	Y	Y	Y	Y	NR	N	N	N	N	NR	N	N	N	Y	N	Y
7. Was the comparison of interest prospectively planned?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

ECRI Institute's Controlled Trial Instrument	Beaumont and Sofronoff 2008(75) nonblinded outcomes	Beaumont and Sofronoff 2008(75)	Solomon et al. 2008(76)	Howlin et al. 2007(46)	Kroger et al. 2007(47)	Rogers et al. 2006(77)	Yoder and Stone 2006(78)	Fisher and Happé 2005(74) KQ1	Fisher and Happé 2005(74) Teacher Questionnaire	Escalona et al. 2002(84)	Field et al. 2001(85)	Fisher and Happé 2005(74) KQ2	Fisher and Happé 2005(74) Teacher Questionnaire	Aldred et al. 2004(79)	Sofronoff et al. 2004, 2002(80,81)	Solomon et al. 2004(82)	Drew et al. 2002(83)
8. Did ≥85% of participants complete the study?	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
9. Was there a ≤15% difference in completion rates in the study's groups?	Y	Y	Y	N	Y	NR	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
10. Were all of the study's groups concurrently treated?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
11. Was compliance with treatment ≥85% in both of the study's groups?	NR	NR	NR	NR	Y	Y	NR	Y	Y	Y	Y	Y	Y	N	N	NR	NR
12. Was there concealment of allocation?	NR	NR	NR	NR	NR	NR	Y	NR	NR	NR	NR	NR	NR	NR	N	NR	NR
13. Were outcome assessors blinded to the group to which the participants were assigned?	N	Y	NR	N	Y	Y	N	NR	Y	N	N	NR	Y	Y	N	NR	NR
14. Was the outcome measure of interest objective and was it objectively measured?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15. Were the same instruments used to measure the outcomes in all of the study's groups?	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y
16. Was the instrument used to measure the outcome standard?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
17. Were the follow-up times in all the study's relevant groups approximately equal?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

ECRI Institute's Controlled Trial Instrument	Beaumont and Sofronoff 2008(75) nonblinded outcomes	Beaumont and Sofronoff 2008(75)	Solomon et al. 2008(76)	Howlin et al. 2007(46)	Kroger et al. 2007(47)	Rogers et al. 2006(77)	Yoder and Stone 2006(78)	Fisher and Happé 2005(74) KQ1	Fisher and Happé 2005(74) Teacher Questionnaire	Escalona et al. 2002(84)	Field et al. 2001(85)	Fisher and Happé 2005(74) KQ2	Fisher and Happé 2005(74) Teacher Questionnaire	Aldred et al. 2004(79)	Sofronoff et al. 2004, 2002(80,81)	Solomon et al. 2004(82)	Drew et al. 2002(83)
18. Was the same treatment given to all the participants enrolled in the experimental group?	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y
19. Was the same treatment given to all participants enrolled in the control group?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N
20. Were all of the study's groups treated at the same center?	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
21. Was the treatment provider's adherence to the intervention protocol (treatment fidelity) assessed?	Y	Y	N	N	N	Y	Y	NR	NR	NR	NR	NR	NR	NR	Y	NR	NR
22. Was the funding for this study derived from a source that does not have a financial or proprietary interest in its results?	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y
Overall Quality Score	8.0	8.4	8.2	6.8	8.0	8.0	8.0	7.0	7.7	8.0	8.2	6.6	7.3	7.7	8.0	7.5	6.8
Median Score Key Question 1: 8.0 Range: 6.8-8.4																	
Median Score Key Question 2: 7.65 Range: 6.6-8.0																	

N No
NR Not reported
Y Yes

Appendix F. Patient Characteristic Tables

Table 22. Participant Eligibility Criteria for Included Studies

Study	Inclusion Criteria	Exclusion Criteria
Beaumont and Sofronoff 2008(75)	Children with a diagnosis of Asperger's syndrome confirmed by a pediatrician; achievement of a WISC-III prorated IQ score of 85 or above; and age between 7½ years to 11 years at the time of intake assessment.	NR
Solomon et al. 2008(76)	The following criteria were used: 1) child was between 5-12 years of age; 2) met the criteria for Autistic Disorder, AS or PDDNOS according to DSM-IV TR, ASD or autism according to ADOS-G, and autistic disorder according to the Autism Diagnostic Interview-Revised; either demonstrated clinically significant externalizing behavior measured by the Behavior Assessment System for Children Externalizing Problem Scale or exceed the cutoff on the Intensity Scale of the Eyberg Child Behavior Inventory.	Children were excluded if they had a full scale IQ of <70 on the Wechsler Abbreviated Scale of Intelligence for Children and did not possess enough receptive and expressive language to participate in the intervention.
Howlin et al. 2007(46)	The following criteria were used: 1) each child must have a formal clinical diagnosis of autism and meet criteria for autism or autism spectrum disorder on the ADOS-Module 1; 2) each child must have little or no functional language; 3) each child must have no evidence of sensory impairment; 4) each child must be aged between 4 and 11 years; 5) each child must not be using PECS beyond Phase 1.	NR
Kroeger et al. 2007(47)	The following criteria were used: 1) children were at or between 4 and 6 years and 2) had a diagnosis of autistic disorder	Children with other autism spectrum disorders (i.e., Asperger's disorder, Rett's disorder, childhood disintegrative disorder, and PDD-NOS)

Study	Inclusion Criteria	Exclusion Criteria
Rogers et al. 2006(77)	The following inclusion criteria were used: 1) diagnosis of autism; 2) spontaneous use of less than five functional words per day; 3) developmental quotient (mental age/chronological /100) of at least 30, and 4) absence of a known co-morbid medical condition.	NR
Yoder et al. 2006(78)	The following inclusion criteria were used: 1) a diagnosis of autistic disorder or PDD-NOS; 2) chronological age between 18 and 60 months; and 3) evidence of being nonverbal or low verbal	Children who demonstrated severe sensory or motor deficits or if primary language spoken in home was not English.
Fisher et al. 2005(74)	The following inclusion criteria were used: 1) mental age over 4 years 3 months, being a level of language at which normally developing children would be expected to pass false belief (FB) tasks and 2) had to fail at least two-thirds false belief tasks.	NR
Aldred et al. 2004(79)	The following inclusion criteria were used: 1) children were between 2.0 to 5.11 years at assessment and 2) children met full diagnostic criteria for autism using the ADI.	Children with severe global developmental delay; children with severe environmental deprivation in infancy; first language other than English; children with diagnosed visual impairment; know chronic psychiatric or physical illness in parents; and no evidence of any desire to interact with adult.
Solomon et al. 2004(82)	The following inclusion criteria were used: 1) children who met the diagnostic criteria for high functioning autism, Asperger's disorder, or PDD-NOS; 2) all children had to obtain I.Q. scores of 75 or above; 3) children needed to demonstrate that they were able to pass a measure of first order theory of mind—such as the Smarties false belief task.	NR
Sofronoff et al. 2004(80) Sofronoff and Farbotko 2002(81) ¹	NR	NR

Study	Inclusion Criteria	Exclusion Criteria
Drew et al. 2002(83)	The following inclusion criteria were used: 1) Children who met diagnostic criteria for autistic disorder based on the ADI-R and 2) children whose parents agreed to participate in randomized trial.	Children with severe global delay
Escalona et al. 2002(84)	Nonverbal children diagnosed with autism by the age of three using DSM-IV criteria.	NR
Field et al. 2001(85)	Nonverbal children diagnosed with autism ranging in age from 4 to 6 years.	NR

¹ Same patient population

ADI: Autism Diagnostic Interview

ADOS: Autism Diagnosis Observation Schedule

PDD-NOS: Pervasive developmental disorder not otherwise specified

PECS: Picture Exchange Communication System

Table 23. Baseline Characteristics of Children in Included Studies

Study	Group	Number of Children	Pretreatment Mean Age in Months (SD)	Gender (Number Boys)	Primary Diagnosis (Number of Children)	Autistic Symptom Severity (SD)	Overall I.Q. or D.Q. (SD)	Number of Nonverbal Children	Concurrent Treatment
Beaumont and Sofronoff 2008(75)	Junior Detective Program	26	115.68 (14.52)	NR	Asperger's syndrome(26)	Childhood Asperger Syndrome Test (CAST): 21.63 (3.51)	107.15 (11.94)	NR	NR
	Wait list control	23	117.72 (15.12)	NR	Asperger's syndrome(23)	CAST: 21.61 (2.78)	107.43 (14.21)	NR	NR
Solomon et al. 2008(76)	Parent-Child Interaction Therapy	10	98.4 (20.4)	10	Asperger's syndrome(6); high functioning autism (4)	ADOS: 13.1 (4.3)	100.11 (19.2)	All children possessed enough receptive and expressive language to participate in the intervention.	NR
	Waitlist control	9	97.2 (26.4)	9	Asperger's syndrome(2); high functioning autism (4); PDD-NOS (3)	ADOS: 11.3 (3.6)	93.4 (16.8)		NR
Howlin et al. 2007(46)	Immediate PEC	26	73.1 (15.8)	21	Autistic disorder or ASD	ADOS language impairment: 2.7 (1.4)	NR	All children had little to no functional language	All children were enrolled in autism-specific classes, which adopted an eclectic approach incorporating structured teaching, such as TEACCH.
	Delayed PEC	29	86.6 (12.7)	27	Autistic disorder or ASD	ADOS language impairment: 3.4 (0.8)	NR		
	No treatment	28	85.6 (13.6)	25	Autistic disorder or ASD	ADOS language impairment: 2.5 (1.5)	NR		

Study	Group	Number of Children	Pretreatment Mean Age in Months (SD)	Gender (Number Boys)	Primary Diagnosis (Number of Children)	Autistic Symptom Severity (SD)	Overall I.Q. or D.Q. (SD)	Number of Nonverbal Children	Concurrent Treatment
Kroeger et al. 2007(47)	Direct teaching social skills	13	65.0 (12.25)	9	Autistic disorder or ASD	GARs score: 92.15 (15.24)	NR	2 (15%)	NR
	Play activities social skills	12	61.42 (9.15)	11	Autistic disorder or ASD	92.58 (9.66)	NR	2 (17%)	NR
Rogers et al. 2006(77)	Communication curriculum of Denver Model	5	40.6 (10.2)	5	Autistic disorder	According to ADOS 1 Mild 3 Moderate 1 Severe	DQ: 47.6 (9.9)	NR	All children enrolled in preschool programs (hours ranged 4 to 30 hours per week) and speech therapy (hours ranged 30 minutes to 3 hours per week)
	PROMPT	5	36.2 (18.50)	5	Autistic disorder	According to ADOS 2 Mild 2 Moderate 1 Severe	DQ: 57.8 (22.5)	NR	
Yoder et al. 2006(78) ^{1,2}	PECS	18	33.6 (8.4)	31	Autistic disorder of PDD-NOS	NR	Cognitive score: 51 (5.3)	NR	Children on average attended 7.4 hours of speech-language therapy per week.
	RPMT	18							

Study	Group	Number of Children	Pretreatment Mean Age in Months (SD)	Gender (Number Boys)	Primary Diagnosis (Number of Children)	Autistic Symptom Severity (SD)	Overall I.Q. or D.Q. (SD)	Number of Nonverbal Children	Concurrent Treatment
Fisher and Happé 2005(74)	Theory of Mind	10	126 (36.24)	NR	26 children diagnosed with either autistic disorder or ASD and 1 child diagnosed with Asperger's Syndrome.	BPVS VMA: 7.23 (2.07) TROG VMA: 5.00 (0.61) Ravens CPM: 22.90 (7.23)	NR	NR	Most children (n = 26) were being educated in specialist schools for autistic children.
	Executive function	10	128.16 (32.16)	NR		BPVS VMA: 6.57 (1.51) TROG VMA: 5.35 (1.41) Ravens CPM: 24.60 (8.07)	NR	NR	
	No treatment	7	116.04 (20.76)	NR		BPVS VMA: 5.44 (1.14) TROG VMA: 4.49 (0.45) Ravens CPM: 20.57 (5.97)	NR	NR	

Study	Group	Number of Children	Pretreatment Mean Age in Months (SD)	Gender (Number Boys)	Primary Diagnosis (Number of Children)	Autistic Symptom Severity (SD)	Overall I.Q. or D.Q. (SD)	Number of Nonverbal Children	Concurrent Treatment
Aldred et al. 2004(79)	Social communication	14	Median age: 48 months (range: 29 to 60)	13	Autistic disorder	Median ADI score: 44 (range: 24 to 56) Median ADOS score: 16.5 (range: 11 to 21)	NR	NR	11 children received speech and language therapy, 1 child received ABA, 6 children received TEACCH, 9 children received some kind of social skills training, 6 received some kind of medical intervention, and 7 were on special gluten free diets

Study	Group	Number of Children	Pretreatment Mean Age in Months (SD)	Gender (Number Boys)	Primary Diagnosis (Number of Children)	Autistic Symptom Severity (SD)	Overall I.Q. or D.Q. (SD)	Number of Nonverbal Children	Concurrent Treatment
	Routine care	14	Median age: 51 months (range: 24 to 71)	12	Autistic disorder	Median ADI score: 38 (22 to 66) Median ADOS score: 16.5 (11 to 22)	NR	NR	12 children received speech and language therapy, 1 child received ABA, 8 children received TEACCH, 8 children received some kind of social skills training, 6 received some kind of medical intervention, and 7 were on special gluten free diets

Study	Group	Number of Children	Pretreatment Mean Age in Months (SD)	Gender (Number Boys)	Primary Diagnosis (Number of Children)	Autistic Symptom Severity (SD)	Overall I.Q. or D.Q. (SD)	Number of Nonverbal Children	Concurrent Treatment
Solomon et al. 2004(82) ³	Social skills group I	5	103 (range: 93 to 117)	5	3 children with AS, 1 with HFA, and 1 with PDD-NOS	Mean ADOS score: 9 (range: 7 to 14)	Mean VIQ: 126 (range: 93 to 117) Mean PIQ: 103 (range: 89 to 112) Mean FSIQ: 115 (99 to 124)	NR	NR
	Social skills group II	4	130 (range: 111 to 146)	4	2 children with HFA and 2 with AS	Mean ADOS score: 15 (range: 12 to 18)	Mean VIQ: 86 (range: 75 to 94) Mean PIQ: 88 (range: 63 to 115) Mean FSIQ: 86 (range: 75 to 100)	NR	NR
	Wait list control group I	5	100 (range: 88 to 117)	5	5 children with AS	Mean ADOS score: 9 (range: 7 to 13)	Mean VIQ: 121 (range: 92 to 142) Mean PIQ: 114 (range: 85 to 136) Mean FSIQ: 119 (range: 88 to 143)	NR	NR

Study	Group	Number of Children	Pretreatment Mean Age in Months (SD)	Gender (Number Boys)	Primary Diagnosis (Number of Children)	Autistic Symptom Severity (SD)	Overall I.Q. or D.Q. (SD)	Number of Nonverbal Children	Concurrent Treatment
	Wait list control group II	4	122 (range: 108 to 140)	4	2 children with HFA and 2 with AS	Mean ADOS score: 14 (11 to 17)	Mean VIQ: 82 (range: 59 to 91) Mean PIQ: 108 (range: 90 to 122) Mean FSIQ: 119 (range: 88 to 143)	NR	NR
Sofronoff et al. 2004(80) Sofronoff and Farbotko 2002(81) ⁴	Parent training workshop	18 parents	112 months (range: 72 to 144)	NR	Asperger's disorder	NR	NR	NR	NR
	Parent training individual intervention	18 parents							
	Wait list	20 parents							

Study	Group	Number of Children	Pretreatment Mean Age in Months (SD)	Gender (Number Boys)	Primary Diagnosis (Number of Children)	Autistic Symptom Severity (SD)	Overall I.Q. or D.Q. (SD)	Number of Nonverbal Children	Concurrent Treatment
Drew et al. 2002(83)	Parent training	12	21.4 (2.7)	11	Of the 46 children assessed to participate, 31 had a diagnosis of autistic disorder and 5 atypical autism or PDD-NOS	ADI-R Reciprocal social interaction score: 19.6 (3.0) ADI-R Nonverbal communication score: 12.8 (1.6) ADI-R Repetitive and stereotyped behavior score: 3.2 (1.1)	Non-verbal I.Q. from Griffiths Scale of Mental Development: 88.1 (11.2)	11	6.3 hours per week in playgroup or nursery, 0.6 hours per week in speech and language therapy, and 8.4 hours per week in other intervention (for 3 children other intervention included intensive applied behavior analysis)
	Local services	12	23.6 (3.8)	12		ADI-R Reciprocal social interaction score: 20.3 (4.5) ADI-R Nonverbal communication score: 12.0 (2.4) ADI-R Repetitive and stereotyped behavior score: 3.7 (1.6)	Non-verbal I.Q. from Griffiths Scale of Mental Development:: 66.0 (16.5)	11	3.5 hours per week in playgroup or nursery, 0.3 hours per week in speech and language therapy, and 0.3 hours per week in other intervention.
Escalona et al. 2002(84)	Imitation	10	Girls: 57.6 (NR)	12	Autism (20)	CARS: 38	NR	20	NR
	Contingent responsivity	10	Boys: 66.0 (NR)			CARS: 37			

Study	Group	Number of Children	Pretreatment Mean Age in Months (SD)	Gender (Number Boys)	Primary Diagnosis (Number of Children)	Autistic Symptom Severity (SD)	Overall I.Q. or D.Q. (SD)	Number of Nonverbal Children	Concurrent Treatment
Field et al. 2001(85)	Imitation	10	64.8 (NR)	10	Autism (20)	Psychoeducational Profile Revised (PEP-R): 18.8 (NR)	NR	20	NR
	Contingent responsivity	10							

¹ Descriptive information about participants was not reported separately for each treatment group (PECS vs. RPMT).

² Cognitive score is based on the Mullen Scales of Early Learning.

³ I.Q. measured using either the Wechsler series of Intelligence Scales for Children or the Wechsler Abbreviated Scale of Intelligence.

⁴ Same patient population.

ADOS: Autism Diagnosis Observation Schedule
AS: Asperger's disorder
ASD: Autism Spectrum Disorder
BPVS VMA: British Picture Vocabulary Scale Verbal Mental Age
DQ: Developmental quotient (mental age/chronological /100)
FSIQ: Full scale I.Q.
GARS: Gilliam Autism Rating Scale
HFA: High functioning autism
PDD-NOS: Pervasive developmental disorder not otherwise specified
PEC: Picture Exchange Communication System
PIQ: Performance I.Q.
PROMPT: Prompts for Restructuring Oral Muscular Phonetic Targets
Raven's CPM: Raven's Colored Progressive Matrices (reported as raw score)
RPMT: Responsive Education and Prelinguistic Milieu Teaching
SD: Standard deviation
TEACCH: Treatment and Education of Autistic and Related Communication Handicapped Children
TROG VMA: Test for Reception of Grammar Verbal Mental Age
VIQ: Visual I.Q.

Appendix G. Treatment Characteristics and Individual Study Results Addressing Key Question 1

Table 24. Treatment Characteristics for Key Question 1

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
Beaumont and Sofronoff 2008(75)	Junior Detective Program	There are four components to this intervention: computer game to teach emotion recognition, emotion regulation and social interaction; small group therapy sessions gave subjects an opportunity to practice skills learned on the computer and provided additional step-by-step guidance on how to solve social problems; parent training sessions to guide parents in how to reward their child for using their newly learned skills: and teacher handouts, also used to encourage the use of newly acquired skills.	Clinic	Introductory session: 2 hours in which parents and children learned the computer game; sessions 1 and 2: 2 hours each, one hour using the computer game and the second hour for either parent training or small group therapy; session 3 and 4: 45 minutes of computer time and 75 minutes of small; sessions 5 and 6 only small group therapy/parent session time; session 7 and the 6 week follow-up consisted of one hour of small group therapy/parent session time and one hour of reassessment time.	Varied.	Each child group consisted of two therapists and three children. The therapists were interns enrolled in post-graduate clinical psychology and counseling degree programs.	The chief investigator and two therapists were available to assist families with conceptual or technical difficulties. Treatment fidelity was monitored using checklists and 25% of sessions were videotaped and examined by two independent raters to insure agreement between the checklists and their observations.	8 sessions conducted over 7 weeks; follow up occurred at the end of treatment, at 6 week and 5 month follow-up

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
	Wait list control	No treatment	NA	NA	NA	NA	NA	7 week study; follow up occurred at 6 weeks and 5 months post treatment
Solomon et al. 2008(76)	Parent-Child Interaction Therapy	PCIT is a highly structured training program which relies on behavioral principles to help parents change their child's problem behaviors.	Clinic	Phase 1: During the child directed interaction phase, therapists coached parents in how to respond to their children using a "bug in the ear" microphone behind a one-way mirror. Parents were taught to be attuned to their children by giving positive attention; ignoring negative behaviors; avoiding criticism, discipline, making requests, giving commands and asking questions. To modify PCIT for an ASD population, parents were also instructed to prohibit children with intense/inappropriate interests from talking on these topics and praise them when they initiated social	Mean sessions: 12.7	Therapists either received 6 months of PCIT training from master PCIT trainers at U.C. Davis Children's Hospital or worked on at least 3 cases with trained therapists.	Although fidelity to the treatment model was not formally measured, fidelity was reviewed at each of the team coding meetings over the course of the study.	Mean sessions: 12.7

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
				interactions. In phase 2, parent-directed interaction, therapists coached parents in how to give clear direct, concise, age appropriate simple commands and to consistently reinforce child compliance.				
	Wait list control	No treatment	NA	NA	NA	NA	NA	NR
Howlin et al. 2007(46) ¹	Immediate PECS and Delayed PECS	PECS aims to teach spontaneous social-communication skills by means of symbols or pictures and teaching relies on behavioral principles, particularly reinforcement.	Treatment took place primarily in the classroom	Teachers, parents, support staff, and speech language therapists (mean 5.1, standard deviation 0.6, for all except parents for which the mean was 3.2 standard deviation 2.4) attended 13 hours of training over the course of two days in PECS by expert consultants and were provided with 6 half day consultation visits	NR	Primarily teachers	Consultants provided encouraged teachers to facilitate children's use of PECS and every attempt was made to make sure teachers adhered to the manualized principles and practices of PECS.	20 weeks

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
				once a month over 5 months.				
	No treatment group (NTG)	Children did not receive PEC, but were enrolled in autism-specific classes, which adopted an eclectic approach incorporating structured teaching, such as TEACCH. Authors noted that teachers in NTG group were not naïve to PECS and some form of PECS or picture symbols was evident.	Classroom instruction	Structured teaching	NR	NR	NR	20 weeks
Kroeger et al. 2007(47)	Structured social skills intervention	The structured or direct teaching group received video modeling instruction for half of the time during each session and was then prompted to generalize skills learned in the video during remainder of each session.	Classroom	Group instruction	15 hours in 15 sessions (mean sessions attended 14.08)	Group facilitators were graduate and undergraduate students in psychology	Students were supervised by primary author of study.	5 weeks

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
	Usual services	Unstructured play group	Classroom	Group instruction	15 hours in 15 sessions (mean sessions attended 14.42)	Group facilitators were graduate and undergraduate students in psychology	Students were supervised by primary author of study.	5 weeks
Fisher and Happé 2005(74)	Theory of Mind training	The training was based on a strategy of thinking about beliefs as “photos in the head.” The methods included use of toys, illustrative stories and introduction of perspectives. Children were trained to criterion.	Classroom	One-to-one	25 minute daily (about 2 hours/week) sessions lasting 4 to 10 days, depending on whether the child met program criteria.	NR	NR	4 to 10 days, depending on when child met program criteria.
	No treatment group (NTG)	The NTG group did not receive active intervention, but were enrolled in specialists schools for autistic children	Classroom	NR	NR	NR	NR	NR
Solomon et al. 2004(82) ¹	Social skills curriculum	Treatment focused on improving participant’s performance on facial expression recognition, theory of mind, and problem solving. The curriculum was divided into two ten week modules, with module 1 focusing on knowledge of	University clinic (M.I.N.D. Institute at the University of California Davis Medical Center	Group sessions	1.5 hours per week (total of 30 hours of treatment)	Social skills group leaders consisted of psychologists, a psychiatrist, and a speech and language pathologist assisted by a male university student who videotaped each session. Parents	Group leaders met on a weekly basis to review tapes and consult about speech and language, sensory, and emotional issues arising in groups.	20 weeks

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
		feelings, non-verbal communication, and conversational skills and module 2 focusing on friendship skills and problem solving. Methods of teaching included modeling and role playing.				served as co-therapists and participated in a psychoeducation group.		
	Wait list control	NR	NR	NR	NR	NR	NR	NR
Aldred et al. 2004(79)	Social communication intervention	Treatment aims to increase the quality of parental adaptation and communication with children with autism by facilitating the child's active communication exchanges and signaling pragmatic intentions. Methods used during therapy sessions included focusing (establishing coordinated attention between parent and child), sensitivity (decreasing intrusive demands made on child), modeling, consolidation (or rehearsing), and elaboration.	Clinic	Parents initially participated in group psychoeducation sessions. Parents and children attended monthly individual treatment sessions.	Parents and children attended monthly sessions for 6 months (time per week or session not reported) followed by a further six months of less frequent sessions. Parents were instructed to spend 30 minutes per day with their child teaching methods taught in therapy sessions.	NR	NR	52 weeks

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
	Routine care	12 children received speech and language therapy, 1 child received ABA, 8 children received TEACCH, 8 children received some kind of social skills training, 6 received some kind of medical intervention, and 7 were on special gluten free diets.	NR	NR	NR	NR	NR	52 weeks
Sofronoff et al. 2004(80) Sofronoff and Farbotko, 2002(81) ^{1,2}	A parent training program focusing on reduction of problem behaviors of children with Asperger's disorder.	The intervention included training parents on the following 6 components: psychoeducation, comic strip conversations, social stories, strategies in managing problem behaviors, strategies for managing rigid behaviors, and strategies for managing anxiety.	Treatment was provided in the home.	Parents either received training through a one-day workshop or	Parent training 6 hours. Hours per week of treatment provided not reported.	Primarily parents	NR	4 weeks
	Wait list control	NR	NR	NR	NR	NR	NR	NR

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
Drew et al. 2002(83)	A parent training program focusing on social pragmatic joint attention.	Parents given advice about behavioral management and promoting compliance using reinforcement and trained using specific activities such as mirror games, index finger pointing in picture book, and nursery rhymes to teach children joint attention behaviors, wholistic learning of language, and motivation to learn.	Home (the program was integrated into everyday routines, such as mealtimes, dressing, washing and bedtime.	Parents participated in group training.	NR	Primarily parents	Parents received supervision/consultation from a speech and language therapist who visited the home every 6 weeks for a 3-hour session. Therapists were also available via telephone.	52 weeks
	Local services only	3.5 hours per week in playgroup or nursery, 0.3 hours per week in speech and language therapy, and 0.3 hours per week in other intervention.	Clinic or nursery	NR	4.1	NR	NR	52 weeks
Escalona et al. 2002(84)	Imitation	Four phases with each phase lasting 3 minutes. In phase 1, a stranger acts like a statue. In phase 2, the stranger imitates all the child's behaviors. In phase 3, the adult again acts like a statue. In phase 4, the stranger and child engage in spontaneous play.	laboratory	Researcher administered treatment	12 minute sessions	Laboratory researcher	Two researchers observed videotapes of the treatment sessions and coded the behaviors observed.	1 session, duration of treatment 12 minutes total.

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
	Contingent responsivity	Four phases with each phase lasting 3 minutes. In phase 1, a stranger acts like a statue. In phase 2, the stranger is contingently responsive to the child's behavior. In phase 3, the adult again acts like a statue. In phase 4, the stranger and child engage in spontaneous play.	laboratory	Researcher administered treatment	12 minute sessions	Laboratory researcher	Two researchers observed videotapes of the treatment sessions and coded the behaviors observed.	1 session, duration of treatment 12 minutes total.
Field et al. 2001(85)	imitation	Four phases with each phase lasting 3 minutes. In phase 1, a stranger acts like a statue. In phase 2, the stranger imitates all the child's behaviors. In phase 3, the adult again acts like a statue. In phase 4, the stranger and child engage in spontaneous play.	laboratory	Researcher administered treatment	12 minute sessions	Laboratory researcher	Researcher is observed by a second researcher through a one-way mirror and given cues on when each phase starts and stops.	3 sessions, duration of treatment NR
	Contingent responsivity	Four phases with each phase lasting 3 minutes. In phase 1, a stranger acts like a statue. In phase 2, the stranger is contingently responsive to the child's behavior. In phase 3, the adult	laboratory	Researcher administered treatment	12 minute sessions	Laboratory researcher	Researcher is observed by a second researcher through a one-way mirror and given cues on when each phase starts and stops.	3 sessions, duration of treatment NR

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
		again acts like a statue. In phase 4, the stranger and child engage in spontaneous play.						

¹ Intervention group compared to a no treatment or routine care control group in which children received the same services with exception to the intervention as children in the intervention group.

² Intervention group compared to wait list control. Authors of the study did not report what, if any, services children in the wait list control group were receiving.

³ Same patient population

PECS: Picture Exchange Communication System

Table 25. Language/Communication Skills of Studies Addressing Key Question 1

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Last Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) and p-values
Howlin et al. 2007(46)	Observation of frequency of child communication initiations): as an ordinal variable rate per minute, 0 per minute, 0.01 to 0.50, 0.51 to 1.00 and >1 per minute.	Immediate treatment with PECS	26	NR ^b	Immediately post-treatment, children who received PECS were 2.73 times more likely to have been in higher initiation rate group than children who received no treatment (95% CI 1.22-6.08) p <0.05; 51.8% of children in the active treatment groups moved up by one or more categories, 28.6% showed no change and 19.6% moved down following treatment vs. 25.0%, 35.7% and 39.3% respectively in the control group. ^a	By the last follow-up, the immediate treatment group was no more likely to be in a higher initiation rate category than controls (OR = 1.08, 95% CI 0.30 to 3.90) p = 0.91. ^a	Could not be calculated. ^b
		Delayed PECS treatment	29				
		Control	28				

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Last Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) and p-values
Howlin et al. 2007(46)	Observation of frequency of speech (including non-word vocalizations): as an ordinal variable rate per minute, 0 per minute, 0.01 to 0.50, 0.51 to 1.00 and >1 per minute.	Immediate treatment with PECS	26	NR ^b	There was no significant main effect of treatment on rate of speech (OR = 1.10, 95% CI 0.46-2.62, p = 0.83). ^a	There was no significant main effect of treatment on rate of speech (OR = 1.10, 95% CI 0.46-2.62, p = 0.83). ^a	Could not be calculated. ^b
		Delayed PECS treatment	29				
		Control	28				
Howlin et al. 2007(46)	Observation of frequency of PECS use: as an ordinal variable rate per minute, 0 per minute, 0.01 to 0.50, 0.51 to 1.00 and >1 per minute.	Immediate treatment with PECS	26	NR ^b	Children receiving PECS were 3.90 times (95% CI 1.75 to 8.68, p <0.001) more likely to be in a higher PECS use category than controls; 58.9% of treated children moved up one or more categories, 26.8% stayed the same and 14.3% moved down one or more categories following treatment vs. 32.0%, 46.4% and 21.5% respectively for controls from pre-test to immediately post-treatment. ^a	By final follow-up, the immediate treatment group was no more likely than controls to be in a higher PECS rate category (OR = 1.56, 95% CI 0.46 to 5.30, p = 0.48). ^a	Could not be calculated. ^b
		Delayed PECS treatment	29				
		Control	28				

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Last Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) and p-values
Howlin et al. 2007(46)	Expressive One Word Picture Vocabulary Test	Immediate treatment with PECS	26	NR	There was no significant effect of treatment (OR = 1.01, 95% CI 0.89 to 1.15, p = 0.87). ^a	There was no significant effect of treatment (OR = 1.01, 95% CI 0.89 to 1.15, p = 0.87). ^a	Could not be calculated.
		Delayed PECS treatment	29				
		Control	28				
Howlin et al. 2007(46)	British Picture Vocabulary Scales	Immediate treatment with PECS	26	NR	There was no significant effect of treatment (OR = 1.54, 95% CI 0.52 to 4.54, p = 0.44). ^a	There was no significant effect of treatment (OR = 1.54, 95% CI 0.52 to 4.54, p = 0.44). ^a	Could not be calculated.
		Delayed PECS treatment	29				
		Control	28				
Howlin et al. 2007(46)	ADOS-G-Communication Domain	Immediate treatment with PECS	26	Immediate treatment: 2.7 (1.4) Delayed treatment: 3.4 (0.8) Control: 2.5 (1.5)	There was no significant effect immediately following treatment (OR = 0.52, 95% CI = 0.24 to 1.12, p = 0.10). ^a	NR ^b	Could not be calculated. ^b
		Delayed PECS treatment	29				
		Control	28				
Aldred et al. 2004(79)	Autism Diagnostic Observation Schedule – communication domain	Social communication intervention	14	NR	No significant treatment effect was found. ^a	Same as previous	Could not be calculated.
		Routine care	14				

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Last Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) and p-values
Aldred et al. 2004(79) ¹	MacArthur Communication Development Inventory – language comprehension	Social communication intervention	14	71.7 (2383)	222.7 (40431)	Same as previous	NC
		Routine care	14	95.4 (426)	146.8 (11426)	Same as previous	
Aldred et al. 2004(79) ¹	MacArthur Communication Development Inventory – expressive language	Social communication intervention	14	28.0 (467)	199.4 (25606)	Same as previous	NC
		Routine care	14	25.6 (683)	33.1 (683)	Same as previous	
Aldred et al. 2004(79)	Observation of parent-child communicative acts	Social communication intervention	14	30.8 (10.2)	37.6 (10.1)	Same as previous	Hedges' g = 0.719 (-0.024 to 1.463, p = 0.058)
		Routine care	14	30.1 (11.1)	27.6 (16.5)	Same as previous	
Aldred et al. 2004(79)	Observation of parent-child shared attention	Social communication intervention	14	72.0 (23.6)	77.6 (17.8)	Same as previous	Hedges' g = 0.219 (-0.502 to 0.941, p = 0.552)
		Routine care	14	62.8 (24.5)	62.6 (32.7)	Same as previous	
Aldred et al. 2004(79)	Vineland Adaptive Behavior Scale – communication subdomain	Social communication intervention	14	22.6 (13.3)	36.9 (21.2)	Same as previous	Hedges' g = 0.326 (-0.399 to 1.050, p = 0.378)
		Routine care	14	20.0 (10.8)	28.7 (16.6)	Same as previous	
Drew et al. 2002(83)	MacArthur Communicative Development Inventory (CDI) words understood	Parent training in joint attention/joint action routines/behavioral management	12	52.0 (60.5)	176.1 (121.9)	Same as previous	Hedges' g = 0.799 (-0.042 to 1.640, p = 0.063)
		Local services	10 ^c	53.0 (63.7)	100.3 (80.2)	Same as previous	

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Last Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) and p-values
Drew et al. 2002(83)	MacArthur Communicative Development Inventory (CDI) words said	Parent training in joint attention/joint action routines/behavioral management	12	6.8 (20.9)	96.6 (118.8)	Same as previous	Hedges' g = 0.580 (-0.245 to 1.406, p = 0.168)
		Local services	10 ^c	6.6 (13.7)	44.0 (50.2)	Same as previous	
Drew et al. 2002(83)	MacArthur Communicative Development Inventory (CDI) total gestures produced	Parent training in joint attention/joint action routines/behavioral management	12	20.9 (7.0)	38.6 (12.5)	Same as previous	Hedges' g = 0.661 (-0.170 to 1.492, p = 0.119)
		Local services	10 ^c	20.9 (14.4)	29.1 (18.4)	Same as previous	
Drew et al. 2002(83)	Griffith Scale of Infant Development: nonverbal IQ subscales D and E	Parent training in joint attention/joint action routines/behavioral management	12	88.1 (11.2)	77.9 (14.8)	Same as previous	Hedges' g = 0.655 (-0.140 to 1.449, p = 0.106)
		Local Services	12	66.0 (16.5)	66.1 (17.1)	Same as previous	
Drew et al. 2002(83)	Autism Diagnostic Interview Revised – nonverbal communication score	Parent training in joint attention/joint action routines/behavioral management	12	12.8 (1.6)	11.0 (2.8)	Same as previous	Hedges' g = 0.713 (-0.085 to 1.511, p = 0.080)
		Local Services	12	12.0 (2.4)	11.9 (1.8)	Same as previous	
Drew et al. 2002(83)	Autism Diagnostic Interview Revised – overall language rating	Parent training in joint attention/joint action routines/behavioral management	12	# nonverbal 11	# nonverbal 4	Same as previous	Odds Ratio = 7.875 (1.105 to 56.123, p = 0.039).
		Local Services	12	# nonverbal 11	# nonverbal 9	Same as previous	

¹ The standard deviations presented in the table are those reported by the authors of the study. Because the values for the standard deviations are unusually high, we did not calculate individual study effect size estimates for this outcome.

^a Calculations were done by study author, not ECRI Institute.

^b Data presented in graph form, but not in a format needed to calculate an effect size.

^c Only 10/12 parents in the local service arm of study completed this instrument.

NC Not calculated

Table 26. Learning Readiness Studies Addressing Key Question 1

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Last Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) and p-values
Kroeger et al. 2007(47)	ABLLS	Group delivered social skills intervention	13 children	NR	Both groups improved by post-treatment ($F(1,23) = 14.843$, $p = 0.001$); the social skills group did not show more improvement than the unstructured play group ($F(1,23) = 3.270$, $p = 0.084$). ^a	Same as previous	Could not be calculated.
		Unstructured play	12 children				

^a Calculations were done by study author, not ECRI Institute.

ABLLS: Assessment of Basic Language and Learning Skills

Table 27. Social Skills Studies Addressing Key Question 1

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Beaumont and Sofronoff 2008(75)	Social Skills Questionnaire (SSQ) parent report	Junior Detective Program	26	25.30 (7.43)	38.08 (9.84)	NR	Hedge's g: 1.22 (0.619 to 1.824) p <0.001
		Wait list control	23	23.16 (9.05)	25.11 (7.91)		
Beaumont and Sofronoff 2008(75)	Emotion Regulation Social Skills Questionnaire (ERSSQ)	Junior Detective Program	26	39.78 (10.17)	57.83 (13.40)	NR	Hedge's g: 1.41 (0.792 to 2.029) p <0.001
		Wait list control	23	39.64 (12.52)	40.14 (10.69)		
Beaumont and Sofronoff 2008(75)	Emotion Recognition from a facial expression (Spence, 1995)	Junior Detective Program	26	17.44 (2.67)	19.92 (2.67)	NR	Hedge's g: 0.389 (-0.169 to 0.946) p = 0.172
		Wait list control	23	18.30(2.46)	19.73 (2.80)		
Beaumont and Sofronoff 2008(75)	Emotion Recognition from body posture (Spence, 1995)	Junior Detective Program	26	20.48 (3.15)	21.81 (2.97)	NR	Hedge's g: 0.332 (-0.224 to 0.888) p = 0.242
		Wait list control	23	20.96(2.44)	21.32 (2.82)		
Beaumont and Sofronoff 2008(75)	Dylan is being teased	Junior Detective Program	26	2.93 (1.62)	5.08 (2.23)	NR	Hedge's g: 1.244 (0.639 to 1.848) p <0.001
		Wait list control	23	2.78 (1.59)	2.64 (1.56)		
Beaumont and Sofronoff 2008(75)	James and the math test	Junior Detective Program	26	1.70 (1.07)	3.81 (1.58)	NR	Hedge's g: 1.408 (0.790 to 2.207) p <0.001
		Wait list control	23	1.74 (1.21)	2.00 (1.11)		

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Solomon et al. 2008(76)	Behavior Assessment System for Children Parent Rating Scales (BASC) – social scale adaptability	PCIT	10	23.90 (7.91)	32.40 (10.23)	Same as previous	Hedge's g: 0.999 (0.082 to 1.916, p = 0.033)
		Wait list control	9	28.44 (6.48)	27.33 (10.38)		
Solomon et al. 2008(76)	Behavior Assessment System for Children Parent Rating Scales (BASC) – social scale social skills	PCIT	10	30.20 (3.77)	37.40 (5.80)	Same as previous	Hedge's g: 0.632 (-0.251 to 1.516, p = 0.161)
		Wait list control	9	35.00 (10.52)	37.33 (6.91)		
Solomon et al. 2008(76)	Behavior Assessment System for Children Parent Rating Scales (BASC) – social scale leadership	PCIT	10	36.20 (4.02)	38.10 (6.15)	Same as previous	Hedge's g: 0.310 (-0.556 to 1.175. p = 0.483)
		Wait list control	9	33.89 (6.07)	37.56 (4.72)		

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Howlin et al. 2007(46)	ADOS-G Reciprocal Social Interaction Domain	Immediate treatment with PECS	26	NR ^b	There was no significant effect immediately following treatment (OR = 0.55, 95% CI 0.25 to 1.19, p = 0.13). ^a	At the 10 month follow-up of the immediate treatment group, there was a significant effect (OR = 0.28, 95% CI 0.09 to 0.89, p <0.05) indicating that treatment was associated with a decrease in the severity score, with children 3.57 times more likely to be in a lower ordinal category. ^a	Could not be calculated. ^b
		Delayed PECS treatment	29				
		Control	28				

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Kroeger et al. 2007(47)	Observation of frequency of prosocial behaviors (initiating, responding, interacting, mean prosocial behaviors) using the Social Interaction Observation Code	Group delivered social skills intervention	13 children	NR ^b	Both groups significantly improved in the frequency of prosocial behaviors; Increases in both groups occurred for initiating behaviors (F (1,23) = 13.234, p = 0.001) responding behaviors (F(1,23) = 9.878, p = 0.005) and interacting (F (1,23) = 12.035, p = 0.002). However, the social skills group improved significantly more than the unstructured play group: initiating (F (1,23) = 6.287, p = 0.020), responding (F (1,23) = 11.243, p = 0.003), and interacting (F (1,23) = 9.324, p = 0.006). ^a The effect sizes for the three interaction effects were: $n^2 = 0.215$ for initiating, $n^2 = 0.328$ for responding, and $n^2 = 0.288$ for interacting. ^{a, d}	Same as previous	Could not be calculated. ^b
		Unstructured play group	12 children				

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Aldred et al. 2004(79)	Autism Diagnostic Observation Schedule – reciprocal social interaction domain	Social communication intervention	14	10.1 (2.7)	7.7 (3.8)	Same as previous	Hedges' g = 0.965 (0.203 to 1.727, p = 0.013)
		Routine care	14	9.8 (3.3)	10.7 (3.2)	Same as previous	
Sofronoff et al. 2004 and 2002(80,81)	Social Skills Questionnaire	One day parent training workshop	18	23.66 (8.92)	30.72 (8.58)	31.00 (9.01)	Pre to post- treatment Hedges' g = 1.045 (0.331 to 1.760, p = 0.004)
		6 individual session parent training	18	25.22 (10.01)	33.00 (7.37)	36.61 (8.24)	
		control	15	25.07 (6.64)	23.60 (9.14)	24.27 (8.57)	Pre to final follow-up Hedges' g = 1.379 (0.663 to 2.126, p = 0.000). ^e
Solomon et al. 2004(82)	Diagnostic Analysis of Non-Verbal Accuracy 2, Adult Facial Expressions	Social adjustment enhancement curriculum and psychoeducational parent training	5 younger children	12.2 (1.1)	13.4 (1.1)	Same as previous	Younger children Hedges' g = 1.041 (-0.168 to 2.250, p = 0.092) Older children Hedges' g = 1.092 (-0.226 to 2.441, p = 0.104).
			4 older children	10.5 (1.3)	12.8 (2.9)		
		Control	5 younger children	11.8 (2.2)	11.2 (1.3)		
			4 older children	12.4 (1.3)	11.8 (2.4)		

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Solomon et al. 2004(82)	Diagnostic Analysis of Non-Verbal Accuracy 2, Child Facial Expressions	Social adjustment enhancement curriculum and psychoeducational parent training	5 younger children	11.6 (1.5)	13.2 (1.8)	Same as previous	Younger children Hedges' g = 1.063 (-0.150 to 2.275, p = 0.086) Older children Hedges' g = 0.435 (-0.789 to 1.658, p = 0.486)
			4 older children	12.0 (2.4)	12.0 (1.8)		
		Control	5 younger children	13.0 (1.2)	12.8 (1.5)		
			4 older children	12.8 (0.9)	11.8 (2.1)		
Drew et al. 2002(83)	Autism Diagnostic Interview Revised – reciprocal social interaction	Parent training in joint attention/ joint action routines/ behavioral management	12	19.6 (3.0)	18.3 (4.9)	Same as previous	Hedges' g = 0.245 (-0.531 to 1.020, p = 0.536).
		Local services	12	20.3 (4.5)	20.1 (4.3)	Same as previous	
Escalona et al. 2002(84)	Time spent in motor activity	Imitation	10	NR	Post hoc ANOVA and Bonferroni t-tests found the imitation group decreased its motor activity time (t = 3.55, p <0.01) from 6.2% to 2.1% vs. 4.4% to 4.3% for the contingently responsive group. ^a	Same as previous	Could not be calculated
		Contingent responsivity	10	NR		Same as previous	

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Escalona et al. 2002(84)	Time spent in motor activity	Imitation	10	NR	Post hoc ANOVA and Bonferroni t-tests found the imitation group spent less time in silence ($t = 1.96$, $p < 0.05$), from 85.3% to 81.2% vs. 84.7% to 77.9% for the contingently responsive group. ^a	Same as previous	Could not be calculated
		Contingent responsivity	10	NR		Same as previous	
Escalona et al. 2002(84)	Time spent looking at an adult	Imitation	10	NR	Post hoc ANOVA and Bonferroni t-tests found the imitation group increased its time spent looking at an adult ($t = 1.79$, $p < 0.05$) from 7.9% to 6.0% vs. 2.6% to 5.1% for the contingently responsive group, which simply increased the contingently responsive group to the initial level observed in the imitation group. ^a	Same as previous	Could not be calculated
		Contingent responsivity	10	NR		Same as previous	

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Escalona et al. 2002(84)	Time spent distant from an adult	Imitation	10	NR	Post hoc ANOVA and Bonferroni t-tests found both groups showed a decrease in the distance from an adult (t = 3.18, p <0.01) from 91.8% to 69.6% vs. 94.6% to 68.6%. ^a	Same as previous	Could not be calculated
		Contingent responsivity	10	NR		Same as previous	
Escalona et al. 2002(84)	Time spent touching an adult	Imitation	10	NR	Post hoc ANOVA and Bonferroni t-tests found the imitation group increased its time touching an adult more than the contingently responsivie group (t = 1.98, p <0.05) from 0.1% to 0.9% vs. 0% to 0.2%. ^a	Same as previous	Could not be calculated
		Contingent responsivity	10	NR		Same as previous	
Field et al. 2001(85)f	Mean percent of time subjects accepted an object	Imitation	10	0.0 (NR)	3.0 (NR)	0.0 (NR)	Could not be calculated.
		Contingent responsivity	10	0.7 (NR)	1.2 (NR)	0.9 (NR)	

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Field et al. 2001(85)f	Mean percent of time subjects played with an object	Imitation	10	60.3 (NR)	90.6 (NR)	80.8 (NR)	Could not be calculated.
		Contingent responsivity	10	54.9 (NR)	62.3 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent more time playing with objects (t = 4.93, p <0.001). ^a	71.5 (NR)	
Field et al. 2001(85)f	Mean percent of time subjects looked at an adult	Imitation	10	4.5 (NR)	20.0 (NR)	15.7 (NR)	Could not be calculated.
		Contingent responsivity	10	3.9 (NR)	7.8 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent more time looking at an adult (t = 7.33, p <0.001). ^a	9.3 (NR)	
Field et al. 2001(85)f	Mean percent of time subjects engaged in mirror play	Imitation	10	1.0 (NR)	6.5 (NR)	10.7 (NR)	Could not be calculated.
		Contingent responsivity	10	2.1(NR)	4.2 (NR)	5.8 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent more time in mirror play (t = 2.05, p <0.05). ^a	

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Field et al. 2001(85)f	Mean percent of time subjects smiled/laughed	Imitation	10	0.1 (NR)	8.9 (NR)	4.3 (NR)	Could not be calculated
		Contingent responsivity	10	0.4 (NR)	3.2 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent more time smiling at an adult (t = 4.42, p <0.001). ^a	2.7 (NR)	
Field et al. 2001(85)f	Mean percent of time subjects vocalized	Imitation	10	5.0 (NR)	11.0 (NR)	7.3 (NR)	Could not be calculated
		Contingent responsivity	10	6.7 (NR)	7.2 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent more time vocalizing (t = 2.58, p <0.01). ^a	5.8 (NR)	
Field et al. 2001(85)f	Mean percent of time subjects were proximal to an adult	Imitation	10	0.7 (NR)	0.7 (NR)	3.3 (NR)	Could not be calculated
		Contingent responsivity	10	0.5 (NR)	0.9 (NR)	1.7 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent more time proximal to an adult (t = 2.45, p <0.05). ^a	

Study	Instrument	Treatment	Group	Baseline Score Mean (SD)	Post-treatment Score Mean (SD)	Final Follow-up Mean (SD)	Post-treatment Between Group Effect Size Estimate Hedges' g or Odds Ratio (95% CI) p value
Field et al. 2001(85) ^f	Mean percent of time subjects were sitting next to an adult	Imitation	10	0.1 (NR)	1.0 (NR)	7.1 (NR)	Could not be calculated
		Contingent responsivity	10	0.4 (NR)	0.5 (NR)	0.8 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent more time sitting next to an adult (t = 2.85, p <0.01). ^a	
Field et al. 2001(85) ^f	Mean percent of time subjects were touching an adult	Imitation	10	0.0 (NR)	0.0 (NR)	6.2 (NR)	Could not be calculated
		Contingent responsivity	10	0.0 (NR)	0.0 (NR)	1.2 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent more time touching an adult (t = 3.47, p <0.001). ^a	
Field et al. 2001(85) ^f	Mean percent of time subjects engaged in reciprocal play	Imitation	10	0.0 (NR)	6.7 (NR)	7.1 (NR)	Could not be calculated
		Contingent responsivity	10	0.2 (NR)	3.1 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent more time engaging in reciprocal play (t = 4.06, p <0.001). ^a	3.2 (NR)	

^a Calculations were done by study author, not ECRI Institute.

^b Data presented in graph form, but not in a format needed to calculate an effect size.

^c Data for mean prosocial initiations were presented in a graph, but not in a format needed to accurately calculate an effect size due to poor quality of the figure.

^d This measure of effect size is based on Cohen, J (1988) Statistical power analysis for the behavioral sciences. Hillsdale, NJ: Earlbaum.

^e Effect size estimates based on individual session training and control.

^f This study compared the results after one treatment session to the results after two treatment sessions and then after the third and final treatment session; post-treatment is after two treatment sessions, final follow-up is after the third and final session and what is included in the baseline column above is actually the results after one treatment session.

Table 28. Problem Behavior Studies Addressing Key Question 1

Study	Instrument	Treatment	Number	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Solomon et al. 2008(76)	Eyberg Child Behavior Inventory – intensity of problem behaviors	PCIT	10	67.00 (5.64)	59.70 (4.95)	Same as previous	Hedge's g: 0.492 (-0.383 to 1.366, $p = 0.270$)
		Wait list control	9	65.67 (8.80)	62.22 (9.77)		
Solomon et al. 2008(76)	Eyberg Child Behavior Inventory – degree to which parents perceive problem	PCIT	10	62.90 (6.30)	52.00 (6.52)	Same as previous	Hedge's g: 0.946 (0.034 to 1.857, $p = 0.042$)
		Wait list control	9	66.78 (8.51)	63.00 (7.31)		
Aldred et al. 2004(79)	Autism Diagnostic Observation Schedule – stereotyped and restricted behavior domain	Social communication intervention	14	1.9 (Range 0-6)	1.3 (Range 0-6) and 2.2 (Range 0-6), respectively. There were non-significant differential changes in this outcome ($F_{1,25} = 3.25$, $p = 0.084$). ^a	Same as previous	Could not be calculated.
		Routine care	14	1.8 (Range 0-6)		Same as previous	

Study	Instrument	Treatment	Number	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Sofronoff et al. 2004 and 2002(80,81)	Eyberg Child Behavior Inventory- number of problem behaviors	One day parent training workshop	18	17.44 (5.77)	11.78 (5.90)	12.50 (6.96)	Pre- to post- treatment Hedges' g = 1.268 (0.533 to 2.003, p = 0.001); Pre to final follow-up Hedges' g = 1.446 (0.692 to 2.200) p = 0.000). ^b
		Individual session parent training	18	16.89 (5.84)	9.22 (4.93)	8.67 (4.93)	
		Control	15	18.13 (5.19)	17.53 (5.65)	18.20 (6.21)	
Sofronoff et al. 2004 and 2002(80,81)	Eyberg Child Behavior Inventory – intensity of problem behaviors	One day parent training workshop	18	149.72 (29.78)	130.44 (25.54)	129.00 (18.13)	Pre to post- treatment Hedges' g = 1.273 (0.537 to 2.009, p = 0.001); Pre to final follow-up Hedges' g = 1.262 (0.527 to 1.996, p = 0.001). ^b
		Individual session parent training	18	140.44 (22.59)	110.66 (19.85)	106.44 (22.99)	
		Control	15	144.73 (26.39)	148.00 (31.75)	144.40 (31.85)	
Drew et al. 2002(83)	Autism Diagnostic Interview Revised – repetitive and stereotyped behavior	Parent training in joint attention/joint action routines/behavior management	12	3.2 (1.1)	39 (1.8)	Same as previous	Hedges' g = 0.113 (-0.886 to 0.660, p = 0.774).
		Local services	12	3.7 (1.6)	4.2 (2.0)	Same as previous	

Study	Instrument	Treatment	Number	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Escalona et al. 2002(84)	Time spent showing motor stereotypies	Imitation	10	NR	Post hoc ANOVA and Bonferroni t- tests showed an increase in the time spent in motor stereotypies for the contingently responsive group (t = 2.10, p <0.05) from 0.9% to 0.9% vs. 0.6% to 1.1%, which simply resulted in the contingent group matching the initial level of the imitation group. ^a	Same as previous	Could not be calculated
		Contingent responsivity	10	NR		Same as previous	
Field et al. 2001(85) ^c	Mean percent of time child engaged in stereotypies	Imitation	10	1.6 (NR)	1.5 (NR)	0.9 (NR)	Could not be calculated
		Contingent responsivity	10	2.1 (NR)	1.9 (NR)	1.7 (NR)	
Field et al. 2001(85) ^c	Mean percent of time child engaged in inactivity	Imitation	10	19.3 (NR)	1.7 (NR)	5.7 (NR)	Could not be calculated
		Contingent responsivity	10	21.2 (NR)	20.7 (NR) Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent less time being inactive (t = 2.48, p <0.05). ^a	19.0 (NR)	

Study	Instrument	Treatment	Number	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow- up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Field et al. 2001(85) ^c	Mean percent of time child engaged in playing alone	Imitation	10	65.7 (NR)	54.1 (NR)	50.9 (NR)	Could not be calculated
		Contingent responsivity	10	67.1 (NR)	61.2 (NR)	60.3 (NR)	
					Post hoc ANOVA and Bonferroni t-tests showed the imitation group spent less time playing alone($t = 2.03$, $p < 0.05$). ^a		

^a Calculations were done by study author, not ECRI Institute.

^b Effect size estimates based on individual session training and control.

^c This study compared the results after one treatment session to the results after two treatment sessions and then after the third and final treatment session; post-treatment is after two treatment sessions, final follow-up is after the third and final session and what is included in the baseline column above is actually the results after one treatment session. This study reported results after two treatment sessions and then after the third and final treatment session. Post-treatment is after two treatment sessions and final follow-up is after the third and final treatment session.

Table 29. Parent/Family Well-Being Studies Addressing Key Question 1

Study	Instrument	Treatment	Number	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Solomon et al. 2008(76)	Behavior Assessment System for Children Parent Rating Scales – social scale atypicality	PCIT	10	75.50 (14.25)	69.10 (20.51)	Same as previous	Hedge's g: 0.631 (-0.253 to 1.514, p = 0.162)
		Wait list control	9	72.33 (21.09)	78.33 (17.11)	Same as previous	
Solomon et al. 2008(76)	Parent Stress Index total score	PCIT	10	NR	There was no significant main effect of time (F (1,16) = 0.568, p = NS) and no group by interaction effect (F (1,16) = 1.88, p = NS) Total stress sores in both groups were above clinical cutoffs both pre- and post-treatment. ^a	Same as previous	Could not be calculated.
		Wait list control	9	NR		Same as previous	
Aldred et al. 2004(79)	Parental Stress Index	Social communication intervention	14	NR	Covarying for baseline scores, there was no significant difference between groups in change in total PSI score (F 0.29: p = 0.597). ^a	Same as previous	Could not be calculated.
		Routine care	14	NR		Same as previous	

Study	Instrument	Treatment	Number	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Drew et al. 2002(83)	Parental Stress Inventory (PSI) – total score	Parent training in joint attention/ joint action routines/behavior management	10 ^b	113.8 (21.7)	104.3 (20.0)	Same as previous	Hedges' g = 0.477 (-0.375 to 1.330, p = 0.273)
		Local services	10 ^b	110.0 (28.6)	112.1 (20.1)	Same as previous	

^a Calculations were done by study author, not ECRI Institute.

^b The PSI was only completed by 10/12 parents in each group.

Table 30. Theory of the Mind Studies Addressing Key Question 1

Study	Instrument	Group	N	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Fisher and Happé 2005(74)	Proportion of ToM tests passed	ToM	10	NR ^b	Proportion of ToM tests passed was significantly higher at post-test for the ToM group. There was no change in the control group. ^a	Proportion of ToM tests passed was significantly higher at final follow-up for the ToM and EF groups. There was no change in the control group. ^a	Could not be calculated. ^b
		EF	10				
		Control	7				
Fisher and Happé 2005(74)	Percent of children who improved on the proportion of ToM tasks passed	ToM	10	NR	Six children in each of the active treatment groups and 2 controls improved.	Five children from each active treatment groups and 1 control improved.	Odds Ratio post-test = 3.75 (0.473 to 29.752) p = 0.211 and final follow-up 6.00 (0.516 to 69.754) p = 0.152
		EF	10				
		Control	7				
Fisher and Happé 2005(74)	Penny hiding task	ToM	10	NR	Both ToM and EF groups improved (z = -1.89, p <0.05 and z = -2.24, p = 0.01). There was no improvement among controls. ^a	NR	Could not be calculated.
		EF	10				
		Control	7				

Study	Instrument	Group	N	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Fisher and Happé 2005(74)	Seeing leads to Knowing task	ToM	10	NR	NR	EF group improved significantly (z = -2.00, p <0.05) while controls and ToM did not improve. ^a	Could not be calculated.
		EF	10				
		Control	7				
Fisher and Happé 2005(74)	Know/guess self task	ToM	10	NR	NR	EF group declined significantly (z = -1.73, p <0.05) while controls and ToM did not change. ^a	Could not be calculated.
		EF	10				
		Control	7				
Fisher and Happé 2005(74)	Deceptive box self task	ToM	10	NR	NR	EF group improved significantly (z = -1.63, p <0.05) while controls and ToM did not change. ^a	Could not be calculated.
		EF	10				
		Control	7				

Study	Instrument	Group	N	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Fisher and Happé 2005(74)	Deceptive box other task	ToM	10	NR	NR	EF group improved significantly (z = -1.73, p <0.05) while controls and ToM did not change. ^a	Could not be calculated.
		EF	10				
		Control	7				
Fisher and Happé 2005(74)	Children's "Reading in the Mind's Eyes" task	ToM	10	3.90 (1.91)	NR	7 ToM, 5 EF and 1 control child improved.	Odds Ratio = 14.00 (1.135 to 172.642, p = 0.039) ^c
		EF	10	5.00 (3.27)			
		Control	7	3.86 (0.69)			
Solomon et al. 2004(82)	Strange Stories Task	Social adjustment enhancement curriculum and psychoeducational parent training	5 young children	10 (1)	10.4 (0.9)	Same as previous	Young children Hedges' g = 0.131 (-0.991 to 1.252, p = 0.819) Older children Hedges' g = 0.438 (-0.786 to 1.662, p = 0.483)
			4 older children	6.5 (1.7)	7.3 (0.5)	Same as previous	
		Control	5 young children	9.2 (1.6)	9.4 (1.8)	Same as previous	
			4 older children	7.41 (1.3)	7.5 (1.3)	Same as previous	

Study	Instrument	Group	N	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Solomon et al. 2004(82)	Faux Pas Stories Task	Social adjustment enhancement curriculum and psychoeducational parent training	5 young children	2.6 (2.1)	5.4 (0.9)	Same as previous	Young children Hedges' g = 0.902 (-0.285 to 2.089, p = 0.136) Older children Hedges' g = 0.246 (-0.966 to 1.457, p = 0.691)
			4 older children	0.75 (0.5)	3.0 (2.2)	Same as previous	
		Control	5 young children	2.8 (1.3)	3.6 (2.5)	Same as previous	
			4 older children	1.2 (0.5)	3.0 (1.2)	Same as previous	

^a Calculations were done by study author, not ECRI Institute.

^b Data presented in graph form, but not in a format needed to calculate an effect size.

^c Comparison is between ToM and Controls.

Table 31. Executive Function Studies Addressing Key Question 1

Study	Instrument	Group	N	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Solomon et al. 2004(82)	Test of Problem Solving (TOPS) – in percentile ranks	Social adjustment enhancement curriculum and psychoeducational parent training	5 young children	32.2 (13.9)	43.2 (22)	Same as previous	Young children Hedges' g = 1.135 (-0.090 to 2.360, p = 0.069) Older children Hedges' g = 0.000 (-1.205 to 1.205, p = 1.000)
			4 older children	2.25 (1.5)	1.5 (1.0)	Same as previous	
		Control	5 young children	41.6 (30)	23.8 (13)	Same as previous	
			4 older children	2.75 (0.5)	2.0 (1.2)	Same as previous	
Fisher and Happé 2005(74)	Modified version of Wisconsin card sort task – aggregate score	ToM	10	4.60 (2.22)	6.20 (3.36)	6.30 (1.95)	Hedges' g = 0.101 (-0.816 to 1.019, p = 0.29) ^b
		EF	10	5.80 (3.29)	NR The EF trained group made no improvement. ^a		
		Control	7	3.86 (2.79)	NR	5.30 (2.93)	

Study	Instrument	Group	N	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Fisher and Happé 2005(74)	Modified version of Wisconsin card sort task	ToM	10	NR	ToM group improved on preservative errors ($z = -1.96$, $p = 0.05$) ^a	ToM group improved on percent conceptual level sorting ($z = -2.09$, $p < 0.05$) ^a	Could not be calculated.
		EF	10	Wilcoxon signed rank test found no improvement on any card sort variables in the EF group (all $p > 0.20$) ^a	There was no improvement in the EF trained group ^a .	There was no improvement in the EF trained group. ^a	
		Control	7		Controls improved on preservative errors ($z = -2.37$, $p < 0.05$) ^a	Controls improved on percent conceptual level sorting ($z = -2.37$, $p < 0.05$) ^a	

Study	Instrument	Group	N	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Fisher and Happé 2005(74)	Teacher rating questionnaire	ToM	8	NR	NA	Two-tailed Wilcoxon signed rank test found no difference in any of the three groups; There were no significant differences on the difference score (score at follow-up – score at pre-test); About 50% of subjects in both the ToM and EF groups improved while none of the controls did, but a Fisher's exact test showed no significant difference between the ToM and controls (p = 0.10) or the EF and controls (p = 0.06); There was no difference between the percentage who improved on the EF scale. ^a	Could not be calculated.
		EF	9				
		Control	5				

Study	Instrument	Group	N	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Final Follow-up Mean (SD)	Effect Size Estimate Hedges' g (95% CI) p value
Fisher and Happé 2005(74)	Trails (EF) task	ToM	10	78.26 (48.98)	Wilcoxon signed rank test found no evidence for improvement on the trails task for any of the three groups; Fisher's exact test found no significant difference between the percentage who improved on the trails task in any of the experimental groups. ^a	Wilcoxon signed rank test found no evidence for improvement on the trails task for any of the three groups; Fisher's exact test found no significant difference between the percentage who improved on the trails task in any of the experimental groups. ^a	Could not be calculated.
		EF	10	45.88 (34.73)			
		Control	7	36.65 (25.63)			

^a Calculations were done by study author, not ECRI Institute.

^b Comparison is between ToM and Controls.

Appendix H. Treatment Characteristics and Individual Study Results of Studies Addressing Key Question 2

Table 32. Treatment Characteristics of Studies Addressing Key Question 2

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
Rogers et al. 2006(77)	Denver Model's Communication Curriculum	Therapy was structured in brief periods of naturalistic social-affective teaching interactions alternated with brief periods of didactic teaching. The content of teaching focused on language and included teaching of non-verbal communication, imitation of actions, receptive understanding, object associations, and increasing verbal approximations.	Clinic (University of Colorado Autism and Developmental Disabilities Research Laboratory)	One-to one instruction	12 hours (12 weekly 1-hour sessions)	Therapist trained in methods of intervention	NR	12 weeks

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
	PROMPT	Neuro-developmental approach to treatment that is based on the philosophy that touch can be used to 1) develop or rebalance speech motor control, 2) provided a foundation for integrating sensory modalities in developing concepts of expressive language and, 3) enhance social-emotional interaction and trust between clinician and client. Treatment is structured so that the child must attend to toy-based activities and produce an intentional sound to request, which is supported through integrated auditory and tactile cues.	Clinic (University of Colorado Autism and Developmental Disabilities Research Laboratory)	One-to one instruction	12 hours (12 weekly 1-hour sessions)	Therapist trained in methods of intervention	NR	12 weeks
Yoder et al. 2006(78)	RPMT	Treatment is composed of two components: one for parents (responsive education) and one for children (PMT, Prelinguistic Milieu Teaching). PMT is a child-led, play-based incidental teaching method designed to teach gestural, nonword vocal, gaze use, and word use. Responsive education for parents is designed to help them play with and talk to their children in ways consistent with RPMT methods.	Clinic	One-to-one	1 hour per week (three 20 minute sessions per week for 72 sessions)	Treatment teams for each treatment group included a master's degree level professional and a bachelor of arts degree level paraprofessional. Each team was trained by one of the originators of the treatment or their representative.	For each treatment, each clinician-child session was coded for fidelity once per month. No other type of supervision was reported.	26 weeks
	PECS	Treatment involves instructing children to make requests by teaching them to hand a picture of a desired object or food to a message recipient.	Clinic	Two-to-one for beginning phases and one-to-one for remainder of treatment	1 hour per week (three 20 minute sessions per week for 72 sessions)			26 weeks

Study	Intervention	Treatment Approach	Primary Setting	Method of Instruction	Hours per Week	Therapists	Supervision	Total Duration of Treatment (or Study)
Fisher and Happé 2005(74)	Theory of Mind training	The training was based on a strategy of thinking about beliefs as "photos in the head." The methods included use of toys, illustrative stories and introduction of perspectives. Children were trained to criterion.	Classroom	One-to-one	25 minute daily (about 2 hours/week) sessions lasting 4 to 10 days, depending on whether the child met program criteria.	NR	NR	4 to 10 days, depending on when child met program criteria.
	Executive Function Training	The training was based on a "brain as machine" analogy. Treatment was structured around teaching of the following 5 rules: people can do lots of things, changing our brain tools can be hard, some brain tools are easier to use than others, sometimes we have to finish our brain tools, and sometimes we have to decide what brain tools to use for ourselves. Each session consisted of a demonstration, practice, and using cards. For example, the concept of changing tools was introduced using a toy truck, which had a range of changeable fitments.	Classroom	One-to-one	25 minute daily (about 2 hours/week) sessions lasting 4 to 10 days, depending on whether the child met program criteria.	NR	NR	4 to 10 days, depending on when child met program criteria.

PECS: Picture Exchange Communication System

PROMPT: Prompts for Restructuring Oral Muscular Phonetic Targets

RPMT: Responsive Education and Prelinguistic Milieu

Table 33. Language/Communication Skills for Key Question 2

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Last Follow-up Mean (SD)	Between Group Effect Size Estimate for Last Reported Follow-up Hedges' g (95% CI) and p-value
Yoder and Stone 2006(78)	Frequency of nonimitative spoken acts	PECS	19	0.25 (0.84) ^a	3.60(4.80)	5.50 (3.20)	Could not be calculated.
		RPMT	17		0.60(4.80)	5.40 (3.20)	
					Cohen's d: 0.63; Analysis of covariance revealed a main effect in favor of PECS: $t(34) = 2.30$, $p = 0.03$. ^b	Cohen's d: 0.00; Analysis of covariance revealed no significant between group differences: $F(1,32) = 0.003$ $p = 0.96$. ^b	
Number of different nonimitative words	PECS	19	0.17(0.56) ^a	2.40 (3.60)	3.10 (2.40)	Could not be calculated.	
	RPMT	17		0.60 (3.6)	2.90 (2.40)		
				Cohen's d:0.50; Analysis of covariance revealed a main effect in favor of PECS: $t(34) = 2.10$, $p = 0.04$ ^b	Cohen's d: 0.00;Analysis of covariance revealed no significant between group differences: $F(1,32) = 0.009$ $p = 0.93$ ^b		
Number of object-exchange turns	PECS	19	Baseline scores on frequency of object exchange turns was significantly higher for the PECS group: $t(27.70) = 2.65$, $p = 0.01$ ^b	NR	NR	NR	Could not be calculated.
	RPMT	17					

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Last Follow-up Mean (SD)	Between Group Effect Size Estimate for Last Reported Follow-up Hedges' g (95% CI) and p-value
Rogers et al.(77)	Mullen Scales of Early Learning – expressive and receptive raw scores	Denver Model	5	Expressive language: 12.8 (1.48) Receptive language: 16.4 (6.35)	Expressive language: 16.2 (5.26) Receptive language: 18.6 (6.69)	NR	Expressive language: Hedges' g 0.087 (-1.033 to 1.207) p = 0.879 Receptive language: Hedges' g 0.178 (-0.945 to 1.300) p = 0.756
		PROMPT	5	Expressive language: 13.0 (4.47) Receptive language: 16.2 (9.25)	Expressive language: 17.0 (8.63) Receptive language: 20.0 (9.67)	NR	
	Vineland Adaptive Behavior Scale	Denver Model	5	NR	NR	NR	Could not be calculated.
		PROMPT	5				
	Average words used per hour	Denver Model	5	NR ^c	Eight of the 10 children demonstrated use of five novel words or more by the completion of treatment. Eight of the ten used speech routinely during therapy sessions and during generalization probes both during and after treatment. However, their use of functional speech during play was markedly less frequent as compared to during treatment. One child in each treatment group did not develop functional speech. ^b	Eight of the 10 children demonstrated use of five novel words or more by the completion of treatment. Eight of the ten used speech routinely during therapy sessions and during generalization probes both during and after treatment. However, their use of functional speech during play was markedly less frequent as compared to during treatment. One child in each treatment group did not develop functional speech. ^b	Could not be calculated. ^c
		PROMPT	5				

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Last Follow-up Mean (SD)	Between Group Effect Size Estimate for Last Reported Follow-up Hedges' g (95% CI) and p-value
	ADOS	Denver Model	5	NR ^c	Collateral gains in social and communicative behaviors and in integration of verbal and nonverbal communication were observed for some of the children in each treatment group. More Denver treated children demonstrated gains in imitation while more Prompt children made gains in functional play. ^b	NR	Could not be calculated. ^c
		PROMPT	5				
	SCQ	Denver Model	5	NR	"Parental response to both treatments was quite positive. Parents were pleased at the children's progress and followed through at some level at home, according to their own reports and the data they kept." ^b	NR	Could not be calculated.
		PROMPT	5				
	MacArthur CDI	Denver Model	5	7.4 (7.92)	50.4 (80.07)	NR	Hedges' g 0.124 (-0.997 to 1.245) p = 0.828.
		PROMPT	5	15.6 (16.64)	69.6 (90.80)		

^a Pretreatment data were presented for all subjects combined.

^b Calculations were done by study author, not ECRI Institute.

^c Data presented in graph form, but not in a format needed to calculate an effect size.

Table 34. Higher-Order Functioning Skills Addressing Key Question 2

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Last Follow-up Mean (SD)	Between Group Effect Size Estimate - Hedges' g or Odds Ratio (95% CI) and p-value
Fisher and Happé 2005(74) ^c	Proportion of ToM tests passed	ToM	10	NR ^b	Proportion of ToM tests passed was significantly higher for ToM trained children (p <0.01). ^a	Proportion of ToM tests passed was significantly higher for ToM trained and EF trained children (p <0.05). ^a	Could not be calculated. ^b
		EF	10				
	% of children who improved on the proportion of ToM tasks passed	ToM	10	NA	Six children in each group improved.	5 children in each group improved.	Odds Ratio: 1.0 (0.167 to 5.99) p = 1.00 and Odds Ratio: 1.0 (0.173 to 5.772) p = 1.00
		EF	10				
	Penny hiding (ToM) task	ToM	10	NR	Both the ToM group (z = -1.89, p <0.05). and the EF group improved significantly (z = -2.24, p <0.01). ^a	NR	Could not be calculated.
		EF	10				
	Seeing Leads to knowing (ToM) task	ToM	10	NR	NR	EF group improved significantly (z = -2.00, p <0.05). ^a	Could not be calculated.
		EF	10				
	Know/guess self (ToM) task	ToM	10	NR	NR	EF group scores significantly declined (z = -1.73, p <0.05). ^a	Could not be calculated.
		EF	10				
Deceptive box self (ToM) task	ToM	10	NR	NR	EF group improved significantly (z = -1.63, p <0.05). ^a	Could not be calculated.	
	EF	10					
Deceptive box other (ToM) task	ToM	10	NR	NR	EF group improved significantly (z = -1.73, p <0.05). ^a	Could not be calculated.	
	EF	10					
Children's "Reading the Mind in the Eyes" (ToM) Task	ToM	10	3.90 (1.91)	NR	7 ToM-trained children and 5 EF- trained subjects improved.	Follow-up Odds Ratio: 2.33 (0.373 to 14.613) p = 0.365	
	EF	10	5.00 (3.27)				

Study	Instrument	Group	Number of Children	Baseline Score Mean (SD)	Post-treatment Mean (SD)	Last Follow-up Mean (SD)	Between Group Effect Size Estimate - Hedges' g or Odds Ratio (95% CI) and p-value
	Trails (EF) task	ToM	10	78.26 (48.98)	Wilcoxon signed rank test found no evidence for improvement on the trails task for either group; Fisher's exact test found no significant difference between the percent who improved on the trails for the ToM and EF groups. ^a	Wilcoxon signed rank test found no evidence for improvement on the trails task for either group; Fisher's exact test found no significant difference between the percent who improved on the trails for the ToM and EF groups. ^a	Could not be calculated.
		EF	10	45.88 (34.73)			
	Modified version of the Wisconsin Card Sort (EF) task – aggregate score	ToM	10	4.60 (2.22)	6.20 (3.36) There was no improvement in this group. ^a	6.30 (1.95) There was a significant improvement in this group by final follow-up. ^a	Could not be calculated.
		EF	10	5.80 (3.29)	NR There was no improvement in the EF trained group. ^a	NR There was no improvement in the EF trained group. ^a	
	Modified version of the Wisconsin Card Sort (EF) task	ToM	10	NR	Wilcoxon signed rank test found no improvement on any of the card sort variables in the EF group (all p >0.20). ToM subjects improved on perseverative errors (z = -1.96, p = 0.05).	Wilcoxon signed rank test found no improvement on any of the card sort variables in the EF group (all p >0.20). ToM improved on percentage of conceptual letter sorting (z = -2.09, p <0.05). ^a	Could not be calculated.
		EF	10				
	Teacher rating of everyday behaviors questionnaire	ToM	8	NR	NA	Wilcoxon test found no difference for either group; there were no significant differences between groups on the difference score (score at follow-up – score at pre-test) and no difference between the groups in the percent who improved on the EF scale. ^a	Could not be calculated.
		EF	9				

^a Calculations were done by study author, not ECRI Institute.

^b Data presented in graph form, but not in a format needed to calculate an effect size.

^c Tasks on which the children were trained were not reported as outcome variables.

Appendix I. Treatment Guidelines, Information from Professional Groups, and Third Party Payer Coverage Policies

Table 35. Treatment Guidelines for ASDs Identified through National Guideline Clearinghouse (NGC) and Healthcare Standards (HCS)

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
Burns Indiana Statutes Annotated 2008(89)	Insurance Coverage for Pervasive Developmental Disorders	To describe the rules governing coverage for Pervasive Developmental Disorders (including Asperger's syndrome and autism)	Not described	<p>Group accident and sickness insurance policies must provide coverage for the treatment of PDD. This treatment must be prescribed by the insured's treating physician. An insurer may not deny or refuse to issue coverage on, refuse to contract with, or refuse to renew or reissue or otherwise terminate or restrict coverage solely because the individual is diagnosed with a PDD.</p> <p>This coverage may not be subject to dollar limits, deductibles, or coinsurance provisions that are less favorable to an insured than the dollar limits, deductibles or coinsurance provisions that apply to physical illness generally under the accident and sickness policy.</p> <p>An insurer that issues accident and sickness insurance on an individual basis must offer to provide coverage for the treatment of PDD.</p>
New York Department of Health Early Intervention Program 2008(90)	<p><i>Clinical Practice Guideline: Autism/Pervasive Developmental Disorders</i></p> <p><i>Assessment and Intervention for Young Children ages 0-3</i></p>	To provide recommendations about best practices for assessment and intervention for young children with autism, with a primary focus on children under 3 years of age	Early intervention services (behavioral and education intervention programs); DIR; Sensory Integration; Auditory Integration Training; Facilitated Communication; Music Therapy; Touch Therapy	<p>Focal treatments:</p> <ul style="list-style-type: none"> There is no research evidence that intervention approaches based on DIR, sensory integration therapy, auditory integration therapy, facilitated communication, music therapy, and touch therapy are effective as intervention for young children with autism. Without evidence from controlled studies using accepted scientific methodology that demonstrates effectiveness, interventions based on these approaches cannot be recommended as primary interventions for young children with autism.

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
				<p>Intensive Behavioral and Educational Intervention Programs:</p> <ul style="list-style-type: none"> The recommendations specify that treatment should be initiated when the child is young, include a minimum of approximately 20 hours per week of individualized behavioral intervention using ABA techniques, and that the number of hours should be reviewed and revised when necessary and child's progress monitored. The evidence reviewed for the guidelines was insufficient to predict the optimal number of hours that will be effective for any given child. Specific behavioral strategies that are useful for children with autism include techniques such as: prompting, modeling, fading and reinforcement.
Agence D'évaluation Des Technologies Et Des Modes D'intervention En Santé (AETMIS) 2007(91)	The role of hyperbaric oxygen (HBO) therapy in the management of autism.	To assess the efficacy of HBO therapy in managing autistic disorder.	HBO	<p>Focal treatment:</p> <p>The scientific evidence for HBO in autism is of low quality and this level of evidence does not allow one to build a strong case for the efficacy of this treatment modality in managing autistic disorder. For now, HBO should be considered an experimental treatment modality and its use should be limited to formal research projects. Five ongoing trials were identified at the time of this writing. A literature watch should be conducted to evaluate the results of these studies as they are published.</p>

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
Scottish Intercollegiate Network (SIGN) 2007(92)	<i>Assessment, diagnosis and clinical interventions for children and young people with autism spectrum disorders. A national clinical guideline</i>	To provide evidence-based recommendations on the assessment, diagnosis and clinical interventions for children and young people with autism spectrum disorders (ASD)	Support for early communication skills, Interventions for social communication and interaction, Intensive behavioral programs, Behavioral interventions, Pharmacologic therapy (Risperidone, Methylphenidate, Melatonin), and Service provision (training of healthcare personnel, provision of information for parents/carers, education and skills interventions for parents of preschool children with ASD)	<p>Focal treatments:</p> <ul style="list-style-type: none"> • Interventions that support communication in ASD are indicated, such as the use of visual augmentation (e.g., in the form of pictures of objects). • Interventions to support social communication should be considered for children and young people with ASD, with the most appropriate intervention being assessed on an individual basis. • Auditory integration training is not recommended. • Facilitated communication should not be used as a means to communicate with children and young people with ASD. <p>Intensive Behavioral and Educational Intervention Programs:</p> <ul style="list-style-type: none"> • The Lovaas program should not be presented as an intervention that will lead to normal functioning. Behavioral Interventions should be considered to address a wide range of specific behaviors in children and young people with ASD, both to reduce symptom frequency and severity and to increase the development of adaptive skills.

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
American Speech-Language Hearing Association 2006(93-95)	Principles for Speech-Language Pathologists in the Diagnosis, Assessment, and Treatment of Autism Spectrum Disorders Across the Life Span And Roles and Responsibilities of Speech-Language Pathologists in Diagnosis, Assessment, and Treatment of Autism Spectrum Disorders Across the Life Span	To describe the role of speech-language pathologists in ASD	Speech-language services	<p>Usual care treatments:</p> <p>It is the position of the American Speech-Language-Hearing Association that speech-language pathologists play a critical role in screening, diagnosing and enhancing the social communication development and quality of life of children, adolescents and adults with ASD and individuals with ASDs should be eligible for these services.</p> <p>This position statement notes that individuals with ASDs are often denied these services based on a priori criteria that do not allow for individual needs: if language abilities do not fall below intellectual scores; older age; absence of cognitive or other skills determined to be prerequisites to benefit from communication services; failure to benefit from previous communication services; lack of funding or adequately trained personnel often fuels exclusions.</p> <p>There is empirical support demonstrating the effectiveness of a range of approaches for enhancing communication skills of individuals with ASD along a continuum from behavioral to developmental. However, evidence that any one approach is more effective than another approach is not available to date. However, the following components of effective programs have been identified: early entry into treatment; intensive programming for a minimum of 5 days a week, 5 hours a day; repeated, planned teaching opportunities; inclusion of the family; low student-teacher ratio; ongoing assessment and program evaluation, including adjustments to the program as needed; instruction should include functional, spontaneous communication, social instruction, play skills, new skill acquisition and generalization and maintenance in a natural setting; functional assessment and positive behavioral support; and functional academic skills when appropriate.</p>

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
The British Psychological Society Position Paper 2006(96)	Autism Spectrum Disorders: Guidance for Chartered Psychologists Working with Children and Young People	This paper outlines the professional practice framework for all Chartered Psychologists working with children and young people up to the age of 19 years with the aim of: raising awareness of ASDs in children and young people, across appropriate British Psychological Society Divisions/ specialties; directing psychologists to recent guidance and key texts; promoting shared minimum standards for those involved in the field; informing other professionals and the general public of the roles, responsibilities and accountability of psychologists; and reflecting current practice, dilemmas and contemporary contexts.	<p>When a child or young person has been identified as having an ASD, there is need to establish what further action is necessary. Many strategies have been developed with differing aims, rationales, practices and claims. Intervention characteristics relevant to efficacy include:</p> <p>Early intervention, Thorough assessment informing intervention, Involvement of parents and carers, Support during and immediately after the diagnosis, Establishing effective interagency partnerships, Individualized programs, Work with individuals on specific aspects of self concept, Interventions aimed at reducing anxiety, A focus on strengths, A focus on the development of communication and social understanding, Analysis of behavior and application of appropriate strategies to promote adaptive functioning,</p> <p>When considering a course of action, the following factors need to</p>	<p>Society should: Insure that pre-registration training (training in Clinical and educational Psychology) enables trainees to develop a basic understanding of the presentation of ASDs and underlying biopsychological factors. Also, the effective ways of supporting children, young people and families where a family member has an ASD are taught.</p> <p>Recommend that Chartered Psychologists who continue to work regularly with children with ASDs consider further training/supervision in ASDs as part of their CPD portfolio</p> <p>Promote and maintain high standards of professional competence across all Divisions on matters relating to ASDs.</p> <p>Promote practice based on current research in ASDs.</p> <p>Consider setting up a Special Interest Group for members who work with/have an interest in ASDs.</p> <p>Consider links with National Organizations.</p> <p>All Chartered Psychologists working with children should be able to demonstrate: adequate basic knowledge and skills in relation to ASD; knowledge of current evidence, legislation, guidance and research in ASDs as relevant to professional practice; awareness of a range of presentations possible for a child with ASD; sufficient knowledge to make a decision whether further specialist assessment is necessary; ability to tailor interventions to meet the needs of an individual child in collaboration with parents and other professionals involved; knowledge of how to promote the development of social and emotional understanding in young people in addition to academic and independence skills; continuing professional development activities in areas of ASDs; participation in regular supportive supervision; recognition of professional boundaries and the particular contribution of different agencies when working with ASD;</p>

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
			<p>be taken into account:</p> <p>The needs of the individual will change over time and will differ according to context; Interventions can be delivered at a number of different levels (for example, encouraging social inclusion, providing training, working with members of the child's family and support networks, both formal and informal, and direct work with the individual child if required); Particular attention should be paid to difficulties with change. These difficulties may be with apparently minor changes such as the transition from one activity to another or major changes such as the transition from primary to secondary school; Evidence base of effectiveness of a particular intervention.</p>	<p>commitment and ability to work alongside with other agencies/professionals as required; awareness of local arrangements for multi-agency assessment and intervention procedures for ASDs.</p> <p>Psychology Service/Agency Managers/Team Coordinator with specialist knowledge should in relation to ASDs: have a copy of the Good Practice guidelines and all other relevant guidance; implement and develop local protocols in accordance with national guidelines; be responsible for informing new staff of departmental and other local protocols; keep up-to-date with key developments or insure appropriate delegation; identify a team coordinator with specialist knowledge who can provide support, advice and information as required; provide ongoing training and continuing professional development opportunities for service members; develop clear structures to facilitate interagency liaison, differential diagnosis and intervention; process knowledge of local educational, health and social resources for young people with ASDs; provide training and support for agencies delivering a service to young people with ASDs; be able to inform decision making at a strategic level and have systems for informing agencies and authorities of developing needs; be able to provide post diagnostic support, emotional support for parents/child, training for parents/carers and others, information on ASDs, and information on support groups, e.g., NAS, local organizations.</p>

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
American Occupational Therapy Association, Inc. 2005(97)	The Scope of Occupational Therapy Services for Individuals with ASDs Across the Lifespan	To describe the role of occupational therapy in ASDs.	Occupational therapy	<p>Usual Care:</p> <p>Occupational therapy is considered a related service under IDEA, meaning it must be provided to students if it will help the student benefit from special education. Occupational therapy enhance performance and participation in activities of daily living and instrumental activities of daily living, education, work, leisure, play, and social participation. Occupational therapists should be involved in the evaluation, intervention and assessment of outcomes of individuals with ASDs.</p>
Burrows, Canadian Pediatric Society 2004 (reaffirmed 2008)(98,99)	<i>Early Intervention for children with autism</i>	<p>To briefly describe the main educational interventions (programs) that are intended to result in global improvement in autism and review the status of the evidence regarding their effectiveness.</p> <p>Behavioral techniques that limit their aim to changing specific areas of functioning in autism were not reviewed</p>	<p>Early Intensive Behavioral Intervention (usually referring to the Lovaas method) and “normalized teaching”</p> <p>Other models for intensive autism treatment (LEAP, Floor Time, and TEACCH) were described but not critiqued because of a paucity of controlled trials</p>	<p>Intensive Behavioral and Educational Intervention Programs:</p> <ul style="list-style-type: none"> • The quality of the existing studies on educational treatment programs was suboptimal but did show a trend toward a positive outcome from intervention. • However, there is no evidence to support adopting a single autism treatment program as the gold standard. • Although evidence of efficacy for educational treatment programs was weak, the studies to date do suggest some guiding principles that may be of use in planning treatment. Given the available information, it appears reasonable to set a target of a minimum of 15 hours a week of structured, individualized teaching; the family should be involved in service provision; and there should be an ongoing program evaluation and adjustment to meet the child’s needs. • There is a great need for well-designed and well-implemented studies in this area including identifying the common effective elements of treatment programs; studies involving children across the full spectrum of autism; studies that identify the optimal age and IQ range of children receiving these services, optimal program

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
				intensity, duration of treatment and parental involvement; the magnitude of effectiveness of these programs; and direct comparison of the various intensive treatment programs.
Ludwig, Alberta Heritage Foundation for Medical Research 2001(100)	<i>Intensive Intervention Programs for Children with Autism</i>	Summarized three systematic/critical reviews done previously by ECRI Institute, British Columbia Office of Health Technology Assessment Report (BCOHTA) and Smith	Intensive intervention programs, including: Lovaas Therapy, The Rutgers Autism Program, The TEACCH Program, The Denver Model, The LEAP Program, The Autism Preschool Program, and Princeton Child Development Program	<p>Intensive Behavioral and Educational Intervention Programs:</p> <ul style="list-style-type: none"> • Because of methodological limitations and weaknesses of the existing research, evidence for the efficacy or effectiveness of one intervention over another remains limited. It does appear that children improve in functioning with intensive intervention programs, but it remains to be determined if one program is more effective than another. • There was insufficient evidence to establish a relationship between amount (intensity and duration) of any intensive intervention program and outcome measures (IQ, language development, adaptive behavior tests).
McGahan, Canadian Coordinating Office for Health Technology Assessment (CCOHTA) 2001(101)	<i>Behavioral Interventions for Preschool Children with Autism</i>	To summarize the evidence and expert opinions regarding behavioral therapy, describe Canadian issues and initiatives, analyze the legal case findings, and identify key factors that influence the provision of services to preschoolers with autism in Canada	Behavioral Interventions: Lovaas, Douglass Developmental Disabilities Center Program, LEAP, May Institute, Autism Preschool Program, Princeton Child Development Institute Program, TEACCH, The Denver Model, and Others	<p>Intensive Behavioral and Educational Intervention Programs:</p> <ul style="list-style-type: none"> • The literature on efficacy of behavioral interventions lacks controlled trials and most studies have methodological flaws that make interpretation of their results difficult. • However, the existing evidence suggests that behavioral intervention, including a minimum intensity of approximately 20 hours per week of one-on-one applied behavioral analysis, can improve aspects of functioning, in particular IQ, in autistic children. • Still to be determined is what subset of children derive the most benefit, which components of therapy are integral to a positive outcome, whether similar results would be observed in older children, whether there are definable long term functional

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
				benefits, or if gains in IQ translate into happier, better functioning people. Policy makers, program developers and clinical researchers should evaluate progress in therapy to determine if therapy is or continues to of benefit.
British Columbia Office of Health Technology Assessment 2000(102)	<p><i>Autism and Lovaas treatment: A systematic review of effectiveness evidence</i></p> <p><i>Critical appraisal of submitted cost-benefit models of 'Lovaas' early intensive behavioral intervention for autism</i></p>	<p>To determine if early, intensive behavioral therapy for preschool-aged children with autism resulted in normal functioning, or essentially a cure</p> <p>To conduct a critical appraisal of two cost-benefit analyses</p>	Lovaas method, TEACCH	<p>Intensive Behavioral and Educational Intervention Programs:</p> <ul style="list-style-type: none"> • While many forms of intensive behavioral therapy clearly benefit children with autism, there is insufficient evidence to establish a causal relationship between a particular program of intensive behavioral treatment and the achievement of normal functioning. • There is insufficient effectiveness evidence to establish a relationship between the amount (per day and total duration) of any form of early comprehensive treatment program and overall outcome. • Randomized trials of alternative early intensive treatment programs are needed. • There is insufficient evidence to conduct a cost-benefit analysis of early, intensive treatment programs in terms of "normalization" of children with autism. • Regarding the one included TEACCH publication, the authors conclude that auxiliary home interventions increase developmental functioning in young autistic children above and beyond gains due to school-based interventions.

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
British Columbia Office of Health Technology Assessment 2000(103)	Critical appraisal of submitted cost-benefit models of 'Lovaas' early intensive behavioral intervention for autism	To conduct a critical appraisal of two cost-benefit analyses.	Lovaas	<p>Intensive Behavioral and Educational Intervention Programs:</p> <p>The two cost-benefit analyses reviewed in this report has several methodological flaws. At best, these two cost-benefit models show that if an effective treatment for autism were available that resulted in normally functioning children, that treatment would massively reduce public service costs over the lifetime of the person with autism. However, until effectiveness is established, cost-benefit models are meaningless. A better approach would be to determine actual costs, both absolute and relative, of existing autism treatment programs.</p>
American Academy of Child and Adolescent Psychiatry 1999(104)	Practice Parameters for the Assessment and Treatment of Children, Adolescents, and Adults with Autism and Other Pervasive Developmental Disorders	To provide guidance on the evaluation process and treatment planning.	Educational services, vocational services, psychosocial interventions including parent training, ancillary treatments outside the school setting and a variety of alternative therapies.	<p>Focal treatments:</p> <p>Dietary and other alternative treatments are not clearly established as being efficacious. Families should be helped to make informed decisions about their use of alternative treatments. Treatments that pose some risk to the child and family should be actively discouraged.</p> <p>Mega vitamins and nutritional supplements have little or questionable scientific basis. Low doses of vitamin supplements pose little threat of harm to the child and do not drain familial resources. However, higher doses can be associated with toxicity.</p> <p>Other alternative treatments pose a danger to the child and family in that a cure is essentially promised to the family, usually after the expenditure of a significant sum of money. Such treatments may actually pose a risk to the child in terms of disruption of ongoing programs which have demonstrated efficacy, have the risk of depleting family resources, and, when they fail to work, may be associated with some degree of blame directed to the parents. Clinicians experienced in work with this population can report may examples of such approaches (e.g., attempts to cure autism through "realignment"</p>

Reference	Title	Guideline Objective	Treatment interventions considered in report	Summary of Recommendations for Non-pharmacological Treatment Interventions
				<p>of brain and nerves, elimination diets, etc.).</p> <p>Another group of alternative treatments has the potential for direct, serious harm to the affected child or family. As an example, the recent fad of facilitated communication had no empirical basis but was used, in some cases, as a rationale for removing a child from the family's care because of reports, via the alleged facilitation, of physical or sexual abuse. Other potentially harmful treatments may involve somatic therapies, such as injection of foreign substances such as sheep brain extract.</p> <p>Treatments such as auditory training, patterning, hugging/ holding, sensory integration, the use of secretin, and the Options method have little or no empirical evidence, to date. In a few instances some research has been conducted, e.g., relative to auditory training, but the research is difficult to interpret or limited because of the small numbers of subjects involved or other problems in design. In other cases when research has been conducted, it has failed to support the usefulness of the approach, e.g., a study of patterning found this treatment to be without benefit. Families should be helped to make informed decisions about their use of alternative treatments. Treatments, which pose some risk to the child and family, should be actively discouraged.</p>
<p>American Academy of Pediatrics, Committee on Children with Disabilities 1998(105)</p>	<p>Auditory Integration Training (AIT) and Facilitated Communication (FC) for Autism.</p>	<p>To review the evidence for AIT and FC in Autism.</p>	<p>AIT FC</p>	<p>Focal treatments:</p> <p>Although two investigations indicated AIT may help some children with autism, as yet there are no good controlled studies to support its use. There is good scientific evidence that FC is ineffective. FC also has the potential for harm, including unsubstantiated allegations of abuse by a third party. Until further information is available, the use of these treatments does not appear warranted at this time, except within research protocols.</p>

Table 36. Guidelines/Practice Parameters Identified through Other Sources

Reference	Title	Guideline Objective	Treatment Interventions Considered in Report	Summary of Recommendations for Non-pharmacological Treatment Interventions
Ministry of Health, New Zealand 2008(171)	<i>New Zealand Autism Spectrum Disorder Guideline</i>	To provide evidence-based guidance on ASD in both children and adults in New Zealand	Comprehensive treatments, educational treatments and psychosocial treatments	<p>Intensive Behavioral and Educational Intervention Programs:</p> <ul style="list-style-type: none"> • Treatment should encourage functional development, skills for independent living to minimize stress on the person with ASD and their family. • Treatment plans should be comprehensive, and include behavioral needs, educational interventions, psychosocial treatments, communication, environmental and systems issues and the suitability (or not) of medication. • Professionals, people with ASD, family, and carers should work together to evaluate treatment approaches before and during implementation. • All behavioral interventions should be of good quality and incorporate the following principles: person-centered planning, functional assessment, positive intervention strategies, multifaceted interventions, focus on environment, meaningful outcomes, focus on ecological validity and systems-level intervention. • When severe behaviors are evident, people with ASD need to be assessed for co-morbid conditions such as seizures, attention deficit hyperactivity disorder (ADHD), anxiety disorders and depression.

Reference	Title	Guideline Objective	Treatment Interventions Considered in Report	Summary of Recommendations for Non-pharmacological Treatment Interventions
Association for Science in Autism Treatment(35)	<i>Summaries of Scientific Research on Interventions on Autism</i>	To describe and summarize the existing research on psychological, educational and therapeutic interventions and provide recommendations for each	Applied Behavioral Analysis, Animal Therapy, Art Therapy, Auditory Integration Therapy, Augmentative Communication, Developmentally based Individual difference Relationship based Intervention (DIR), Facilitated Communication, Holding Therapy, Music Therapy, Oral-Motor Training/Therapy, Patterning, Picture Exchange Communication System (PECS), TEACCH, Psychoanalytic and Humanistic Play Therapy, Recreational Sports/Exercise, Relationship Development Intervention, Sensory Integrative Therapy, Socialization related classes, Social Stories, Son Rise, Video Modeling, and Vision Therapy	<p>Intensive Behavioral and Educational Intervention Programs:</p> <ul style="list-style-type: none"> Applied Behavioral Analysis: ABA is an effective intervention for ASD. This program should be supervised by a qualified behavior analyst. As there is scientific support for this program, professional and families may wish to obtain additional information about this approach. Larger studies with strong scientific designs are needed to assess the long-term outcomes of early, intensive ABA and other comprehensive ABA intervention programs. <p>Other treatments:</p> <ul style="list-style-type: none"> In general, for all other therapies assessed, the authors of the report concluded that researchers may wish to conduct studies with strong scientific designs to evaluate the therapies, and professionals should present them as untested and encourage families who are considering one of these interventions to evaluate it carefully.

Reference	Title	Guideline Objective	Treatment Interventions Considered in Report	Summary of Recommendations for Non-pharmacological Treatment Interventions
Prior and Roberts 2006(172)	<i>Early Intervention for Children with Autism Spectrum Disorders: Guidelines for Best Practice</i>	To summarize the research findings related to early intervention for autism, outline the kinds of programs available in Australia, identify research and evidence based guidelines for best practice in early intervention and provides a list of contacts for programs across Australia	Educational interventions including Applied Behavioral Analysis (ABA), Relationship Development Intervention (RDI), Picture Exchange Communication System (PECS), Auditory Integration Training (AIT), Treatment and Education of Autistic and related Communication handicapped Children (TEACCH), Music Intervention Therapy, and family based interventions such as The Hanen Program	<p>Intensive Behavioral and Educational Intervention Programs:</p> <ul style="list-style-type: none"> • The most systematic evidence available has come from intensive behavioral programs such as Lovaas or Applied Behavior Analysis. • Evaluations on intensive behavioral programs show improved learning and behavioral development in a significant proportion of children. These methods do not suit all children, however, and strict conditions of timing, intensity and quality of therapist training influence the success of these methods. • The following are key elements necessary for effective intervention: an autism specific curriculum focusing on attention, compliance, imitation, language, and social skills; a highly supportive teaching environment which provides predictability and routine and addresses challenging behaviors, obsessions and ritual behaviors; provides support for children in their transition from the preschool classroom; promotes a partnership between parents and treatment professionals; provides services for a minimum of 20 hours a week over a at least a two year period; adapts to meet the individual child's needs by taking account of their strengths and weaknesses and family circumstances. • Other programs have not shown sufficient evidence of short or long term improvement to qualify for unreserved support.

Reference	Title	Guideline Objective	Treatment Interventions Considered in Report	Summary of Recommendations for Non-pharmacological Treatment Interventions
National Early Childhood Technical Assistance Center (NECTAC)(173)	<i>Elements of Effective Programs</i>	To present a consensus opinion about what are the most important elements of treatment programs for individuals with an ASD	Seven well-known treatment models families are likely to recognize and frequently request	<ul style="list-style-type: none"> • The six elements identified as part of all effective treatment programs include: the earliest possible start to intervention, individualization of services to meet unique needs of the child and his/her family, systematic teaching strategy that builds toward meaningful goals, specialized curriculum that focuses on ASD deficits, the amount of time in which the child is being taught or actively learning, and family involvement. • In addition, the three other important elements that were identified as part of some, but not all effective programs include a structured environment, programs guided by information about child development, and interventions that include interactions with typically developing children.

Table 37. Guidelines/Practice Parameters by State

Reference	Title	Guideline Objective	Recommended Non-pharmacological Treatment Interventions may be found at:
California Departments of Education and Developmental Services 1997(174)	<i>Best Practices for Designing and Delivering Effective Programs for Individuals with ASDs: Recommendations of the Collaborative Work Group on Autistic Spectrum Disorders</i>	To summarize suggested strategies for addressing common issues in program development, transition planning, provision of effective staff development, and program evaluation	www.isciii.es/htdocs/centros/enfermedades/aras/pdf/aut_gcalif.pdf
Connecticut Birth to Three System 2008(175)	<i>Service Guideline: Autism Spectrum Disorder Intervention guidance for service providers and families of young children with ASDs</i>	The purpose of this guideline is to help families and service providers develop and carry out intervention plans for families of children who have characteristics of disorders on the Autism Spectrum, including Pervasive Developmental Disorder (PDD).	http://www.birth23.org/Publications/Autism%202008.pdf
Indiana Institute on Disability and Community 2001(176)	<u>Early Intervention for Young Children with Autism Spectrum Disorders: Recommendations for Designing Effective Programs</u>	Written for both family members and professionals, this publication describes the key components of an effective early intervention program for young children with an autism spectrum disorder and provides practical recommendations for implementing these key components.	http://www.iidc.indiana.edu/
Maine Administrators of Services for Children with Disabilities (MADSEC) 2000(177)	<i>Report of the MADSEC Autism Task Force</i>	Perform a detailed analysis of methodologies used to educate children with autism, focusing on the scope and quality of the scientific research to determine each method's effectiveness. Based upon the research analysis, this report makes recommendations for the consideration of decision makers.	www.madsec.org
New Jersey 2004(178)	<i>Service Guidelines For Children with Autism Spectrum Disorders</i>	To enhance the capacity of families to meet the developmental needs of children, birth to age three, who have delays or disabilities, by providing quality services and support to families and their children.	http://www.state.nj.us/health/fhs/documents/autismguidelines.pdf
New Jersey Department of Education 2004(179)	<i>Autism Program Quality Indicators</i>	To identify research-based indicators found in successful programs.	http://www.celebratethechildren.org/Documents/Indicators.pdf

Reference	Title	Guideline Objective	Recommended Non-pharmacological Treatment Interventions may be found at:
New Mexico Family Infant Toddler Program 2004(180)	<u><i>Autism Spectrum Disorders - Guidance on providing supports and services to young children with autism spectrum disorders and their families</i></u>	To provide guidance on providing support and services to young children with ASDs and their families	<u>http://www.health.state.nm.us/ddsd/fit/pdf%5CAutism-Spectrum-Disorders.pdf</u>
The New York State Education Department Office of Vocational and Educational Services for Individuals with Disabilities Special Education Policy, Planning and Partnerships 2004(181)	<i>The Availability and Effectiveness of Programs for Preschool Children with Autism</i>	To report on the availability and effectiveness of approved programs providing special education services to preschool children with autism	<u>http://www.vesid.nysed.gov/specialed/autism/preschoolstudy.htm</u>
New York State Department of Health Early Intervention Program 1999(182)	<u><i>Clinical Practice Guideline: Report of the Recommendations: Autism/Pervasive Developmental Disorders. Assessment and Intervention for Young Children (Age 0-3 Years)</i></u>	This document provides an extraordinarily thoughtful and balanced presentation of the critical issues in assessment and intervention for this group of children. There is no doubt in my mind that readers will find the Guideline to be a valuable resource, as it will allow numerous individuals with different levels of expertise to gain a firm understanding and make highly informed decisions with respect to assessment and intervention for young children with autism and pervasive developmental disorders.	<u>http://www.health.state.ny.us/community/info/nts_children/early_intervention/autism/index.htm</u>
North Dakota Department of Public Instruction 2003(183)	<i>Guidelines: Identifying, Serving, and Educating Children and Youth with Autism</i>	To review and discuss the issues relative to the assessment and education of individuals with autism, including best practice strategies, family support and early intervention	<u>www.dpi.state.nd.us/speced/guide/autism.pdf</u>
Ohio Developmental Disabilities Council(184)	<i>Service Guidelines for Individuals with Autism Spectrum Disorder/Pervasive Developmental Disorder (ASD/PDD) Birth through Twenty-one</i>	To provide recommendations based on the current knowledge about “best practices” for the assessment of individual needs and the delivery of appropriate services for children and young adults with ASD	<u>http://ddc.ohio.gov/Pub/Child/htm</u>

Reference	Title	Guideline Objective	Recommended Non-pharmacological Treatment Interventions may be found at:
Washington State Infant Toddler Early Intervention Program(185)	<i>Successes in Serving Families and Infants and Toddlers with Autism</i>	To insure services are reasonably calculated to confer developmental benefit, this guideline describes a Individualized Family Service Plan (IFSP) process that includes the family and shares information about the importance of integrated services, methods and approaches	http://www1.dshs.wa.gov/word/adsa/iteip/SLM_Autism.doc .
Department of Health Services State of Wisconsin 2007(186)	<i>Intensive In Home Service</i>	To describe intensive in home services and provide guidelines for how they should be implemented	http://dhs.wisconsin.gov/bdds/waivermanual/waiverch04_08.pdf#page=85

Table 38. Third Party Payer Coverage Policies for Services to Individuals with Autism Spectrum Disorder

Third-party Payer	Web site	Coverage Policy	Policy/Bulletin Number	Treatments Considered to be Experimental and Not Covered
Aetna(187)	http://www.aetnaushc.com/cpb/cpb_alpha.html	For pervasive developmental disorder (PDD), intensive educational interventions and alternative/augmentative communication aids are covered.	0648	Auditory Integration Training; Chelation Therapy; Cognitive Rehabilitation; Elimination Diets; Facilitated Communication; Holding Therapy; Immune Globulin Infusion; Music therapy and rhythmic entrainment interventions; nutritional supplements; Secretin infusion; Sensory Integration Therapy; Vision therapy.
American Medical Association(188-190)	http://coverageandpayment.mediregs.com	As of 2008, payment for these services may not be made if the service was provided to either a patient in a hospital outpatient department or to an inpatient of the hospital by an independently practicing Physical/occupational therapist: cognitive skills development and sensory integrative techniques.	NR	NR
Athens area Health Plan Select, Inc., Athens Georgia 2005(191)	http://www.aahps.com/pdfs/EOCamend012006.pdf	Treatment for autism shall be covered on the same basis as other diagnosed neurological disorders.	NR	NR
Blue Cross/ Blue Shield of Alabama(192)	http://www.bcbsal.org/providers/policies/	NR	NR	Chelation therapy
Blue Cross/ Blue Shield of Massachusetts (193,194)	http://www.bcbsma.com/common/en_US/hresource/medcat.jsp	Early intervention is covered if child is 3 or less with an established, biological or environmental risk; has a known disabling physical or mental condition; four or more risk factors.	281,439	Recreational services; orthoptic (vision) training; auditory integration training; facilitated communication; cognitive rehabilitation therapy; sensory integration therapy.

Third-party Payer	Web site	Coverage Policy	Policy/Bulletin Number	Treatments Considered to be Experimental and Not Covered
Blue Cross/ Blue Shield of Tennessee(195)	http://www.bcbst.com/providers/mpm.shm	NR	NR	Speech/language therapy, occupational therapy and physical therapy for the treatment of autism are considered investigational except when the Tennessee State Mandate applies. The Tennessee State Mandate applies to individual policies, fully insured accounts, and self-funded accounts not governed by ERISA, and to children with ASDs less than 12 years of age. Specifically, the mandate states: A contract or policy of an insurer that provides benefits for neurological disorders, whether under an individual or group health insurance policy providing coverage on an expense-incurred basis, an individual or group service contract issued by a health maintenance organization, a self-insured group arrangement to the extent not preempted by federal law or a managed health care delivery entity of any type or description shall provide benefits and coverage for the treatment of ASDs that are at least as comprehensive as those provided for other neurological disorders.

Third-party Payer	Web site	Coverage Policy	Policy/Bulletin Number	Treatments Considered to be Experimental and Not Covered
Cigna(196)	http://www.cigna.com/health/provider/medical/procedural/coverage_positions/medical/index.html	NR	0447	Sensory integration therapy; auditory integration therapy; facilitated communication; augmentative communication devices; chelation therapy; cognitive behavioral therapy; cognitive rehabilitation; dietary/nutritional interventions; hyperbaric oxygen therapy; intensive intervention programs (e.g., Lovaas, ABA), immune globulin therapy; music therapy, secretin infusion; vision therapy.
Health Partners(197)	http://www.healthpartners.com/policies/	Medical policy for PDD currently being revised.	NR	NR
Kaiser Permanente Health Plan, Northern California Region 2004(198)	www.kaiserpermanente.org	Mental health services for PDD or autism are covered, including evaluation, crisis intervention, outpatient visits, psychological testing, visits for the purpose of monitoring drug therapy, inpatient psychiatric care, and structured multidisciplinary programs of psychiatric care as an alternative to inpatient psychiatric care.	NR	NR

Third-party Payer	Web site	Coverage Policy	Policy/Bulletin Number	Treatments Considered to be Experimental and Not Covered
MAMSI Life and Health Insurance Company State of Maryland(199)	www.mamsiunitedhealthcare.com/s/g/md/0726299-0105MD.pdf	Habilitative including speech, occupational and physical therapy) services are limited to 50 visits per year combined per condition. Treatment related to autism or PDD except as it relates to habilitative services for children under the age of 19 is excluded. However, the assessment of these disorders is covered.	NR	Policy also routinely excludes the following treatments which are sometimes used to treat ASD: art therapy; massage therapy; mental health services; therapy for eyes and eye exercises; special education, counseling therapy or care for learning deficiencies or behavioral problems; confinement, treatment, services or supplies related to learning disabilities, mental retardation and/or mental deficiency; educational assessments and vocational training.
Medica(200,201)	http://provider.medica.com/C9/MedicalPolicies/default.aspx	NR	NR	Lovaas therapy/intensive early intervention behavior therapy services/intensive behavioral intervention; Health Research Institute/Pfeiffer Treatment Center Protocols; Sensory Integration Therapy; Auditory Integration Training; Chelation Therapy.
Premera Blue Cross 2008(202)	http://www.ashya.org/about/legislation-advocacy/2008/PremeraBlueCross.htm	Speech-generating devices (SGD) and other Augmentative and Alternative Communication (AAC) devices are covered.	NR	NR

Third-party Payer	Web site	Coverage Policy	Policy/Bulletin Number	Treatments Considered to be Experimental and Not Covered
Regence Blue Cross/ Blue Shield(203)	http://www.regence.com/trgmedpol/	Augmentative communication devices and systems (ACD) , also known as augmentative and alternative communication devices and speech generating devices are covered if recommended by a therapist, individual either unable to communicate or learn to communicate through mean such as writing; willingness to use device; if for a degenerative disease, device is able to meet individual's anticipated needs; if pre-literate but anticipated to learn to read and spell, device should have spelling and text capabilities in addition to symbols.	52	NR
Wellmark Blue Cross/ Blue Shield(204,205)	http://www.wellmark.com/e_business/provider/medical_policies/medical_policies.asp	NR	08.03.04; 08.01.06	Sensory Integration therapy; chelation therapy

Appendix J. Names of Those Involved in the Preparation of This Report

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