

The National Autism Center's

# National Standards Project

## Findings and Conclusions



ADDRESSING THE NEED FOR EVIDENCE-  
BASED PRACTICE GUIDELINES FOR  
AUTISM SPECTRUM DISORDERS





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We have endeavored to build consensus among experts from diverse fields of study and theoretical orientation. We collaboratively determined the strategies used to evaluate the literature on the treatment of Autism Spectrum Disorders. In addition, we jointly determined the intended use of this document. We used a systematic process to provide all of our experts multiple opportunities to provide feedback on both the process and the document. Given the diversity of perspectives held by our experts, the information contained in this report does not necessarily reflect the unique views of each of its contributors on every point. We are pleased with the spirit of collaboration these experts brought to this process.



## IN MEMORY OF EDWARD G. CARR, PH.D., BCBA

*This report is dedicated to the memory of Dr. Ted Carr, an internationally recognized leader in the treatment of Autism Spectrum Disorders and in the field of Positive Behavior Supports.*

*From the outset, Ted was a major contributor to the National Standards Project. He played a pivotal role in shaping the methodology used in the Project. Ted understood that the value of the National Standards Project was based not only on the scientific validity of its design and implementation, but also on its social validity within the broader community. We are grateful to Ted for his insightful input, and his persistent focus on ensuring that this document be useful to families, educators, and service providers.*

*Throughout his career, Ted often led the charge for the intelligent care and compassionate and respectful treatment of individuals with Autism Spectrum Disorders and other developmental disabilities. We at the National Autism Center, along with countless organizations and professionals throughout the world, will miss him and keenly feel his loss.*

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## Acknowledgments

There are many challenges in undertaking a project of this nature. A series of complex decisions must be made over the course of several years that influence the usefulness of the final document. I would like to take the opportunity to thank the extraordinary number of professionals, family members, and organizations that have made this task easier.

I have had the good fortune to receive feedback from family members and individuals on the autism spectrum at the numerous conferences at which I have discussed the National Standards Project. Your input has influenced both the process we have used and this final document. I hope you continue to provide us feedback as we develop future editions of the National Standards Project. I have also received feedback at these conferences from professionals representing different fields of expertise and theoretical orientations. These professionals grapple with the very complicated process of providing best practices in homes, schools, and communities. Thank you for your assistance and your sustained input to the National Standards Project.

I am also grateful to the professionals and lay members of the autism community who provided very detailed feedback at various stages of this project. It would be hard to overstate the importance of your contributions. Your disparate views aided in the development of the review process and the completion of this document. Many of you are identified in our contributors section. I appreciate the consistent support of our expert panelists and conceptual reviewers who contributed tirelessly throughout this process. The input of families and professionals was also essential to the development of this project.

The National Standards Project could not have been completed without an important group of organizations and individuals. We appreciate both their willingness to underwrite the costs associated with the project and their consistent neutrality regarding the outcomes reported in this document. May Institute has supported the National Standards Project from its inception. Most costs associated with the first plenary session which began the development of this project were provided by the Autism Education Network (AEN). Without the support of Michelle Waterman and Janet Lishman of AEN, the early development of this project would have been far more challenging. Additional costs for the project were underwritten by the California Department of Developmental Services. We also appreciate the support and feedback we received from the Oversight and Advisory Committees through the California Department of Developmental Services and the professionals involved in the "Autism Spectrum Disorders: Guidelines for Effective Interventions" document that will be available soon.



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# 1

## Introduction

### About the National Standards Project

The National Standards Project, a primary initiative of the National Autism Center, addresses the need for evidence-based practice guidelines for Autism Spectrum Disorders (ASD).

The National Standards Project seeks to:

- provide the strength of evidence supporting educational and behavioral treatments that target the core characteristics of these neurological disorders
- describe the age, diagnosis, and skills/behaviors targeted for improvement associated with treatment options
- identify the limitations of the current body of research on autism treatment
- offer recommendations for engaging in evidence-based practice for ASD

#### *Who will benefit from national standards?*

*We believe that parents, caregivers, educators, and service providers who must make complicated decisions about treatment selection will benefit from national standards.*

## About the National Autism Center

The National Autism Center is dedicated to serving children and adolescents with Autism Spectrum Disorders (ASD) by providing reliable information, promoting best practices, and offering comprehensive resources for families, practitioners, and communities.

An advocate for evidence-based treatment approaches, the National Autism Center identifies effective programming and shares practical information with families about how to respond to the challenges they face. The Center also conducts applied research as well as develops training and service models for practitioners. Finally, the Center works to shape public policy concerning ASD and its treatment through the development and dissemination of national standards of practice.

Guided by a Professional Advisory Board, the Center brings concerned constituents together to help individuals with Autism Spectrum Disorders and their families pursue a better quality of life.

# 2

## Overview of the National Standards Project

### What is the Purpose?

The National Standards Project serves three primary purposes:

1. To identify the level of research support currently available for educational and behavioral interventions used with individuals (below 22 years of age)<sup>1</sup> with Autism Spectrum Disorders (ASD). These interventions address the core characteristics of these neurological disorders. Knowing levels of research support is an important component in selecting treatments that are appropriate for individuals on the autism spectrum.
2. To help parents, caregivers, educators, and service providers understand how to integrate critical information in making treatment decisions. Specifically, evidence-based practice involves the integration of research findings with {a} professional judgment and data-based clinical decision-making, {b} values and preferences of families, and {c} assessing and improving the capacity of the system to implement the intervention with a high degree of accuracy.
3. To identify limitations of the existing treatment research involving individuals with ASD.

We hope that the National Standards Project will help individuals with ASD, their families, caregivers, educators, and service providers to select treatments that support people on the autism spectrum in reaching their full potential.

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<sup>1</sup> For the purpose of this report, we use the phrase “individuals with Autism Spectrum Disorders” to refer to individuals on the autism spectrum who are under 22 years of age.

# What was the Process?

## Developing the Model

The National Standards Project began with the development of a model for evaluating the scientific literature involving the treatment of ASD by a working group consisting of Pilot Team 1 and outside consultation from methodologists<sup>2</sup>. The process for the initial development of the National Standards Project is outlined in Flowchart 1. We developed a model based on an examination of evidence-based practice guidelines from other health and psychology fields<sup>3</sup> as well as from 25 experts (see expert panel) attending planning sessions for the National Standards Project. This model was sent to the original experts as well as an additional 20 experts (see conceptual reviewers) who represent diverse fields of study and theoretical orientations. The model was modified based on their feedback and then served as the foundation for data collection procedures.

## Identifying the Research

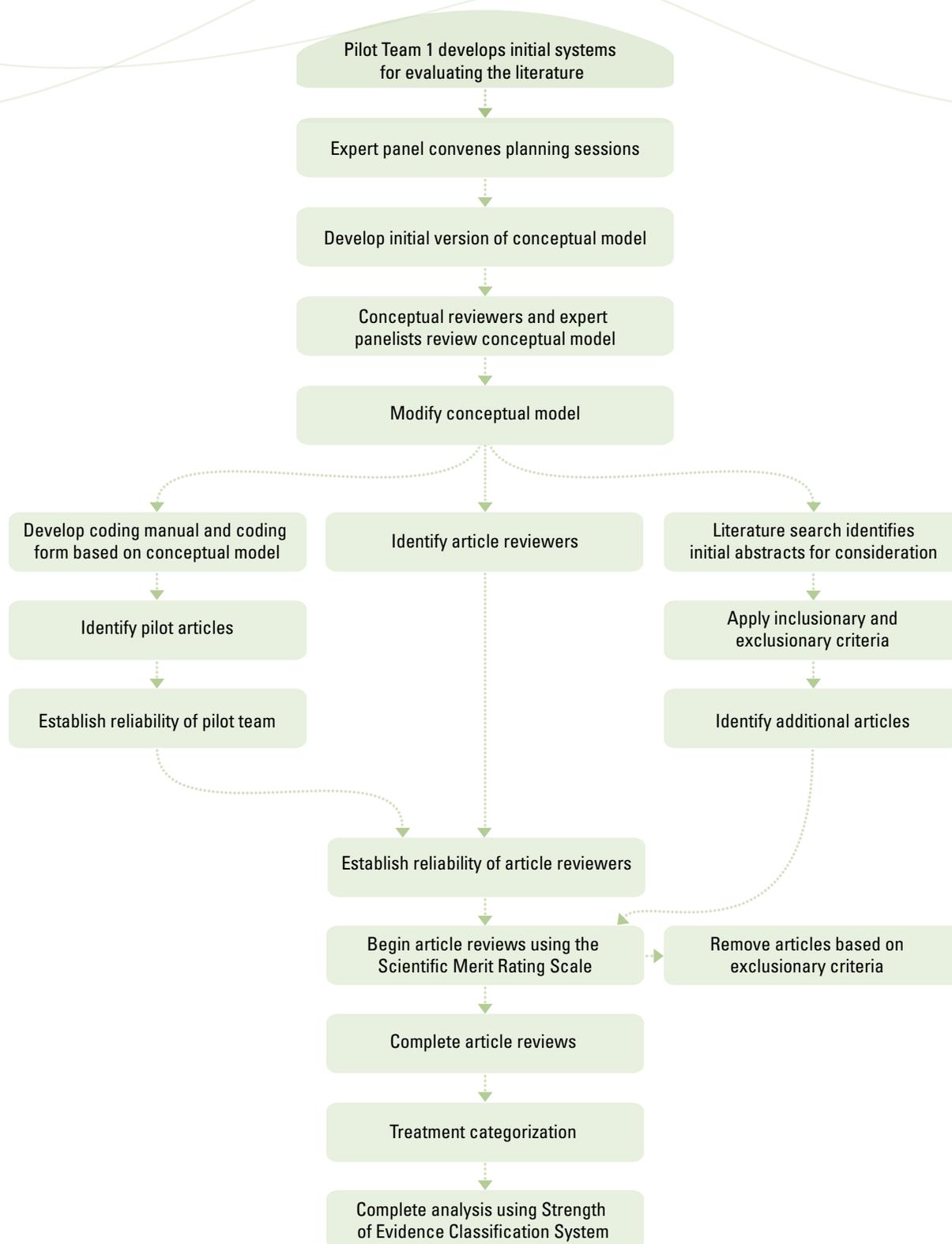
Prior to data collection, we identified the ASD treatment articles that should be included in our review. These treatments were generally designed to address the core features of these neurological disorders. A number of these studies also addressed the associated features of ASD. The studies were conducted in a wide variety of settings such as universities, university-based clinics, medical settings, and schools and were conducted by a broad range of professionals (e.g., psychologists, speech-language

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<sup>2</sup> The pilot team relied on the following sources: Sidman (1960); Johnston & Pennypacker (1993); Kazdin (1982; 1998); New York State Department of Health, Early Intervention Program (1999) and; Task Force on Promotion and Dissemination of Psychological Procedures (1995).

<sup>3</sup> These systems were developed based on an examination of previous evidence-based practice guidelines including the Agency for Healthcare Research and Quality (West, King, Carey, Lohr, McKoy et al., 2002), American Psychological Association Presidential Task Force on Evidence-Based Practice (2003), and the Task Force on Evidence-Based Interventions in School Psychology (APA, 2005). These were also based on an examination of publications about evidence-based practice by authors {a} Chambless, Baker, Baucom, Beutler, Calhoun, Crits-Christoph, et al., (1998) and {b} Horner, Carr, Halle, McGee, Odom, & Wolery (2005).

## Flowchart 1} Process of the Initial Development of the National Standards Project



pathologists, educators, occupational or physical therapists). Search engines produced a total of 6,463 abstracts for consideration; an additional 644 abstracts were identified by our experts, attendees to national autism conferences, and project participants who reviewed recent book chapters. These abstracts were compared against our inclusion/exclusion criteria (see Appendix 1). An additional 413 articles were removed by trained field reviewers (described below). We included 724 peer-reviewed articles in our final review. Because more than one study was published in several of these articles, a total of 775 research studies were reviewed and analyzed.

## Ensuring Reliability

To ensure a high degree of agreement (i.e., reliability) among reviewers, the coding of articles began with observer calibration. That is, a pilot team reviewed articles and made modifications to a coding manual until interobserver agreement reached an acceptable level (>80%). All field reviewers then received a copy of the coding manual, the coding form, and a pilot article to code. Field reviewers who reached an acceptable level of agreement (>80%) were invited to review articles for the National Standards Project.

## About the Scientific Merit Rating Scale

We developed the Scientific Merit Rating Scale as a means of objectively evaluating whether the methods used in each study were strong enough to determine whether or not a treatment was effective for participants on the autism spectrum. This information allows us to determine if the results are believable enough that we would expect similar results in other studies that used equal or better research methodologies.

We then applied each of the dimensions (listed below) included in the Scientific Merit Rating Scale in the same way to each article. This allowed us to consistently answer questions relevant to the scientific merit of each study specifically related to individuals with ASD. Table 1 briefly describes some of the questions answered with the Scientific Merit Rating Scale. (A detailed outline of the Scientific Merit Rating Scale is available in Appendix 2.)

### The five dimensions of the Scientific Merit Rating Scale include:

1. experimental rigor of the research design;
2. quality of the dependent variable;
3. evidence of treatment fidelity;
4. demonstration of participant ascertainment; and
5. generalization data collected.

**Table 1}** Examples of Questions Addressed with the Scientific Merit Rating Scale

**Rating}** Scores fall between 0 and 5 with higher scores representing higher indications of scientific merit specific to the ASD population

<b>Design:</b> <i>Two classes of research design were considered</i>		<b>Measurement of Dependent Variable:</b> <i>Two types of data were considered</i>		<b>Measurement of Independent Variable</b>	<b>Participant Ascertainment</b>	<b>Generalization of Tx Effect(s)</b>
<b>Group</b>	<b>Single-subject</b>	<b>Test, scale, checklist, etc.</b>	<b>Direct behavioral observation</b>			
Answers questions such as:	Answers questions such as:	Answers questions such as:	Answers questions such as:	Answers questions such as:	Answers questions such as:	Answers questions such as:
How many participants were included? How many groups were included? Were relevant data lost? What was the research design?	How many comparisons were made? How many data points were collected? How many participants were included? Were relevant data lost?	Was the protocol standardized? What are the psychometric properties? Were the evaluators blind and/or independent?	What type of measurement was used? Is there evidence of reliability? How much data were collected?	Is there evidence the treatment was implemented accurately? How much treatment fidelity data were collected? Is there evidence of reliability for treatment fidelity?	Who delivered the diagnosis? Was the diagnosis confirmed? Were psychometrically sound instruments used? Were DSM or ICD criteria used?	Were objective data collected? Were maintenance and/or generalization data collected?

Each category was weighted. Dimensions that have been consistently acknowledged as essential in research since the first studies were published were given stronger weights. Factors that have most recently been considered important were given lesser weights. The weights assigned were as follows: Research Design (.30) + Dependent Variable (.25) + Participant Ascertainment (.20) + Procedural Integrity (.15) + Generalization (.10).

## Treatment Effects Ratings

In addition, each study was examined to determine if the treatment effects were: {a} beneficial, {b} ineffective, {c} adverse, or {d} unknown.

- Beneficial is identified when there is sufficient evidence that we can be confident favorable outcomes resulted from the treatment.
- Unknown was identified when there was not enough information to allow us to confidently determine the treatment effects.

- Ineffective is identified when there is sufficient evidence that we can be confident favorable outcomes did not result from the treatment.
- Adverse is identified when there is sufficient evidence that the treatment was associated with harmful effects.

Appendix 3 outlines the criteria for treatment effects.

The reason separate scores are required to determine scientific merit and treatment effects is they tap into separate but equally important concerns related to each study. For example, a study could have a very strong research design (high scientific merit) but show that the treatment was actually ineffective. Decision-makers should be aware of a finding of this type.

Similarly, a study could have a relatively weak research design (lower scientific merit) but show that the treatment was effective. Scientists would not necessarily believe the treatment was actually effective in this case because the outcomes could be due to some factor other than the treatment (e.g., the passage of time, some unknown variable that was not accounted for in the study, etc.).

Once we coded all studies, we combined the results of the Scientific Merit Rating Scale and the Treatment Effects Ratings to identify the level of research support that is currently

available for each educational and behavioral intervention we examined. We identified 38 treatments<sup>4</sup>. The term “treatment” may represent either intervention strategies (i.e., therapeutic techniques that may be used in isolation) or intervention classes (i.e., a combination of different intervention strategies that have core characteristics in common). Whenever possible, we combined intervention strategies into treatment classes in order to lend clarity to the effectiveness of the treatment. When this was not possible, we reported results on isolated intervention strategies. The experts involved in the project provided feedback when reviewing earlier drafts of this report. That is, they were given the opportunity to provide input three times before the final 38 treatments were identified.

After we identified the treatments, we applied the Strength of Evidence Classification System criteria.

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<sup>4</sup> Reliability in the form of interobserver agreement was .92 for treatment categorization.

## Strength of Evidence Classification System

The Strength of Evidence Classification System can be used to determine how confident we can be about the effectiveness<sup>5</sup> of a treatment. Ratings reflect the level of quality, quantity, and consistency of research findings for each type of intervention. There are four categories in the Strength of Evidence Classification System.<sup>6</sup> Table 2 identifies the criteria associated with each of the ratings.

**These general guidelines can be used to interpret each of these categories:**

- **Established.** Sufficient evidence is available to confidently determine that a treatment produces favorable outcomes for individuals on the autism spectrum. That is, these treatments are established as effective.
- **Emerging.** Although one or more studies suggest that a treatment produces favorable outcomes for individuals with ASD, additional high quality studies must consistently show this outcome before we can draw firm conclusions about treatment effectiveness.
- **Unestablished.** There is little or no evidence to allow us to draw firm conclusions about treatment effectiveness with individuals with ASD. Additional research may show the treatment to be effective, ineffective, or harmful.
- **Ineffective/Harmful.** Sufficient evidence is available to determine that a treatment is ineffective or harmful for individuals on the autism spectrum.

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<sup>5</sup> Professionals often describe a treatment as “effective” when it has been shown to work in real world settings such as home, school, and community. For the purposes of this report, the word “effective” refers to studies conducted in real world, clinical, and research settings.

<sup>6</sup> The Strength of Evidence Classification System was modified to its current four-point format to ease interpretation of outcomes for the general public. Although the Strength of Evidence Classification System was modified from a six-point format, the interpretation of outcomes remains identical across formats. For example, all treatments that were previously identified as having sufficient evidence of effectiveness did not vary across the two systems.

**Table 2}** Strength of Evidence Classification System

Established	Emerging	Unestablished	Ineffective/Harmful
<p>Several<sup>a</sup> published, peer-reviewed studies</p> <ul style="list-style-type: none"> <li>• Scientific Merit Rating Scales scores of 3, 4, or 5</li> <li>• Beneficial treatment effects for a specific target</li> </ul> <p>These may be supplemented by studies with lower scores on the Scientific Merit Rating Scale.</p>	<p>Few<sup>b</sup> published, peer-reviewed studies</p> <ul style="list-style-type: none"> <li>• Scientific Merit Rating Scale scores of 2</li> <li>• Beneficial treatment effects reported for one dependent variable for a specific target</li> </ul> <p>These may be supplemented by studies with higher or lower scores on the Scientific Merit Rating Scale.</p>	<p>May or may not be based on research</p> <ul style="list-style-type: none"> <li>• Beneficial treatment effects reported based on very poorly controlled studies (scores of 0 or 1 on the Scientific Merit Rating Scale)</li> <li>• Claims based on testimonials, unverified clinical observations, opinions, or speculation</li> <li>• Ineffective, unknown, or adverse treatment effects reported based on poorly controlled studies</li> </ul>	<p>Several<sup>a</sup> published, peer-reviewed studies</p> <ul style="list-style-type: none"> <li>• Scientific Merit Rating Scales scores of 3</li> <li>• No beneficial treatment effects reported for one dependent measure for a specific target (Ineffective)</li> </ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> <li>• Adverse treatment effects reported for one dependent variable for a specific target (Harmful)</li> </ul> <p>Note: Ineffective treatments are indicated with an "I" and Harmful treatments are indicated with an "H"</p>

<sup>a</sup> Several is defined as 2 group design or 4 single-subject design studies with a minimum of 12 participants for which there are no conflicting results or at least 3 group design or 6 single-subject design studies with a minimum of 18 participants with no more than 1 study reporting conflicting results. Group and single-case design methodologies may be combined.

<sup>b</sup> Few is defined as a minimum of 1 group design study or 2 single-subject design studies with a minimum of 6 participants for which no conflicting results are reported.\* Group and single-subject design methodologies may be combined.

\*Conflicting results are reported when a better or equally controlled study that is assigned a score of at least 3 reports either {a} ineffective treatment effects or {b} adverse treatment effects.

# 3

## Outcomes

### Established Treatments

We identified 11 treatments as Established (i.e., they were established as effective) for individuals with Autism Spectrum Disorders (ASD). Established Treatments are those for which several well-controlled studies have shown the intervention to produce beneficial effects. There is compelling scientific evidence to show these treatments are effective; however, even among Established Treatments, universal improvements cannot be expected to occur for all individuals on the autism spectrum.

The following interventions are Established Treatments:

- Antecedent Package
- Behavioral Package
- Comprehensive Behavioral Treatment for Young Children
- Joint Attention Intervention
- Modeling
- Naturalistic Teaching Strategies
- Peer Training Package
- Pivotal Response Treatment
- Schedules
- Self-management
- Story-based Intervention Package

Each of these treatments is defined below. Whenever possible, we provided examples of treatment strategies associated with each Established Treatment. These examples should also be considered Established Treatments for individuals with ASD. The number of studies conducted that contributed to this rating is listed in brackets after the treatment name.

## Established Treatments with definitions and examples:

- **Antecedent Package** {99 studies}. These interventions involve the modification of situational events that typically precede the occurrence of a target behavior. These alterations are made to increase the likelihood of success or reduce the likelihood of problems occurring. Treatments falling into this category reflect research representing the fields of applied behavior analysis (ABA), behavioral psychology, and positive behavior supports.

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Examples include but are not restricted to: behavior chain interruption (for increasing behaviors); behavioral momentum; choice; contriving motivational operations; cueing and prompting/prompt fading procedures; environmental enrichment; environmental modification of task demands, social comments, adult presence, intertrial interval, seating, familiarity with stimuli; errorless learning; errorless compliance; habit reversal; incorporating echolalia, special interests, thematic activities, or ritualistic/obsessional activities into tasks; maintenance interspersal; noncontingent access; noncontingent reinforcement; priming; stimulus variation; and time delay.

- **Behavioral Package** {231 studies}. These interventions are designed to reduce problem behavior and teach functional alternative behaviors or skills through the application of basic principles of behavior change. Treatments falling into this category reflect research representing the fields of applied behavior analysis, behavioral psychology, and positive behavior supports.

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Examples include but are not restricted to: behavioral sleep package; behavioral toilet training/dry bed training; chaining; contingency contracting; contingency mapping; delayed contingencies; differential reinforcement strategies; discrete trial teaching; functional communication training; generalization training; mand training; noncontingent escape with instructional fading; progressive relaxation; reinforcement; scheduled awakenings; shaping; stimulus-stimulus pairing with reinforcement; successive approximation; task analysis; and token economy.

Treatments involving a complex combination of behavioral procedures that may be listed elsewhere in this document are also included in the behavioral package category. Examples include but are not restricted to: choice + embedding + functional communication training + reinforcement; task interspersal with differential reinforcement; tokens + reinforcement + choice + contingent exercise + overcorrection; noncontingent reinforcement + differential reinforcement; modeling + contingency management; and schedules + reinforcement + redirection + response prevention. Studies targeting verbal operants also fall into this category.

● **Comprehensive Behavioral Treatment for Young Children** {22 studies}. This treatment reflects research from comprehensive treatment programs that involve a combination of applied behavior analytic procedures (e.g., discrete trial, incidental teaching, etc.) which are delivered to young children (generally under the age of 8). These treatments may be delivered in a variety of settings (e.g., home, self-contained classroom, inclusive classroom, community) and involve a low student-to-teacher ratio (e.g., 1:1). All of the studies falling into this category met the strict criteria of: {a} targeting the defining symptoms of ASD, {b} having treatment manuals, {c} providing treatment with a high degree of intensity, and {d} measuring the overall effectiveness of the program (i.e., studies that measure subcomponents of the program are listed elsewhere in this report).

These treatment programs may also be referred to as ABA programs or behavioral inclusive program and early intensive behavioral intervention.

● **Joint Attention Intervention** {6 studies}. These interventions involve building foundational skills involved in regulating the behaviors of others. Joint attention often involves teaching a child to respond to the nonverbal social bids of others or to initiate joint attention interactions.

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Examples include pointing to objects, showing items/activities to another person, and following eye gaze.

● **Modeling** {50 studies}. These interventions rely on an adult or peer providing a demonstration of the target behavior that should result in an imitation of the target behavior by the individual with ASD. Modeling can include simple and complex behaviors. This intervention is often combined with other strategies such as prompting and reinforcement.

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Examples include live modeling and video modeling.

### ● **Naturalistic Teaching Strategies**

{32 studies}. These interventions involve using primarily child-directed interactions to teach functional skills in the natural environment. These interventions often involve providing a stimulating environment, modeling how to play, encouraging conversation, providing choices and direct/natural reinforcers, and rewarding reasonable attempts.

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Examples of this type of approach include but are not limited to focused stimulation, incidental teaching, milieu teaching, embedded teaching, and responsive education and prelinguistic milieu teaching.

### ● **Peer Training Package**

{33 studies}. These interventions involve teaching children without disabilities strategies for facilitating play and social interactions with children on the autism spectrum. Peers may often include classmates or siblings. When both initiation training and peer training were components of treatment in a study, the study was coded as “peer training package.” These interventions may include components of other treatment packages (e.g., self-management for peers, prompting, reinforcement, etc.).

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Common names for intervention strategies include peer networks, circle of friends, buddy skills package, Integrated Play Groups™, peer initiation training, and peer-mediated social interactions.

### ● **Pivotal Response Treatment**

{14 studies}. This treatment is also referred to as PRT, Pivotal Response Teaching, and Pivotal Response Training. PRT focuses on targeting “pivotal” behavioral areas—such as motivation to engage in social communication, self-initiation, self-management, and responsiveness to multiple cues, with the development of these areas having the goal of very widespread and fluently integrated collateral improvements. Key aspects of PRT intervention delivery also focus on parent involvement in the intervention delivery, and on intervention in the natural environment such as homes and schools with the goal of producing naturalized behavioral improvements.

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This treatment is an expansion of Natural Language Paradigm which is also included in this category.

### ● **Schedules**

{12 studies}. These interventions involve the presentation of a task list that communicates a series of activities or steps required to complete a specific activity. Schedules are often supplemented by other interventions such as reinforcement.

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Schedules can take several forms including written words, pictures or photographs, or work stations.



● **Self-management** {21 studies}. These interventions involve promoting independence by teaching individuals with ASD to regulate their behavior by recording the occurrence/non-occurrence of the target behavior, and securing reinforcement for doing so. Initial skills development may involve other strategies and may include the task of setting one's own goals. In addition, reinforcement is a component of this intervention with the individual with ASD independently seeking and/or delivering reinforcers.

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Examples include the use of checklists (using checks, smiley/frowning faces), wrist counters, visual prompts, and tokens.

● **Story-based Intervention Package** {21 studies}. Treatments that involve a written description of the situations under which specific behaviors are expected to occur. Stories may be supplemented with additional components (e.g., prompting, reinforcement, discussion, etc.).

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Social Stories™ are the most well-known story-based interventions and they seek to answer the “who,” “what,” “when,” “where,” and “why” in order to improve perspective-taking.

The Established Treatments identified in this document arise from diverse theoretical orientations or fields of study.

However, certain trends emerged from an examination of these Established Treatments. Approximately two-thirds of the Established Treatments were developed exclusively from the behavioral literature (e.g., applied behavior analysis, behavioral psychology, and positive behavioral supports). Of the remaining one-third, 75% represent treatments for which research support comes predominantly from the behavioral literature. Additional contributions were made from the non-behavioral literature emanating from the fields of speech-language pathology and special education. These researchers often gave strong emphasis to developmental considerations. Less than 10% (i.e.,

Story-based Intervention Package) of the total number of Established Treatments arose from the theory of mind perspective. Interestingly, even these interventions often included a behavioral component.

This pattern of findings suggests that treatments from the behavioral literature have the strongest research support at this time. Yet it is important to recognize that treatments based on alternative theories, in isolation or combined with behavioral interventions, should continue to be examined empirically. Further, it demonstrates that all treatment studies can be compared against a common methodological standard and show evidence of effectiveness. Despite the preponderance of evidence associated with the behavioral literature, it is important to acknowledge the important contributions non-behavioral approaches are making at present, and to fund research examining both the behavioral and non-behavioral literature as we move forward.

## Detailed Summary of Established Treatments

Most treatments are not intended to address every treatment target (i.e., skills to be increased or behaviors to be decreased). Similarly, they may not be developed with the expectation that they will target every age or diagnostic group. For example, joint attention is a skill set that typically develops in very young children. Knowing this, we would expect to see most of the research on joint attention conducted with infants, toddlers, or preschool-aged children. In fact, this is exactly what our review shows. However, whenever a treatment could reasonably be effective for different treatment targets, age groups, or diagnostic groups, researchers should set as a goal to extend research into these different targets or groups.

Table 3 shows which Established Treatments have demonstrated favorable outcomes for each treatment target, age group, or diagnostic group. Although not all Established Treatments should be expected to apply to each of these areas, many of these interventions could be applied to a broader array of treatments. A brief summary follows.

### Treatment Targets

Established Treatments have demonstrated favorable outcomes for many treatment targets. See Appendix 4 for definitions for each of the treatment targets.

- Antecedent Package, Behavioral Package, and Comprehensive Behavioral Treatment for Young Children have demonstrated favorable outcomes with more than half of the skills that are often targeted to be increased (see Table 3 for examples).
- Behavioral Package has demonstrated favorable outcomes with three-quarters of the behaviors that are often targeted to decrease (see Table 3 for examples).
- Other Established Treatments have demonstrated favorable outcomes with a smaller range of treatment targets. In many cases, this provides a rich opportunity to extend research findings.

## Age Groups

Established Treatments have demonstrated favorable outcomes with many age groups.

- Behavioral Package has demonstrated favorable outcomes with all age groups.
- Antecedent Package, Comprehensive Behavioral Treatment for Young Children, Modeling, and Self-management have demonstrated favorable outcomes with two-thirds of all age groups.
- Naturalistic Teaching Strategies have demonstrated favorable outcomes with one-half of all age groups.
- Only one Established Treatment has been associated with favorable outcomes for the early adult age group. Further investigation is necessary for this age group.
- Other Established Treatments have demonstrated favorable outcomes with a small range of age groups. In many cases, this provides a rich opportunity to extend research findings.

## Diagnostic Groups

Established Treatments have demonstrated favorable outcomes with many diagnostic groups.

- Behavioral Package, Comprehensive Behavioral Treatment for Young Children, Joint Attention Intervention, Modeling, Naturalistic Teaching Strategies, and Peer Training Package have demonstrated favorable outcomes with most diagnostic groups.
- A few Established Treatments (i.e., Modeling and Story-based Intervention Package) have been associated with favorable outcomes for Asperger's Syndrome. Further investigation is necessary for this diagnostic group.
- Other Established Treatments have demonstrated favorable outcomes with a smaller range of diagnostic groups. In many cases, this provides a rich opportunity to extend research findings.

**Table 3}** Established Treatments with Favorable Outcomes Reported

Skills Increased					
Academic	Communication	Higher Cognitive Functions	Interpersonal	Learning Readiness	
Behavioral Package	Antecedent Package Behavioral Package CBTYC Joint Attention Modeling NTS Peer Training PRT	CBTYC Modeling	Antecedent Package Behavioral Package CBTYC Joint Attention Modeling NTS Peer Training PRT Self-management Story-based	Antecedent Package Behavioral Package NTS	
Motor	Personal Responsibility	Placement	Play	Self-Regulation	
CBTYC	Antecedent Package Behavioral Package CBTYC Modeling	CBTYC	Antecedent Package Behavioral Package CBTYC Modeling NTS Peer Training PRT	Antecedent Package Behavioral Package Schedules Self-management Story-based	
Behaviors Decreased					
Problem Behaviors	Restricted, Repetitive, Nonfunctional Behavior, Interests, or Activities		Sensory/Emotional Regulation	General Symptoms	
Antecedent Package Behavioral Package CBTYC Modeling Self-management	Behavioral Package Peer Training		Antecedent Package Behavioral Package Modeling	CBTYC	
Ages					
0-2	3-5	6-9	10-14	15-18	19-21
Behavioral CBTYC Joint Attention NTS	Antecedent Behavioral CBTYC Joint Attention Modeling NTS Peer Training PRT Schedules Self-management	Antecedent Behavioral CBTYC Modeling NTS Peer Training PRT Schedules Self-management Story-based	Antecedent Behavioral Modeling Peer Training Schedules Self-management Story-based	Antecedent Behavioral Modeling Self-management	Behavioral
Diagnostic Classification					
Autistic Disorder		Asperger's Syndrome		PDD-NOS	
Antecedent Behavioral CBTYC Joint Attention Modeling NTS		Peer Training PRT Schedules Self-management Story-based		Modeling Story-based	
				Behavioral Package CBTYC Joint Attention Modeling NTS Peer Training	

Antecedent=Antecedent Package; Behavioral=Behavioral Package; CBTYC=Comprehensive Behavioral Treatment for Young Children; Joint Attention=Joint Attention Intervention; NTS=Naturalistic Teaching Strategies; Peer Training=Peer Training Package; PRT=Pivotal Response Treatment; Story-based=Story-based Intervention Package

## Emerging Treatments

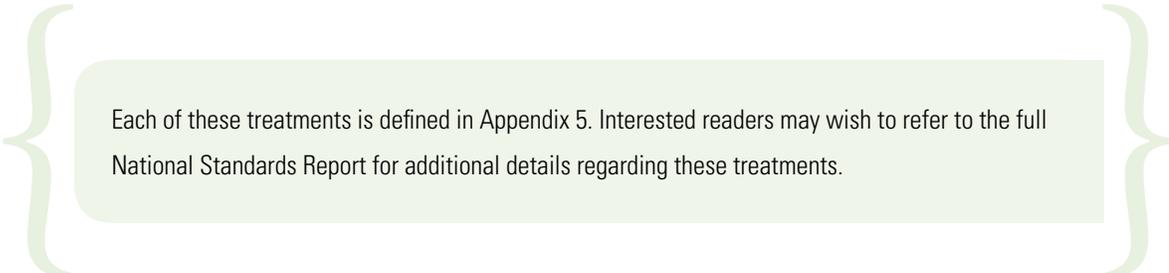
Emerging Treatments are those for which one or more studies suggest the intervention may produce favorable outcomes. However, additional high quality studies that consistently show these treatments to be effective for individuals with ASD are needed before we can be fully confident that the treatments are effective. Based on the available evidence, we are not yet in a position to rule out the possibility that Emerging Treatments are, in fact, not effective.

A large number of studies fall into the “Emerging” level of evidence. We believe scientists should find fertile ground for further research in these areas. The number of studies conducted that contributed to this rating is listed in parentheses after the treatment name.

**The following treatments have been identified as falling into the Emerging level of evidence:**

- Augmentative and Alternative Communication Device {14 studies}
- Cognitive Behavioral Intervention Package {3 studies}
- Developmental Relationship-based Treatment {7 studies}
- Exercise {4 studies}
- Exposure Package {4 studies}
- Imitation-based Interaction {6 studies}
- Initiation Training {7 studies}
- Language Training (Production) {13 studies}
- Language Training (Production & Understanding) {7 studies}
- Massage/Touch Therapy {2 studies}
- Multi-component Package {10 studies}

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- Music Therapy {6 studies}
  - Peer-mediated Instructional Arrangement {11 studies}
  - Picture Exchange Communication System {13 studies}
  - Reductive Package {33 studies}
  - Scripting {6 studies}
  - Sign Instruction {11 studies}
  - Social Communication Intervention {5 studies}
  - Social Skills Package {16 studies}
  - Structured Teaching {4 studies}
  - Technology-based Treatment {19 studies}
  - Theory of Mind Training {4 studies}



Each of these treatments is defined in Appendix 5. Interested readers may wish to refer to the full National Standards Report for additional details regarding these treatments.

## Unestablished Treatments

Unestablished Treatments are those for which there is little or no evidence in the scientific literature that allows us to draw firm conclusions about the effectiveness of these interventions with individuals with ASD. There is no reason to assume these treatments are effective. Further, there is no way to rule out the possibility these treatments are ineffective or harmful.

The following treatments have been identified as falling into the Unestablished level of evidence:

- Academic Interventions {10 studies}
- Auditory Integration Training {3 studies}
- Facilitated Communication {5 studies}

*Note: The National Standards Project followed strict inclusionary/exclusionary criteria. As a result, we eliminated a large number of studies on the treatment of Facilitated Communication that {a} involved adults 22 years of age or older, {b} involved individuals with infrequently occurring co-morbid conditions, and {c} focused on the adult facilitators (as opposed to the individuals with ASD). Although our results indicate Facilitated Communication is an “Unestablished Treatment,” we believe it is necessary to make readers aware that a number of professional organizations have adopted resolutions advising against the use of facilitated communication. These resolutions are often related to concerns regarding “immediate threats to the individual civil and human rights of the person with autism...” (American Psychological Association, 1994).*

- Gluten- and Casein-Free Diet {3 studies}

*Note: Early studies suggested that the Gluten- and Casein-Free diet may produce favorable outcomes but did not have strong scientific designs. Better controlled research published since 2006 suggests there may be no educational or behavioral benefits for these diets. Further, potential medically harmful effects have begun to be reported in the literature. We recommend reading the following studies before considering this option:*

1. Arnold, G. L., Hyman, S. L., Mooney, R. A., & Kirby, R. S. (2003). Plasma amino acids profiles in children with autism: Potential risk of nutritional deficiencies, *Journal of Autism and Developmental Disabilities*, 33, 449-454.
2. Heiger, M. L., England, L. J., Molloy, C. A., Yu, K. F., Manning-Courtney, P., & Mills, J. L. (2008). Reduced bone cortical thickness in boys with autism or autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 38, 848-856.

- Sensory Integrative Package {7 studies}

Each of these treatments is defined in Appendix 5. Interested readers may wish to refer to the full National Standards Report for additional details regarding these treatments.

There are likely many more treatments that fall into this category for which no research has been conducted or, if studies have been published, the accepted process for publishing scientific work was not followed. There are a growing number of treatments that have not yet been investigated scientifically. These would all be Unestablished Treatments. Further, any treatments for which studies were published exclusively in non-peer-reviewed journals would be Unestablished Treatments.

## Ineffective/Harmful Treatments

Ineffective or Harmful Treatments are those for which several well-controlled studies have shown the intervention to be ineffective or to produce harmful outcomes, respectively. At this time, there are no treatments that have sufficient evidence specific to the ASD population that meet these criteria.

This outcome is not entirely unexpected. When preliminary research findings suggest a treatment is ineffective or harmful, researchers tend to change the focus of their scientific inquiries into treatments that may be effective. That is, research often stops once there is a suggestion that the treatment does not work or that it is harmful. Further, research showing a treatment to be ineffective or harmful may be available with different populations (e.g., developmental disabilities, general populations, etc.). Ethical researchers are not going to then apply these ineffective or harmful treatments specifically to children or adolescents on the autism spectrum just to show that the treatment is equally ineffective or harmful with individuals with ASD.

See the Evidence-based Practice section to learn how practitioners' knowledge of interventions outside the ASD population should be integrated into the decision-making process.

# 4

## Recommendations for Treatment Selection

Treatment selection is complicated and should be made by a team of individuals who can consider the unique needs and history of the individual with Autism Spectrum Disorder (ASD) along with the environments in which he or she lives. We do not intend for this document to dictate which treatments can or cannot be used for individuals on the autism spectrum.

Having stated this, we have been asked by families, educators, and service providers to recommend how our results might be helpful to them in their decision-making. As an effort to meet this request, we provide suggestions regarding the interpretation of our outcomes. In all cases, we strongly encourage decision-makers to select an evidence-based practice approach.

Research findings are not the sole factor that should be considered when treatments are selected. The suggestions we make here refer only to the “research findings” component of evidence-based practice and should be only one factor considered when selecting treatments.

### Recommendations based on research findings:

- Established Treatments have sufficient evidence of effectiveness. We recommend the decision-making team give serious consideration to these treatments because {a} these treatments have produced beneficial effects for individuals involved in the research studies published in the scientific literature, {b} access to treatments that work can be expected to produce more positive long-term outcomes, and {c} there is no evidence of harmful effects. However, it should not be assumed that these treatments will universally produce favorable outcomes for all individuals on the autism spectrum.
- Given the limited research support for Emerging Treatments, we generally do not recommend *beginning* with these treatments. However, Emerging Treatments should be considered promising and warrant serious consideration if Established Treatments are deemed inappropriate by the decision-making team. There are several very legitimate reasons this might be the case (see examples in the Professional Judgment or Values and Preferences sections of Chapter 5).
- Unestablished Treatments either have no research support or the research that has been conducted does not allow us to draw firm conclusions about treatment effectiveness for individuals with ASD. When this is the case, decision-makers simply do not know if this treatment is effective, ineffective, or harmful because researchers have not conducted any or enough high quality research. Given how little is known about these treatments, we would recommend considering these treatments *only* after additional research has been conducted and this research shows them to produce favorable outcomes for individuals with ASD.

These recommendations should be considered along with other sources of critical information when selecting treatments (see Chapter 5).

# 5

## Evidence-based Practice

One of the primary objectives of this document is to identify evidence-based treatments. We are not alone in this activity. The National Standards Project is a natural extension of the efforts of the National Research Council {2001}, the New York State Department of Health, Early Intervention Division {1999}, and other related documents produced at state and national levels.

Knowing which treatments have sufficient evidence of effectiveness is likely to—and should—influence treatment selection. Evidence-based practice, however, is more complicated than simply knowing which treatments are effective. Although we argue that knowing which treatments have evidence of effectiveness is essential, other critical factors must also be taken into consideration.

**We have identified the following four factors of evidence-based practice:**

- **Research Findings.** The strength of evidence ratings for all treatments being considered must be known. Serious consideration should be given to Established Treatments because there is sufficient evidence that {a} the treatment produced beneficial effects and {b} they are not associated with unfavorable outcomes (i.e., there is no evidence that they are ineffective or harmful) for individuals on the autism spectrum.

Ideally, treatment selection decisions should involve discussing the benefits of various Established Treatments. Despite the fact there is compelling evidence to suggest these treatments generally produce beneficial effects for individuals on the autism spectrum, there are reasons alternative treatments (e.g., Emerging Treatments) might be considered. A number of these factors are listed below.

- **Professional Judgment.** The judgment of the professionals with expertise in Autism Spectrum Disorders (ASD) must be taken into consideration. Once treatments are selected, these professionals have the responsibility to collect data to determine if a treatment is effective. Professional judgment may play a particularly important role in decision-making when:
  - A treatment has been correctly implemented in the past and was not effective or had harmful side effects. Even Established Treatments are not expected to produce favorable outcomes for all individuals with ASD.

- ▶ The treatment is contraindicated based on other information (e.g., the use of extra-stimulus prompts for a child with a prompt dependency history).
  - ▶ A great deal of research support might be available beyond the ASD literature and should be considered when required. For example, if an adolescent with ASD presents with anxiety or depression, it might be necessary to identify what treatments are effective for anxiety or depression for the general population. The decision to incorporate outside literature into decision-making should only be made after practitioners are familiar with the ASD-specific treatments. Research that has not been specifically demonstrated to be effective with individuals with ASD should be given consideration along with the ASD-specific treatments only if compelling data support their use and the ASD-specific literature has not fully investigated the treatment.
  - ▶ The professional may be aware of well-controlled studies that support the effectiveness of a treatment that were not available when the National Standards Project terminated its literature search.
- **Values and Preferences.** The values and preferences of parents, careproviders, and the individual with ASD should be considered. Stakeholder values and preference may play a particularly important role in decision-making when:
- ▶ A treatment has been correctly implemented in the past and was not effective or had harmful side effects.
  - ▶ A treatment is contrary to the values of family members.
  - ▶ The individual with ASD indicates that he or she does not want a specific treatment.
- **Capacity.** Treatment providers should be well positioned to correctly implement the intervention. Developing capacity and sustainability may take a great deal of time and effort, but all people involved in treatment should have proper training, adequate resources, and ongoing feedback about treatment fidelity. Capacity may play a particularly important role in decision-making when:
- ▶ A service delivery system has never implemented the intervention before. Many of these treatments are very complex and require precise use of techniques that can only be developed over time.
  - ▶ A professional is considered the “local expert” for a given treatment but he or she actually has limited formal training in the technique.
  - ▶ A service delivery system has implemented a system for years without a process in place to ensure the treatment is still being implemented correctly.

# 6

## Limitations

Like other projects of this nature, there are limitations to the National Standards Project. Readers should be familiar with these limitations in order to use this document most effectively.

### We have indentified the following limitations:

- This document focuses exclusively on research involving individuals with Autism Spectrum Disorders (ASD) who are under 22 years of age.
  - This document does not include a review of the literature for children “at risk” for ASD. New evidence suggests that very young children who are eventually diagnosed with autism have a genetic predisposition that alters their interactions with the typical learning environment.<sup>7</sup> This area is especially important because providing effective interventions (e.g., behavioral interventions) to these infants may be the first critical step to altering early brain development<sup>8</sup> so that the neural circuitry regulating social and communication functions more effectively.
  - This document does not include a review of the adult ASD literature.
  - This document is not an exhaustive review of all treatments for all individuals. There are treatments that might have solid research support for related populations (e.g., developmental disabilities, anxiety, depression, etc.) but have limited or no evidence of research support for individuals with ASD in the National Standards Report. See Chapter 5 for how this might influence treatment selection.
- As noted in the treatment classification section of this report, determining the categories for treatments presents a real challenge. This is equally true whenever comprehensive reviews of the literature are completed for any diagnostic group. Some of our experts suggested making the unit of analysis larger for some categories; others suggested making the unit of analysis smaller for most categories. In the end, we attempted to develop categories that “made sense.” We expect that

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<sup>7</sup> Klin, A., Lin, D.J., Gorrindo, P., Ramsay, G., & Jones, W. (2009). Two-year-olds with autism orient to non-social contingencies rather than biological motion. *Nature*, 1-7. doi:10.1038/nature07868.

<sup>8</sup> Dawson, G. (2008). Early behavioral intervention, brain plasticity, and the prevention of autism spectrum disorders. *Development and Psychopathology*, 20, 775-803.

many readers may be interested in more detailed analysis using a smaller unit of analysis, or data using on a different arrangement of treatment categories based on a larger unit of analysis. We look forward to your feedback to guide the next version of the National Standards Project.

- This review included an examination of most group and single-subject research design studies but did not include every type of study.
  - ▶ For this report, we only looked at research that was designed to answer questions about the measurable effectiveness of an intervention based on quantifiable data. We did not look at research that was designed to explore questions about the perceived quality of an intervention or the experiences of the children based on qualitative data.
  - ▶ There are studies relying on single-case or group design methods that were not included in this review because they fell outside the commonly agreed-upon criteria for evaluating the effectiveness of study outcomes. The experts involved in the development of these Standards made the decision to include only those methodologies that are generally agreed-upon by scientists as sufficient for answering the question, “Is this treatment effective?”
- ▶ We only included studies that have been published in professional journals. It is likely that some researchers conducted studies that provided different or additional data that have not been published. This could influence the reported quality, quantity, or consistency of research findings.
- When establishing interobserver agreement (IOA), field reviewers were asked to examine the coding manual and rate the pilot article they received. Ideally, we would have conducted a training session before they began rating the articles. Also, the pilot articles were selected randomly. Now that we have identified articles with the highest, moderate, and lowest ratings for both single-subject and group research designs, we will use these articles for establishing IOA in future versions of the National Standards Project.
- We did not include articles reviewed in languages other than English. This has the potential to influence the ratings reported in this document. For example, a study that was not included in this review was published in French on Integrated Play Groups™ (Richard & Goupil, 2005). We hope to include volunteer field reviewers from across the world who can effectively review the non-English literature in the next version of the National Standards Project.

- The National Standards Project did not evaluate the extent to which treatment approaches have been studied in “real world” versus laboratory settings. We hope to shed light on this issue in future versions of the National Standards Project.
- One of the primary purposes of the National Standards Project was to identify the level of research support currently available for a range of educational and behavioral interventions. We did not set as our goal the determination of the level of intensity required for delivery of these interventions. The next version of the National Standards Project may provide further analysis in this area. In the interim, we believe treatment providers should continue to follow the recommendations for intensity of services provided by the National Research Council regarding children less than 8 years of age. Specifically,

“ The committee recommends that educational services begin as soon as a child is suspected of having an autistic spectrum disorder. Those services should include a minimum of 25 hours a week, 12 months a year, in which the child is engaged in systematically planned, and developmentally appropriate educational activity toward identified objectives. What constitutes these hours, however, will vary according to a child’s chronological age, developmental level, specific strengths and weaknesses, and family needs. Each child must receive sufficient individualized attention on a daily basis so that adequate implementation of objectives can be carried out effectively. The priorities of focus include functional spontaneous communication, social instruction delivered throughout the day in various settings, cognitive development and play skills, and proactive approaches to behavior problems. To the extent that it leads to the acquisition of children’s educational goals, young children with an autistic spectrum disorder should receive specialized instruction in a setting in which ongoing interactions occur with typically developing children. ”

We argue that unless compelling reasons exist to do otherwise, intervention services should be comprised of Established Treatments and they should be delivered following the specifications outlined in the literature (e.g., appropriate use of resources, staff to student ratio, following the prescribed procedures, etc.).

- Writing a report of this type can be quite time-consuming. The National Standards Project terminated the literature review phase in September of 2007. Additional studies have been published in the interim that are not reflected in the current report. This means that if a review were conducted today, the strength of evidence ratings for a given treatment may have improved or be altered. We intend to regularly update this document to assist decision-makers in their selection of treatments. In the meantime, professionals should familiarize themselves with the literature published since the fall of 2007.
- Ideally, research answers important questions beyond treatment effectiveness. This report does not review the following areas that may be important in selecting treatments:
  - Cost-effectiveness;
  - Social validity;
  - Studies examining mediating or moderating variables. Mediating variables can help explain why a treatment is effective. Moderating variables can make a difference in the likelihood a treatment is effective for a given subpopulation; and
  - Research supporting Established Treatments may have been developed in analog settings (e.g., highly structured research settings), which may not reflect real world settings accurately.

Despite its limitations, we sincerely hope this document is useful to you. We also recognize that even more information might be helpful. For example, there may be new or different ways of organizing information that you believe could be useful. If you would like to help shape the direction of the next version of the National Standards Project, please provide feedback to the National Autism Center at [info@nationalautismcenter.org](mailto:info@nationalautismcenter.org).

# 7

## Future Directions

### Future Directions for the Scientific Community

One of the goals of the National Standards Project is to identify limitations of the existing literature base. We believe we have done so in two ways: {a} we have identified areas benefiting from or requiring future investigation and {b} we have developed the Scientific Merit Rating Scale and Strength of Evidence Classification System, against which future research can be compared. We expand on these issues below.

There is room for additional research for all treatments. It will be important to extend the current research base for Established Treatments to all reasonable treatment goals, age groups, and diagnostic groups. Additional research must be conducted for treatments falling in the Emerging and Unestablished Treatment categories to determine if {a} the treatments are effective and {b} the treatments are ineffective or harmful. High quality research is perhaps most important for treatments falling into the Unestablished Treatments category.

## Future Directions with Methodology

Five dimensions were identified for the Scientific Merit Rating Scale: {a} research design, {b} dependent variable, {c} treatment fidelity, {d} participant ascertainment, and {e} generalization (see Table 3). We identified these dimensions based on the most recent scientific standards that are being advocated in behavioral and social science research. However, scientific standards change over time.

For example, there were no psychometrically sound instruments specifically designed to diagnose Autism Spectrum Disorders (ASD) available when the earliest studies included in this review were conducted. If there had been, the instruments would look very different today based on changes in the diagnostic criteria over the years. For this reason, it is not surprising that many older studies did not achieve the highest possible ratings in this area.

Similarly, it is only recently that evidence of treatment fidelity has been consistently emphasized by the scientific community. This means that although many studies may do an excellent job of describing the procedures used, they still received low ratings on their ability to provide evidence that they completed all procedures exactly as prescribed. This leaves room for improvement in the scientific literature in either the research design or the extent to which scientists report on these important variables.

We encourage researchers to strive to meet the most rigorous standards of scientific merit in future research. We hope the Scientific Merit Rating Scale will assist them



in doing so. But it is also essential that journal editors recognize the importance of the five dimensions of scientific merit identified in this report. Important information may sometimes be cut from articles due to space limitations. We hope that researchers will be able to point to the Scientific Merit Rating Scale as an example of critical information that should never be removed from scholarly work.

The Strength of Evidence Classification System may be expanded over time to reflect additional scientific lines of inquiry. For example, it is reasonable to use alternate criteria for different research designs, which is why we did so in the current version of the Strength of Evidence Classification System. However, if qualitative research is included in the next version of the National Standards Project, the current version of the Strength of Evidence Classification System would be insufficient to accurately evaluate these studies.

# Future Directions for the National Standards Report

We aim to address many of the limitations of the current National Standards Report in future documents.

For example, we expect:

- To review literature covering the lifespan. This will include a special section on children “at risk” for ASD.
- To reconsider the inclusion of qualitative studies or other types of peer-reviewed studies that are currently excluded.
- To modify treatment classification based on feedback from the many experts in the autism community.
- To examine the extent to which treatments have been studied in “real world” versus laboratory settings.
- To add reviewers who can accurately interpret peer-reviewed articles published in non-English journals.

With additional funding, we hope to help address questions related to cost effectiveness, social validity, studies examining mediating variables, and effectiveness of treatments in real world settings.

We suspect that this report will raise additional questions that we hope to address in future publications. Our ultimate goal is to answer relevant questions related to evidence-based practice in response to the changing expectations of professionals and the needs of families, educators, and service providers.

## Appendix 1} Inclusionary and Exclusionary Criteria

### Inclusionary Criteria

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The National Standards Project is a systemic review of the behavioral and educational treatment literature involving individuals with Autism Spectrum Disorders (ASD) under the age of 22. For the purposes of this review, Autism Spectrum Disorders were defined to include Autistic Disorder, Asperger's Syndrome, and Pervasive Developmental Disorder—Not Otherwise Specified (PDD-NOS).

### Exclusionary Criteria

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Participants who were identified as “at risk” for an ASD or who were described as having “autistic characteristics” or “a suspicion of ASD” were not included in this review.

Studies were included if the treatments could have been implemented in or by school systems, including toddler, early childhood, home-based, school-based, and community-based programs.

Studies in which parents, care providers, educators, or service providers were the sole subject of treatment were not included in the review. If these adults were one subject but data were also available regarding changes in child behavior or skills, the study was retained, but only those results pertaining to the child's behavior or skills were included in the review.

Articles were only included in the review if they had been published in peer-reviewed journals.

Studies examining biochemical, genetic, and psychopharmacological treatments were excluded (see exception below). These treatments have not historically focused on the core characteristics of ASD. We made the decision to include curative diets because professionals are often expected to implement curative diets across a variety of settings with a high degree of fidelity and the treatment is intended to address the core characteristics of ASD.

Results for study participants who were diagnosed with both ASD and co-morbid conditions that do not commonly co-occur with ASD were excluded from this review because their results could skew the outcomes.

Articles were excluded if they did not include empirical data, if there were no statistical analyses available for studies using group research design, if there was no linear graphical presentation of data for studies using single-case research design, or if the studies relied on qualitative methods.

Studies were excluded if their sole purpose was to identify mediating or moderating variables.

Articles were excluded if all participants were over the age of 22 or if a study included participants both over and under the age of 22, but separate analyses were not conducted for individuals under the age of 22. We anticipate the next version of the National Standards Project will expand the focus of the review to include treatments involving participants across the lifespan.

Articles were excluded from the National Standards Project if they were published exclusively in languages other than English.

## Appendix 2} Scientific Merit Rating Scale

Research Design		Measurement of Dependent Variable		Measurement of Independent Variable <i>(procedural integrity or treatment fidelity)</i>	Participant Ascertainment	Generalization of Tx Effect(s)
Group	Single-subject <sup>a</sup>	Test, scale, checklist, etc.	Direct behavioral observation			
Number of groups: two or more  Design: Random assignment and/or no significant differences pre-Tx  Participants: n > 10 per group or sufficient power for lower number of participants  Data Loss: no data loss	A minimum of three comparisons of control and treatment conditions  Number of data points per condition: > five  Number of participants: > three  Data loss: no data loss possible	Type of measurement: Observation-based  Protocol: standardized  Psychometric properties solid instrument  Evaluators: blind and independent	Type of measurement: continuous or discontinuous with calibration data showing low levels of error  Reliability: IOA ≥ 90% or kappa > .75  Percentage of sessions: Reliability collected in ≥ 25%  Type of conditions in which data were collected: all sessions	Implementation accuracy measured at ≥ 80%  Implementation accuracy measured in 25% of total sessions  IOA for treatment fidelity ≥ 80%	Diagnosed by a qualified professional  Diagnosis confirmed by independent and blind evaluators for research purposes using at least one psychometrically solid instrument  DSM or ICD criteria or commonly accepted criteria during the identified time period reported to be met	Objective data  Maintenance data collected  AND  Generalization data collected across at least two of the following: setting, stimuli, persons

### SMRS} Rating 5

SMRS} Rating 4

Research Design		Measurement of Dependent Variable		Measurement of Independent Variable <i>(procedural integrity or treatment fidelity)</i>	Participant Ascertainment	Generalization of Tx Effect(s)
Group	Single-subject <sup>a</sup>	Test, scale, checklist, etc.	Direct behavioral observation			
Number of groups: two or more Design: Matched groups; No significant differences pre-Tx; or better design Participants: n > 10 per group or sufficient power for lower number of participants Data Loss: some data loss possible	A minimum of three comparisons of control and treatment conditions Number of data points per condition: > five Number of participants: > three Data loss: some data loss possible	Type of measurement: Observation-based measurement Protocol: standardized Psychometric properties sufficient Evaluators: blind OR independent	Type of measurement: continuous or discontinuous with no calibration data Reliability: IOA ≥ 80% or kappa > .75 Percentage of sessions: Reliability collected in ≥ 25% Type of conditions in which data were collected: all sessions	Implementation accuracy measured at ≥ 80% Implementation accuracy measured in 20% of total session for focused interventions only IOA for treatment fidelity: not reported	Diagnosis provided/confirmed by independent and blind evaluators for research purposes using at least one psychometrically sufficient instrument	Objective data Maintenance data collected AND Generalization data collected across at least one of the following: setting, stimuli, persons

SMRS} Rating 3

Research Design		Measurement of Dependent Variable		Measurement of Independent Variable <i>(procedural integrity or treatment fidelity)</i>	Participant Ascertainment	Generalization of Tx Effect(s)
Group	Single-subject <sup>a</sup>	Test, scale, checklist, etc.	Direct behavioral observation			
Number of groups: two or more Design: Pre-Tx differences controlled statistically or better design Data loss: some data loss possible	A minimum of two comparisons of control and treatment conditions Number of data points per condition: > three Number of participants: > two Data loss: some data loss possible	Type of measurement: Observation-based measurement Protocol: non-standardized or standardized Psychometric properties adequate Evaluators: neither blind nor independent required	Type of measurement: continuous or discontinuous with no calibration data Reliability: IOA $\geq$ 80% or kappa > .4 Percentage of sessions: Reliability collected in $\geq$ 20% Type of conditions in which data were collected: all or experimental sessions only	Implementation accuracy measured at $\geq$ 80% Implementation accuracy measured in 20% of partial session for focused interventions only IOA for treatment fidelity: not reported	Diagnosis provided/confirmed by independent OR blind evaluator for research purposes using at least one psychometrically adequate instrument OR DSM criteria confirmed by a qualified diagnostician or independent and/or blind evaluator	Objective data Maintenance data collected OR Generalization data collected across at least one of the following: setting, stimuli, persons

SMRS} Rating 2

Research Design		Measurement of Dependent Variable		Measurement of Independent Variable <i>(procedural integrity or treatment fidelity)</i>	Participant Ascertainment	Generalization of Tx Effect(s)
Group	Single-subject <sup>a</sup>	Test, scale, checklist, etc.	Direct behavioral observation			
<p>Number of groups and Design: If two groups, pre-Tx difference not controlled or better research design</p> <p>OR</p> <p>a one group repeated measures pre-test/post-test design</p> <p>Data Loss: significant data loss possible</p>	<p>A minimum of two comparisons of control and treatment conditions</p> <p>Number of data points per Tx condition: &gt; three</p> <p>Number of participants: &gt; two</p> <p>Data loss: significant data loss possible</p>	<p>Type of measurement: Observation-based or subjective</p> <p>Protocol: non-standardized or standardized</p> <p>Psychometric properties modest</p> <p>Evaluators: neither blind nor independent required</p>	<p>Type of measurement: continuous or discontinuous with no calibration data</p> <p>Reliability: IOA <math>\geq</math> 80% or kappa <math>&gt;</math> .4</p> <p>Percentage of sessions: Not reported</p> <p>Type of conditions in which data were collected: not necessarily reported</p> <p>Operational definitions are extensive or rudimentary</p>	<p>Control condition is operationally defined at an inadequate level or better</p> <p>Experimental (Tx) procedures are operationally defined at a rudimentary level or better</p> <p>Implementation accuracy measured at <math>\geq</math> 80%</p> <p>Implementation accuracy regarding percentage of total or partial sessions: not reported</p> <p>IOA for treatment fidelity: not reported</p>	<p>Diagnosis with at least one psychometrically modest instrument</p> <p>OR</p> <p>diagnosis provided by a qualified diagnostician or blind and/or independent evaluator with no reference to psychometric properties of instrument</p>	<p>Subjective data</p> <p>Maintenance data collected</p> <p>AND</p> <p>Generalization data collected across at least 1 of the following: setting, stimuli, persons</p>

**SMRS} Rating 1**

Research Design		Measurement of Dependent Variable		Measurement of Independent Variable <i>(procedural integrity or treatment fidelity)</i>	Participant Ascertainment	Generalization of Tx Effect(s)
Group	Single-subject <sup>a</sup>	Test, scale, checklist, etc.	Direct behavioral observation			
Number of groups and Design: two group, post-test only or better research design OR retrospective comparison of one or more matched groups Data loss: significant data loss possible	A minimum of two comparisons of control and treatment conditions  Number of participants: > one  Data loss: significant data loss possible	Type of measurement: Observation-based or subjective  Protocol: non-standardized or standardized  Psychometric properties weak  Evaluators: Neither blind nor independent required	Type of measurement: continuous or discontinuous with no calibration data  Type of conditions in which data were collected: not necessarily reported  Operational definitions are extensive or rudimentary	Control condition is operationally defined at an inadequate level or better  Experimental (Tx) procedures are operationally defined at a rudimentary level or better  IOA and procedural fidelity data are unreported	Diagnosis provided by {a} review of records  OR {b} instrument with weak psychometric support	Subjective or subjective supplemented with objective data  Maintenance data collected  OR Generalization data collected across at least one of the following: setting, stimuli, persons

**SMRS} Rating 0**

Does not meet criterion for a score of 1	Does not meet criterion for a score of 1	Does not meet criterion for a score of 1	Does not meet criterion for a score of 1	Does not meet criterion for a score of 1	Does not meet criterion for a score of 1	Does not meet criterion for a score of 1
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<sup>a</sup> For all designs except alternating treatments design (ATD). For an ATD, the following rules apply:

- {5} Comparison of baseline and experimental condition; ≥ five data points per experimental condition, follow-up data collected, carryover effects minimized through counterbalancing of key variables (e.g., time of day), and condition discriminability; n ≥ three; no data loss
- {4} Comparison of baseline and experimental condition; ≥ five data points per experimental condition; carryover effects minimized through counterbalancing of key variables (e.g., time of day), OR condition discriminability; n ≥ three; some data loss possible
- {3} ≥ five data points per condition, carryover effects minimized counterbalancing of key variables OR condition discriminability; n ≥ two; some data loss possible
- {2} ≥ five data points per condition; n ≥ two; significant data loss possible
- {1} ≥ five data points per condition; n ≥ one; significant data loss possible
- {0} Does not meet criterion for a score 1

## Appendix 3} Treatment Effects

<b>Beneficial Treatment Effects Reported</b>	<b>Unknown Treatment Effects Reported</b>	<b>Ineffective Effects Reported</b>	<b>Adverse Treatment Effects Reported</b>
<p><b>Single:</b> A functional relation is established and is replicated at least two times</p>	<p><b>For all research designs:</b> The nature of the data does not allow for firm conclusions about whether the treatment effects are beneficial, ineffective, or adverse</p>	<p><b>Single:</b> A functional relation was not established and {a} results were not replicated but at least two replications were attempted {b} a minimum of five data points were collected in baseline and treatment conditions {c} a minimum of two participants were included {d} a fair or good point of comparison (e.g., steady state) existed</p>	<p><b>Single:</b> A functional relation is established and is replicated at least two times  The treatment resulted in greater deficit or harm on the dependent variable based on a comparison to baseline conditions</p>
<p><b>ATD:</b> Moderate or strong separation between at least two data series for most participants  Carryover effects were minimized  A minimum of five data points per condition</p>		<p><b>ATD:</b> No separation was reported and baseline data show a stable pattern of responding during baseline and treatment conditions for most participants</p>	<p><b>ATD:</b> Moderate or strong separation between at least two data series for most participants  Carryover effects were minimized  A minimum of five data points per condition  Treatment conditions showed the treatment produced greater deficit or harm for most or all participants when compared to baseline</p>
<p><b>Group:</b> Statistically significant effects reported in favor of the treatment</p>		<p><b>Group:</b> No statistically significant effects were reported with sufficient evidence an effect would likely have been found*  *The criterion includes: {a} there was sufficient power to detect a small effect {b} the type I error rate was liberal, {c} no efforts were made to control for experiment-wise Type I error rate, and {d} participants were engaged in treatment</p>	<p><b>Group:</b> Statistically significant finding reported indicating a treatment resulted in greater deficit or harm on any of the dependent variables</p>

## Appendix 4} Treatment Target Definitions

### Skills Targeted for Increase

---

***Academic***

Tasks required for success with school activities

***Communication***

Tasks that involve nonverbal or verbal methods of sharing experiences, emotions, information

***Higher Cognitive Functions***

Tasks that require complex problem-solving skills outside the social domain

***Interpersonal***

Tasks that require social interaction with one or more individuals

***Learning Readiness***

Tasks that serve as the foundation for successful mastery of complex skills in other domains

***Motor Skills***

Tasks that require coordination of muscle systems to produce a specific goal involving either fine motor or gross motor skills

***Personal Responsibility***

Tasks that involve activities embedded into everyday routines

***Placement<sup>1</sup>***

Identification of a placement into a particular setting

***Play***

Tasks that involve non-academic and non-work related activities that do not involve self-stimulatory behavior or require interaction with other people

***Self-Regulation***

Tasks that involve the management of one's own behaviors in order to meet a goal

### Skills Targeted for Decrease

---

***General Symptoms***

General Symptoms includes a combination of symptoms that may be directly associated with ASD or may be a result of psychoeducational needs that are sometimes associated with ASD

***Problem Behaviors***

Behaviors that can be harmful to the individual or others, result in damage to objects, or interfere with the expected routines in the community

***Restricted, Repetitive, Nonfunctional patterns of behavior, interests, or activity (RRN)***

Limited, frequently repeated, maladaptive patterns of motor activity, speech, and thoughts

***Sensory or Emotional Regulation (SER)***

Sensory and emotional regulation refers to the extent to which an individual can flexibly modify his or her level of arousal or response to function effectively in the environment

<sup>1</sup> Although placement is not a "skill," it represents an important accomplishment toward which intervention programs strive.

## Appendix 5} Names and Definitions of Emerging and Unestablished Treatments

### Emerging Treatments

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#### *Augmentative and Alternative*

##### *Communication Device (AAC)*

These interventions involved the use of high or low technologically sophisticated devices to facilitate communication. Examples include but are not restricted to: pictures, photographs, symbols, communication books, computers, or other electronic devices.

#### *Cognitive Behavioral Intervention Package*

These interventions focus on changing everyday negative or unrealistic thought patterns and behaviors with the aim of positively influencing emotions and/or life functioning.

#### *Developmental Relationship-based Treatment*

These treatments involve a combination of procedures that are based on developmental theory and emphasize the importance of building social relationships. These treatments may be delivered in a variety of settings (e.g., home, classroom, community). All of the studies falling into this category met the strict criteria of: {a} targeting the defining symptoms of ASD, {b} having treatment manuals, {c} providing treatment with a high degree of intensity, and {d} measuring the overall effectiveness of the program (i.e., studies that measure subcomponents of the program are listed elsewhere in this report). These treatment programs may also be referred to as the Denver Model, DIR (Developmental, Individual Differences, Relationship-based)/Floortime, Relationship Development Intervention, or Responsive Teaching.

#### *Exercise*

These interventions involve an increase in physical exertion as a means of reducing problems behaviors or increasing appropriate behavior.

#### *Exposure Package*

These interventions require that the individual with ASD increasingly face anxiety-provoking situations while preventing the use of maladaptive strategies used in the past under these conditions.

#### *Imitation-based Interaction*

These interventions rely on adults imitating the actions of a child.

#### *Initiation Training*

These interventions involve directly teaching individuals with ASD to initiate interactions with their peers.

#### *Language Training (Production)*

These interventions have as their primary goal to increase speech production. Examples include but are not restricted to: echo relevant word training, oral communication training, oral verbal communication training, structured discourse, simultaneous communication, and individualized language remediation.

***Language Training (Production & Understanding)***

These interventions have as their primary goals to increase both speech production and understanding of communicative acts. Examples include but are not restricted to: total communication training, position object training, position self-training, and language programming strategies.

***Massage/Touch Therapy***

These interventions involve the provision of deep tissue stimulation.

***Multi-component Package***

These interventions involve a combination of multiple treatment procedures that are derived from different fields of interest or different theoretical orientations. These treatments do not better fit one of the other treatment “packages” in this list nor are they associated with specific treatment programs.

***Music Therapy***

These interventions seek to teach individual skills or goals through music. A targeted skill (e.g., counting, learning colors, taking turns, etc.) is first presented through song or rhythmic cuing and music is eventually faded.

***Peer-mediated Instructional Arrangement***

These interventions involve targeting academic skills by involving same-aged peers in the learning process. This approach is also described as peer tutoring.

***Picture Exchange Communication System***

This treatment involves the application of a specific augmentative and alternative communication system based on behavioral principles that are designed to teach functional communication to children with limited verbal and/or communication skills.

***Reductive Package***

These interventions rely on strategies designed to reduce problem behaviors in the absence of increasing alternative appropriate behaviors. Examples include but are not restricted to water mist, behavior chain interruption (without attempting to increase an appropriate behavior), protective equipment, and ammonia.

***Scripting***

These interventions involve developing a verbal and/or written script about a specific skill or situation which serves as a model for the child with ASD. Scripts are usually practiced repeatedly before the skill is used in the actual situation.

***Sign Instruction***

These interventions involve the direct teaching of sign language as a means of communicating with other individuals in the environment.

***Social Communication Intervention***

These psychosocial interventions involve targeting some combination of social communication impairments such as pragmatic communication skills, and the inability to successfully read social situations. These treatments may also be referred to as social pragmatic interventions.

***Social Skills Package***

These interventions seek to build social interaction skills in children with ASD by targeting basic responses (e.g., eye contact, name response) to complex social skills (e.g., how to initiate or maintain a conversation).

***Structured Teaching***

Based on neuropsychological characteristics of individuals with autism, this intervention involves a combination of procedures that rely heavily on the physical organization of a setting, predictable schedules, and individualized use of teaching methods. These procedures assume that modifications in the environment, materials, and presentation of information can make thinking, learning, and understanding easier for people with ASD if they are adapted to individual learning styles of autism and individual learning characteristics. All of the studies falling into this category met the strict criteria of: (a) targeting the defining symptoms of ASD; (b) having treatment manuals; (c) providing treatment with a high degree of intensity; and (d) measuring the overall effectiveness of the program (i.e., studies that measure subcomponents of the program are listed elsewhere in this report). These treatment programs may also be referred to as TEACCH (Treatment and Education of Autistic and related Communication-Handicapped Children).

***Technology-based Treatment***

These interventions require the presentation of instructional materials using the medium of computers or related technologies. Examples include but are not restricted to Alpha Program, Delta Messages, the Emotion Trainer Computer Program, pager, robot, or a PDA (Personal Digital Assistant). The theories behind Technology-based Treatments may vary but they are unique in their use of technology.

***Theory of Mind Training***

These interventions are designed to teach individuals with ASD to recognize and identify mental states (i.e., a person's thoughts, beliefs, intentions, desires and emotions) in oneself or in others and to be able to take the perspective of another person in order to predict their actions.

## Unestablished Treatments

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### *Academic Interventions*

These interventions involve the use of traditional teaching methods to improve academic performance. Examples include but are not restricted to: “personal instruction”; paired associate; picture-to-text matching; The Expression Connection; answering pre-reading questions; completing cloze sentences; resolving anaphora; sentence combining; “special education”; speech output and orthographic feedback; and handwriting training.

### *Auditory Integration Training*

This intervention involves the presentation of modulated sounds through headphones in an attempt to retrain an individual’s auditory system with the goal of improving distortions in hearing or sensitivities to sound.

### *Facilitated Communication*

This intervention involves having a facilitator support the hand or arm of an individual with limited communication skills, helping the individual express words, sentences, or complete thoughts by using a keyboard of words or pictures or typing device.

### *Gluten- and Casein-Free Diet*

These interventions involve elimination of an individual’s intake of naturally occurring proteins gluten and casein.

### *Sensory Integrative Package*

These treatments involve establishing an environment that stimulates or challenges the individual to effectively use all of their senses as a means of addressing overstimulation or understimulation from the environment.

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