



Naturalistic Developmental Behavioral Interventions

for AUTISM SPECTRUM
DISORDER

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Naturalistic Developmental Behavioral Interventions for Autism Spectrum Disorder

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Foreword

The outcomes of children with autism spectrum disorder (ASD) may be about to change radically for the better in the next decade. If so, a world of promise, rather than a world of challenges, may open to the approximately 66,000 children who are born every year in the United States alone who will have autism. This possibility is within the grasp of this coming generation of autism investigators and clinicians to attain, in deep collaboration with parents and community providers.

Yet, if we are to succeed in optimizing developmental potential and quality of life of the next generations of children with ASD, three priority goals need to be achieved. We need to identify ASD early; we need to translate early detection into access to evidence-based, effective early treatments; and we need to provide ongoing high-quality supports and solutions to children and families affected by ASD. The challenges in these domains are considerable but not insurmountable.

Why is early detection critical? By the time we celebrate a baby's first birthday, his or her brain has doubled, and synaptic density has quadrupled. Brain maturation guides a baby's experiences, which in turn deeply influences brain organization and continued specialization. By the end of their second year of life, babies have undergone their period of maximal lifetime neuroplasticity. By 18–24 months, there may be an emergence of autism symptoms, making possible reliable diagnosis by expert clinicians. For treatment to have optimal benefits, there is a need to capitalize on this early brain malleability, before speech-language and communication development is severely derailed and problem behaviors become entrenched. Yet, the median age of autism diagnosis has not changed in consecutive cohorts followed by Centers for Disease Control and Prevention surveillance efforts. Fifty percent of children with autism are diagnosed after the age of 4–5 years, and children from underserved populations—minorities, low income, rural—are diagnosed later still.

What is the solution? Despite some controversy on this topic in the past 5 years, most investigators, as well as science, policy, and advocacy organizations, believe that populationwide surveillance programs can effectively deploy universal screening for ASD and related developmental delays and that the screening process can be made actionable via increased access to diagnostic services.

The promise of early detection can only be delivered if screening programs are shown to increase access to effective early intervention services. Most studies of early treatment in autism have shown major benefits in learning and language acquisition. Yet, it is likely that the potential benefits of early treatment have

been grossly underestimated. One reason may be the fact that most investigations have focused on children age 3 years old and older; another reason may be the fact that most studies have reported on relatively small studies conducted by research groups rather than on population trends resulting from federally mandated birth-to-3 services. More studies are needed of early treatment involving toddlers if we are to take neuroplasticity seriously, and more “big data” studies of state-by-state indicators of service access and outcomes are needed if we are to judge the populationwide effects of the Program for Infants and Toddlers with Disabilities (Part C) of the Individuals with Disabilities Education Act (IDEA), and of the now 11-year-old recommendations of the American Academy of Pediatrics. The promise is clear: Optimize development and learning potential by age 3 years, and the child’s lifetime prospects are likely to change dramatically; make high-quality early treatment accessible, and the longtime, financial equation burdens are alleviated for individual families and for the entire health care and education systems. Yet, a large number of children with ASD receiving special education in their school years have not benefited from early treatment, and some who receive services before the age of 3 may obtain treatments that vary in quality and intensity, indeed services that may fail to maximize what might be achieved otherwise.

What is the solution? You are holding it in your hands. This book compiles the best promise we have of treatments that work, that leverage the best science we currently have, and that are scalable to meet the demands of the community at large. The authors on these pages are some of the leading innovators and experts in this field. Their commitment to evidence-based practice, to individualized and personalized treatments, and to the wedding of quality and access is second to none. Most of all, their commitment is to the families of children with autism and to the providers who are in the trenches: They need to navigate a labyrinth of information, some of which is questionable or even predatory, in order to identify and secure what is best for children. The authors of this book make this task easy and straightforward. Unhelpful arguments that verge on ideological fights are left behind; acronyms that create differences when there are none, and that confuse rather than illuminate, are sidestepped in order to focus instead on principles that work and have been proven via scientific rigor and on active ingredients that can be easily identified, studied, and promoted. This book is a victory of common sense: a consensual framework that will serve as the basis for improvements of treatment efficacy, effectiveness, and community uptake in what is now the highest priority, with potentially the highest gains in the field.

Why is the provision of supports and solutions to children and families affected by ASD so critical? Although early detection and intervention promise life-changing opportunities for the next generations of children with autism, those affected by ASD now cannot wait. Families, community providers, and schools can deploy treatments that work in fostering communication and adaptive skills and that decrease the risk of problem behavior. Communication skills facilitate meaningful inclusion and make possible friendships and other relationships, as well as a world of vocational opportunities. Adaptive skills promote independence, self-reliance, and self-determination. The management of challenging behavior decreases the risk of isolation, enhances quality of life, and makes it possible for a child to learn and adapt to environmental demands. Yet, families are often confused and frustrated with the lack of direction, integration, and helpful navigation

through the struggles of the day; providers are often overwhelmed at the very sight of the plethora of titles sitting on their book shelves that do not necessarily translate into a concrete plan and approach for their day of therapy and teaching. How are we to distill from this chaotic state the straightforward principles of treatment and supports that work, the roadmap to generate learning that generalizes, and the strategies to promote communication skills that are self-driven and effective across environments?

The solution, again, is in your hands. This book describes ways to leverage children's daily lives as the stage for their learning. Teach skills in isolation, and the road from skill acquisition to spontaneous skill deployment is a much longer and winding road. The importance of developmental considerations is extended to all ages: Not only are the children with ASD growing up, but so are their peers. And with the passage of developmental stages comes the unfolding of increasingly more challenging environmental demands. Remove therapy and supports from the developmental context in which they need to work, and one may witness further isolation, prompt dependency, and reduced adaptation. Similarly, the reader will learn about environmental controls and reinforcement management techniques that foster habit formation, accelerate skill learning, and promote self-motivation and self-regulation. Fail to consider that, and you may find yourself struggling with continued disruption, lack of engagement, despondency, and heightened anxiety. These are principles of treatment and intervention that should guide our work with children of all ages, from infancy through adolescence and beyond.

How does this book achieve the sorely needed synthesis? First and foremost, it represents the culmination of some 50 years of science in early treatment of autism, a process that has greatly accelerated in the past 10 years. Facts matter, and science has produced a great body of evidence justifying the integrative approach taken by the authors. In this approach, there is great respect for a clinical principle, enshrined in the language of educational law, that treatments and intervention programs should be individualized to a child's profile, addressing the child's needs while capitalizing on the child's assets. This principle unravels many of the ideological debates. A treatment devised to promote communication skill acquisition in a nonverbal 6-year-old at risk of never speaking is unlikely to be beneficial in the case of a 2-year-old who vocalizes and shows intent to communicate with others, albeit inconsistently, and vice versa. There is no need to train a child to display a complex behavior by chaining discrete and disconnected behaviors if the child has the ability to learn how to learn in more naturalistic settings. In this way, generalization challenges are reduced; prompts and consequences are inherent in the real world; and pivotal skills generate more learning, in more settings, and in more contexts.

The authors also leverage behavioral science in ways that do not turn it into a stereotype. The science of Applied Behavior Analysis (ABA) has generated some of the most critical advances in the care of individuals with developmental disabilities. Anyone who has worked in a residential facility for individuals with severe disabilities is quick to appreciate this fact. But ABA is not synonymous to narrow applications that may have its place for some children but not for others. ABA is a vast body of science that painstakingly assesses and changes human behavior. At its core is learning theory with its focus on an individual's behavior acquisition and display as a function of environmental conditions. For primates in general, but certainly for humans, that environment consists of people and their referents in the

surroundings. Making these connections is central to the acquisition of speech, language, and communication. We fail to follow ABA principles at our peril; indeed, we are all behaviorists in real life, but unfortunately most of us are bad behaviorists, often pre-empting the very result we seek to achieve.

By advancing individualized, naturalistic approaches and the basic scientific tenets of learning theory, there should be no surprise that the individual child, his or her style of learning, and his or her perceived environment take center stage in any effective program of treatment and intervention. In between an antecedent and a response, there is a single child with a specific age and stage of development, assets and needs, emotional state, capacity for self-regulation, motivations, social relatedness, interests, fears, and personalized environment. For too long, learning theorists proceeded in their scientific endeavors by pretending to ignore a child's individualized agency: The brain is no black box! Similarly, for too long, developmental scientists proceeded in their scientific endeavors by focusing on sweeping generalities that were not easily translatable into manualized treatments capable of singling out active ingredients and of achieving greater fidelity. Why these two currents of human ideas forged parallel paths for so many decades is as infuriating as it is counterproductive to any evidence-based synthesis of effective treatment for young vulnerable children. Thankfully, the authors of this book leave this anachronistic notion behind us all. The behaviorists versus developmentalist confrontation should be relegated to the history of the field, thus erased and eradicated from its future science and its future scientists.

By moving the nonsensical aside, and by leveraging the best science from within, this book generates a consensual synthesis, whose name includes the very words that generated this unsatisfactory state of artificial conflagration in our past: Naturalistic Developmental Behavioral Interventions. The very name is our best assurance that research on early treatments will continue to thrive on healthy scientific grounds.

This book is more than a compilation of evidence-based treatment principles; it is also a recipe for viability and for increased access. In an early intervention world of scarce resources, to state that a 40-hour regimen of treatment delivered by an expert clinician is aspired standard of care, as we have learned to believe over the past 2 decades, is a recipe for frustration. With few exceptions in the country, most states, where maybe 1–2 hours a week is the reality of treatment, need more viable solutions. Children need to access effective services when they need them and where they are. For that to happen, a number of stakeholders need to be involved. It is the responsibility of investigators and clinicians to use the best implementation science to generate innovations that can be deployed in the real world, advancing quality as well as accessibility. Parents need to be engaged in the most important role in their lives: to promote the development of their children. Parent-mediated interventions are emerging as both viable and effective: Professional interventionists can use their limited availability to train parents to turn every waking moment of the child's life into a learning moment, using routine daily activities as naturalistic platforms for treatment, with the intensity and emotional engagement needed to achieve lasting results. Similarly, generalist child development providers and teachers can promote similar principles in group settings. In this fashion, a new ecosystem of care becomes possible, in which divisions across contexts and settings can dissolve thanks to common goals and strategies.

Most important, the involvement of parents and child care providers allows treatments to be downward extended into toddlerhood and maybe even infancy: There is no reason to wait until a diagnosis is attained to turn surveillance and parent education into strategies that promote development—of all children. All vulnerable children, and certainly those with autism, are likely to benefit from a robust dosage of facilitation of social and communication engagement. This is already the approach taken by those trying to counter the effects of intergenerational poverty on a child's language acquisition. And therein lies one of the greatest promises in the field: the beneficial effects of child development surveillance and parental engagement on the outcomes of all children. Perhaps if we were to deploy these generalist strategies systemically in a communitywide fashion, children would reach the age of more individualized and intensive treatments at a much higher level of readiness to learn.

These may seem like lofty aspirations. Yet, after the publication of this book, we, as a field, are closer to these goals than ever before. The authors have made a terrific contribution in our effort to ensure that every child with ASD is afforded what they need in order to fulfill their promise.

Ami Klin, Ph.D.

Director, Marcus Autism Center

Children's Healthcare of Atlanta and Emory University School of Medicine

I would like to acknowledge those who have supported me and my career personally, and those who have made this work possible through their contributions to the field. Personally, I could not have asked for a better colleague, coauthor, and friend than Yvonne Bruinsma. I am also grateful to my mentors and colleagues for the knowledge and opportunities they have provided, including Marji Charlop, Ami Klin, Bob and Lynn Koegel, Tara O'Connor, Bryan King, and Maddie Parsons. The body of work that has preceded the NDBI framework must be fully acknowledged because it is the foundation for the content of this book, which we believe will propel the field forward. I have also learned so much from the children and families that I work with, which I anticipate will continue lifelong; however, my greatest teachers are my own children, who have taught me that life is messy and hard but full of humor and joy, which I hope carries over to the rest of my career and life as well.

Mendy B. Minjarez, Ph.D.

Over many years, I have had the good fortune to work with amazing students, colleagues, researchers, teachers, and community members of all kinds. Most important, I have had the good fortune to work with wonderful children and families who have taught me so much and have showed me the real power of what we do and what we can accomplish. I want to acknowledge the efforts of all these people who have worked so hard at getting us to where we are today. I see the development of NDBI as the fruit of these efforts.

Laura Schreibman, Ph.D.

Many people have devoted their time and expertise to make this project a reality. First, thank you to all the amazing NDBI developers willing to support the integration of their individual evidence-based interventions into a coherent model. Each reviewed the descriptions of their respective interventions in this book and supported the concept of NDBI through the original article. Second, thank you to all my colleagues who helped shape my understanding of NDBI across contexts. Third, thanks to my research and treatment teams in San Diego and Sacramento, who bring it all to life. Finally, thank you to all the children, families, teachers, therapists, and advocates who have supported this work.

Aubyn C. Stahmer, Ph.D., BCBA-D

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Overview

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Understanding NDBI

Laura Schreibman, Allison B. Jobin, and Geraldine Dawson

Autism spectrum disorder (ASD) affects as many as 1 in 59 children (Baio et al., 2018). Although this statistic certainly has an impact across service systems, the impact is far greater for those individuals and families affected. While ASD may have been considered a dire prognosis for these children and families from the 1950s through the 1980s and beyond, the state of affairs is much brighter today. Research since the 1960s conducted across multiple academic disciplines has led to the identification and development of treatments for ASD that are both highly effective and efficient. The development of these effective intervention strategies, coupled with an ability to diagnose ASD at earlier ages, has broadened and strengthened the positive effect of treatment efforts. Early intervention by using empirically based treatments has proven to have a substantial impact on the future functioning of children with ASD, changing the outlook for these individuals and their families (e.g., Dawson, 2008; Dawson et al., 2012; Rogers & Dawson, 2010). Although early intervention using these newer strategies has certainly improved the prognosis for young children with ASD, treatments based on these same principles have also proven to be effective for individuals throughout the life span, as well as for individuals with related disorders that share some of the same features of ASD (e.g., language acquisition delays, behavior problems, cognitive impairment).

Our goal in writing this book was to describe a scientifically validated set of interventions, derived primarily from the fields of Applied Behavior Analysis (ABA) and developmental psychology. These interventions are called *Naturalistic Developmental Behavioral Interventions* (NDBI) to reflect the essential combined contributions of these two disciplines. As described in later chapters, there are several established NDBI utilized with children with ASD and related disorders; although specific NDBI have differences, they all have general concepts and procedures in common. This book describes the development of NDBI, identifies and describes

the concepts and procedures that unite them, and provides an implementation guide for practitioners and others who wish to use NDBI with children with ASD. Section I introduces NDBI and key NDBI models. Section II explains core concepts and foundational principles common to all NDBI, highlighting topics such as the selection of meaningful skills, parent empowerment, and inclusion. Section III dives deeper into specific NDBI strategies, and Section IV offers an implementation-focused look at NDBI in practice.

This book is a resource for practitioners, educators, and other professionals who make treatment decisions for children with ASD. Those searching for ASD treatment are often confused and overwhelmed because there is so much information available. Much of what is available via the web or other sources is not likely to be helpful and can even be harmful. Some proposed treatments have proven to be dangerous (e.g., certain drug regimens or chelation). Other treatment approaches elevated through celebrity advocacy, although perhaps the most visible, often lack evidence for effectiveness. Furthermore, even if a child receives a relatively benign but not scientifically validated treatment (e.g., equine or dolphin therapy), it still can be harmful if it is costly or results in the child spending less time in effective treatment.

There are so many treatments and claims of effectiveness (often patently false) that the process of identifying effective interventions for a child with ASD too often becomes a burden for parents and treatment providers. This book offers a solution by not only identifying proven treatments but also by describing the basic, important concepts that characterize such treatments to help parents, teachers, and practitioners decide if interventions meet the standards of established NDBI. Although specific NDBI may have different names, such as Pivotal Response Treatment (or Training) (PRT), Early Start Denver Model, and Project ImPACT, they all involve the same important core concepts discussed in this book. Our hope is that by helping parents, teachers, and practitioners determine whether a treatment meets the standard of research-based practice, we will make the initially unmanageable, manageable.

ASD DEFINED

Before diving in to the more complicated topics that follow in this book, perhaps it is best to establish a common understanding of what we mean by autism spectrum disorder (ASD). Autism was first identified as a specific disorder by Leo Kanner in 1943. Kanner described a group of children who exhibited a set of features unlike those of any other known pediatric disorder. These features included severe social deficits, such as failure to bond with parents, social avoidance of others, failure to establish eye contact, failure to acquire language or particular pathological features of language if it did develop, lack of appropriate interaction or interest in toys or other features of the environment, and the presence of repetitive, nonpurposeful behaviors. He also believed that these children possessed normal or above-normal intelligence. Kanner named this disorder early infantile autism to describe the fact that the symptoms were exhibited very early in life and involved a severe withdrawal. Since 1943, much has changed in terms of understanding of the disorder, including requisite diagnostic features (Schreibman, 2005).

According to the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)* (American Psychiatric Association, 2013), the following diagnostic criteria for ASD have been established:

1. Persistent deficits in social-communication and social interaction such as abnormal social approach, reduced sharing of emotions or affect, and failure to initiate or respond to the social initiations of others
2. Persistent deficits in verbal and nonverbal behaviors used for social interaction, such as failure to develop speech, inadequate eye contact, failure to use or understand gestures for social purposes, failure to develop and maintain social relationships, and absence of interest in, or sharing with, peers
3. Presence of restricted, repetitive patterns of behavior, interest, or activities (including stereotyped or repetitive motor movements or use of objects; inflexibility to changes in routines; and highly restricted, fixated interests that are abnormal in intensity of focus)
4. Hyper- or hyporeactivity of the sensory environment

Also, whereas Kanner did not associate autism with cognitive impairment, a significant number of these individuals do experience cognitive impairment. (See the *DSM-5* and *Autism Speaks* at <http://www.autismspeaks.org> for a more detailed and comprehensive description of ASD.)

HISTORY OF ASD INTERVENTION

To fully appreciate where the field of ASD intervention is now, it is important to look back at where the field began and how it has progressed. Prior to the early 1960s, educators widely assumed that children with ASD could not learn. The early work of Charles Ferster and Marian DeMyer (1961, 1962) demonstrated that children with ASD could learn a simple task if their responses reliably resulted in a positive effect. The task was pressing a lever for candy in the presence of a stimulus, and the positive effect was delivery of candy. Although this was not a particularly functional curriculum, it did demonstrate that the principles of learning could be used effectively to teach children with ASD. This early work was followed by a substantial increase in the study of **operant learning** approaches to teach a variety of skills. Examples of these skills include language (Lovaas, Berberich, Perloff, & Schaeffer, 1996; Risley & Wolf, 1967), social skills (Ragland, Kerr, & Strain, 1978; Strain, Kerr, & Ragland, 1979), play (Koegel, Firestone, Kramme, & Dunlap, 1974; Lifter, Sulzer-Azaroff, Anderson, & Cowdery, 1993; Stahmer, 1999; Stahmer & Schreibman, 1992), adaptive skills (Ayllon & Azrin, 1968; Baker, 2004), and academic skills (McGee, Krantz, & McClannahan, 1986; McGee & McCoy, 1981), as well as skills to reduce the occurrence of interfering or challenging behaviors (Carr & Durand, 1985; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982; Schreibman & Carr, 1978).

This work reflected the new field of ABA, which studies the laws governing how the environment affects behavior. Once researchers had determined these laws, they began to study how to alter the environment to change others' behavior for the better. For example, the principle of **positive reinforcement** (i.e., a behavior followed by a positive event will become stronger) is not only well established but is used by everyone (e.g., saying "please" to request a treat will become a stronger

response if the treat follows saying the word). The field of ABA has established many of these laws and continues to refine understanding of how to improve the life of others. It offers specific experimental methodologies to investigate and prove the effects of procedures aimed at changing behavior.

The application of behavioral principles to teach new skills and reduce behavioral challenges for children with ASD took a huge leap forward through the work of Ivar Lovaas; Lovaas and his colleagues developed an intensive and comprehensive intervention program that focused on many of these skills (Lovaas, 1987, 2002). Although Lovaas's successes, and those of other behavioral researchers, propelled behavioral treatment into the forefront, his 1987 treatment study had the most profound impact. In that study, Lovaas provided intensive (i.e., up to 40 hours per week) behavioral intervention to a group of young children with ASD. In contrast to a control group of children who did not receive the treatment at such intensity, the children in the experimental group showed significant gains in IQ score and success in typical school placements. This work greatly altered the expectations of treatment, especially early treatment, for ASD. The field began to realize that tremendous progress, potentially leading to limited ongoing need for services and supports, might be possible for almost half of children with ASD if they receive excellent treatment early enough and with enough intensity. This work, and subsequent studies demonstrating efficacy of early intervention, led to two main trends in ASD treatment.

First, parents, understandably very encouraged by these findings, began advocating for their children to receive early intensive behavioral intervention, which led to changes in educational practices and policies. Second, **discrete trial training (DTT)**, the behavioral approach used in Lovaas's (1987) study, became increasingly popular. In brief, DTT involves one system of implementation of operant methodology. In this type of intervention, teaching is conducted via successive discrete trials, with each trial consisting of an **antecedent** (a cue to indicate when a response should be emitted), a response or behavior, and a consequence (an event following the response). We call this the **three-term contingency** and abbreviate it **A-B-C**.

In DTT, educators break skills down into smaller, separate components and teach them one at a time using discrete training trials until the complete skill is acquired. For example, if a teacher wanted to teach a child to put on a pair of pants when told to put on pants, he or she might first teach the child to point to a pair of pants when told to put on pants. Once the child reliably points to the pants, the teacher would teach the next component of the skill by requiring the child to point to and then pick up the pants. Once that is mastered, the child would be required to put one leg in the pants and so forth until the child could perform the entire skill when told to put on pants. Thus, the teacher broke the complex skill of putting on pants down into smaller steps and taught them separately.

Although DTT became increasingly popular with parents and other treatment providers, intervention research in the late 1980s found that highly structured intervention such as DTT had some limitations (Schreibman, 2005). These limitations included 1) failure to generalize newly learned skills across multiple contexts, 2) occurrence of escape/avoidance-motivated challenging behaviors, 3) lack of spontaneity in responding, and 4) **overdependence on prompts**. These limitations, plus the successes of behavioral interventions, led many ASD treatment researchers from different disciplines to focus their efforts on addressing these identified

limitations and otherwise improving and expanding treatment effectiveness. Advances in the developmental sciences—particularly those in the area of promoting early communication skills, social engagement, and **affective engagement**—set the stage for advancing early intervention methods beyond the highly structured format of DTT. The marriage of ABA principles and principles derived from developmental science has proven to be particularly important and relevant because the ability to diagnose ASD in children at earlier ages has led to an increased number of children receiving early intervention.

DEVELOPMENTAL SCIENCE AND ITS INFLUENCE IN ASD EARLY INTERVENTION

In the late 1980s and 1990s, researchers started to think that ASD could be best understood by explaining how the developmental trajectory of children with the diagnosis deviated from that of typically developing children. This perspective was fueled by the emergence of the field of developmental psychopathology (Cicchetti, 1989), which allowed for the scientific study of atypical development. Researchers realized that typical and atypical development are mutually informative and that their understanding of ASD would be enhanced by studying the basic processes that caused development to diverge from typical pathways. This led to a search for the earliest fundamental developmental processes that could explain the core symptoms of ASD. At this time, there was also greater emphasis on longitudinal studies and perspectives. The result was formative work that helped define the core distinguishing early characteristics of ASD.

Studies comparing preschool-age children with and without ASD were especially useful in shedding light on some of the early deficits that distinguished children with ASD. Such deficits were found in the areas of **social orienting** (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998), **imitation** (Dawson & Adams, 1984; Rogers, Bennetto, McEvoy, & Pennington, 1996), joint attention (Mundy, Sigman, Ungerer, & Sherman, 1986), **affective reciprocity** (Dawson, Hill, Spencer, Galpert, & Watson, 1990; Yirmiya, Kasari, Sigman, & Mundy, 1989), and responses to emotional cues (Sigman, Kasari, Kwon, & Yirmiya, 1992). Studies of home videotapes showed that young infants who later developed ASD did not orient to name, point, show, or make eye contact, demonstrating the earliest symptoms of ASD by 10–12 months of age (Werner, Dawson, Osterling, & Dinno, 2000).

These findings began to shape both the strategies used in early intervention and the targets of intervention. For example, theories of typical development emphasized the active role of the child in constructing both the social and non-social world. Researchers found that even young infants learn by forming ideas or hypotheses and then testing these ideas through playing with objects, interacting with people, and using social interaction to test those hypotheses (Saffran, Aslin, & Newport, 1996). Thus, researchers focused intervention methods more on children's initiation and spontaneity rather than on their response to cues and prompts. Likewise, research on typically developing infants and young children showed that learning is promoted when that learning occurs in the context of an affectively rich social environment, such as social play involving smiling and eye contact (Kuhl, 2007). Research on young children with ASD demonstrated that the disorder is associated with deficits in **affective sharing** and social motivation

(Dawson et al., 1990). Thus, ASD treatments began using strategies to promote affective engagement (e.g., Prizant et al., 2003; Rogers & DiLalla, 1991), or using social emotion to act on and respond to the world. Studies of typically developing infants found that early emerging skills, such as joint attention and imitation, were critical for setting the stage for a wide range of later skills. As a result, early intervention began targeting skills that were fundamental precursors to the development of language, including joint attention (Mundy, Sigman, & Kasari, 1990).

As the theoretical frameworks and research findings from the fields of developmental psychology and developmental psychopathology were incorporated into early intervention models, it became clear that they could be readily integrated with the strategies of ABA. This integrated approach improved children's motivation to learn, speed of acquisition of skills, and ability to generalize newly acquired skills to novel environments. NDBI were the result of this integration of developmental and ABA principles.

INTEGRATION OF BEHAVIORAL AND DEVELOPMENTAL SCIENCES

Despite their distinct theoretical foundations, methodologies, and implications for intervention, the fields of behavioral and developmental science came together with the emergence of NDBI (see Schreibman et al., 2015). These interventions incorporated components of both fields, demonstrating that integrating behavioral and developmental sciences had a profound effect. The merging of these two fields led to interventions that are informed by the strengths of each perspective and that better serve the younger ASD population in particular. NDBI essentially are research-based interventions that incorporate well-established behavioral interventions to affect developmentally important and appropriate behavior change. Thus, NDBI ensure that the treatment strategies employed remain guided by understanding of child development.

The core elements of NDBI fall into three general areas: the nature of the teaching targets, contexts in which the interventions are delivered, and instructional strategies (see Schreibman et al., 2015).

Nature of Teaching Targets

The teaching targets selected in NDBI typically come from a broad range of developmental domains, including language and communication, play, social interaction, cognition, and motor skills. The skills are selected based on the **cascading effect** (i.e., flow or progression from lower level skills toward higher level skills) and the foundational role they play in later development, especially in regard to the core social deficits of ASD. These skills include imitation; shared and reciprocal engagement; **joint attention**; and **functional communication** via the use of gestures, facial expressions, and words, among others. Moreover, various domains are targeted concurrently during learning episodes, in contrast to more highly structured methods that may teach each domain separately. This distinction reflects a developmental systems approach, whereby different skills are integrated from the start to promote generalization. Generalization is the use of skills across various people, places, and materials with the ultimate goal of promoting long-lasting and functional use of learned skills in real-world settings. For example, a young child who learns new words while playing kitchen with a therapist would also practice those

same words during dinnertime at home or during another daily routine. During these activities, the therapist or parent would also incorporate other developmental skills, such as gesture use, imitation, shared engagement, or joint attention.

Contexts of Treatment Delivery

The empirical literature has provided evidence that children's experiences affect neurobiological development (Dawson et al., 2012; Knudsen, 2004) and that experiences have a cascading effect on development (e.g., Thelen & Smith, 1994). The contexts in which early learning occurs need to allow children to experience the natural contingencies of their own behavior (Gibson, 1973). For example, asking an adult for help reaching a toy leads to acquiring the toy. Increasing evidence is emerging that learning is enhanced when it is embedded in activities that contain emotionally meaningful social interactions, compared to situations in which instruction occurs without meaningful social engagement (Topál, Gergely, Miklósi, Erdohegyi, & Csibra, 2008). Spelke, Bernier, and Skerry (2013) argued that providing children the opportunity to learn within a socially engaged context sets the stage for them to learn about the social landscape around them. For example, an educator can teach a child about different pieces of furniture by teaching the labels *chair* or *table* separately, but learning is improved if a social partner teaches the child while playing house. The child could sit a doll in the chair or put a dish on the table for his or her mother so that the child learns the pieces of furniture within the context of the **natural environment**.

In NDBI, these concepts are brought to fruition through child-initiated and motivation-based (i.e., following the child's preferences) interactions. These interventions take place during enjoyable play routines and familiar daily routines using a variety of materials. Teaching usually looks and feels like the everyday interactions that are central to toddler experiences. In fact, first-time observers of these approaches have said they do not look like therapy. Parent and family involvement is also common to NDBI because it broadens the context in which teaching occurs and increases the frequency of **learning opportunities**. Learning opportunities include imitating facial expressions and actions, identifying body parts during bath time with mom or dad, or building shared engagement and social initiations during a game of Peekaboo or chase with the child's therapist. Skill acquisition has been shown to be more effective in engaged contexts such as these (Dawson et al., 2010; Delprato, 2001). Thus, specific characteristics of learning contexts, including the activities, materials, and quality and emotional valence of the adult-child interaction, contribute toward optimal learning and generalization of newly developing skills.

Instructional Strategies

Finally, NDBI have in common the use of development-enhancing strategies, which are described in more detail in other chapters. These strategies promote learning and motivation within **ecologically valid** contexts and routines. At first, the child may learn through highly predictable and salient response-reinforcer sequences. For example, he or she may get to push a car down a steep ramp after making brief eye contact with the play partner. This might later be expanded to following instructions around the vehicle-based activity or even taking turns and sharing

enjoyment around that theme with the therapist. By incorporating behavioral strategies, such as **modeling, shaping, chaining, prompting, and differential reinforcement**, the therapist, teacher, or parent supports the child throughout these activities in the development of expressive communication, receptive language understanding, early cooperative play, and shared engagement. The rewarding value of these child-centered, everyday activities maximizes motivation. Research has also demonstrated a decrease in maladaptive behaviors as they are replaced with more functional, adaptive skills (e.g., Carr & Durand, 1985).

These skills are relevant for older individuals as well. Although this feature of NDBI is most commonly utilized in early intervention, researchers and practitioners realize the importance of skills such as imitation and joint attention as foundations for many more advanced skills. For example, joint attention skills are an important component of successful social interaction. Thus, they are good skills for older individuals learning social skills. These skills need to be taught at any age if the individual has not already acquired them. Another key feature of NDBI is that the components can be adapted for any age and any skill area.

EXAMPLES OF NDBI

While developing interventions for ASD, several clinical research laboratories independently realized the need for more naturalistic treatments that would greatly expand on the earlier work of Hart and Risley (1968) and increased focus on strategies that would enhance child motivation and improve generalization of learned skills. Thus, these laboratories established distinct NDBI that had several commonalities. Examples include incidental teaching (IT; Hart & Risley, 1968, 1975; McGee, Morrier, & Daly, 1999), Pivotal Response Treatment (Koegel & Koegel, 2006; Koegel et al., 1989; Schreibman & Koegel, 2005), the Early Start Denver Model (ESDM; Dawson et al., 2012; Dawson et al., 2010; Rogers & Dawson, 2010; Rogers, Dawson, & Vismara, 2012), Enhanced Milieu Teaching (EMT; Kaiser & Hester, 1994), Project ImPACT (Improving Parents as Communication Teachers; Ingersoll & Wainer, 2013a, 2013b), and Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER; Kaale, Fagerland, Martinsen, & Smith, 2014; Kaale, Smith, & Sponheim, 2012; Kasari, Gulsrud, Wong, Kwon, & Locke, 2010; Kasari, Kaiser, et al., 2014; Kasari, Lawton, et al., 2014; Kasari, Paparella, Freeman, & Jahromi, 2008). Although this list is not exhaustive, it includes many of the models with the most research, each of which is discussed in greater detail in Chapter 2. Some of the intervention models are comprehensive (i.e., they target a broad range of functioning across multiple developmental domains), whereas others are focused interventions that address specific areas of behavior or development (e.g., social-communication only). The emphasis throughout this book, however, is on the commonalities among these NDBI.

COMMON ELEMENTS OF EMPIRICALLY VALIDATED NDBI

As noted previously, all NDBI share common elements that distinguish them from other forms of intervention (see Schreibman et al., 2015). Thus, when a practitioner or parent wishes to determine whether a specific intervention qualifies as one of the NDBI, he or she can look for these common elements (see Box 1.1). (The common elements are covered in more detail in subsequent sections of this book.)

Ready, Set, Implement!

BOX 1.1: What are the common elements of empirically validated NDBI?

Core Components

- Are based on the well-established principles developed via the science of ABA
- Use developmentally based intervention strategies and sequences to guide goal development that is individualized to each child

Common Procedural Elements

- Have an intervention manual or manuals that clearly specify the procedures of the intervention
- Include procedures for assessing **treatment fidelity**
- Involve ongoing measurement of progress during treatment

Common Instructional Strategies

- Specify how the environment should be arranged to ensure that the child must initiate or interact with an adult in order to gain access to desired materials, favored activities, or familiar routines
- Utilize natural reinforcement and other motivation-enhancing procedures
- Use prompting and **prompt fading** during acquisition of new skills
- Use balanced turns within teaching routines
- Use modeling
- Utilize adult imitation of the child's language, play, or body movements
- Work to broaden the attentional focus of the child
- Involve some form of child-initiated teaching episodes

Core Components of NDBI

This section discusses foundational tenets underlying all NDBI, presented along a continuum of emphasis/degree across NDBI.

- All evidence-based NDBI are based on the well-established principles developed via the science of ABA.

As might be expected from ABA-based strategies, NDBI all involve the three-part contingency of antecedent → behavior (response) → consequence, which helps the child understand when to respond and ensures that the intervention provides feedback to the child. Although more recent strategies for ASD intervention, such as NDBI, differ in various forms from earlier behavioral interventions, the basic tenets of NDBI are the same as those of their original ABA roots. For example, Skinner's (1953) work on motivation and Stokes and Baer's (1977) seminal work on enhancing generalization of intervention effects are well represented in NDBI strategies. Skinner described the **contingent** application of rewarding events as seminal to the process of acquiring new behaviors.

Motivation to respond is enhanced when rewarding events can be anticipated. NDBI utilize strategies that promise these rewards (reinforcers) for responding and thus increase the child's motivation to respond. Stokes and Baer (1977) described how generalization of acquired behaviors may be enhanced by utilizing a specific set of teaching strategies. To illustrate, a generalization-enhancing strategy is to use multiple examples of materials during training. Thus, when teaching a child the concept of a car, the teacher would utilize cars of various colors, shapes, and sizes to ensure the child learns the general concept of car instead of learning *car* means a red object of medium size on a specific table. NDBI employ strategies to ensure that the child's teaching environment contains a variety of stimuli.

- Having a base in developmental science, NDBI use developmentally based intervention strategies and sequences to guide goal development that is individualized to each child.

Some NDBI are associated with a specific developmental assessment and curriculum (e.g., ESDM; Rogers & Dawson, 2010). In almost all NDBI, goals are developed with the use of standardized assessment, observation, and developmental checklists, which serve to guide the clinician in determining individualized treatment targets across behavior domains. Strategies for assessment and goal development are outlined in detail in later chapters.

Common Procedural Elements

Common procedural elements are procedures that consistently accompany use of NDBI and should be incorporated throughout implementation of the intervention approaches. Those elements are as follows:

- NDBI have an intervention manual or manuals that clearly specify the procedures of the intervention.

Research has shown that accurate implementation of an intervention requires adherence to clearly stated procedures (Durlak & DuPre, 2008; Fixsen, Naoom, Blasé, Friedman, & Wallace, 2005; Greenberg, Domitrovich, Graczyk, & Zins, 2005). Manualization helps with consistency of implementation and with training of treatment providers (e.g., clinicians, parents). Some manuals for NDBI are published and thus readily available to the public, whereas others are available primarily in research settings. Of course, clearly described procedures and manualization of intervention are important in ensuring accuracy of implementation, but manuals alone are unlikely to lead to proficiency. Additional training, including coaching and feedback, will be required (Bush, 1984; Cornett & Knight, 2009).

- NDBI include procedures for treatment fidelity.

Treatment fidelity refers to the degree to which an intervention is being applied correctly, as it was designed (i.e., Gresham, 1989; Rabin, Brownson, Haire-Joshu, Kreuter, & Weaver, 2008; Schoenwald et al., 2011). That is, it indicates that treatment providers are implementing NDBI accurately. This is essential because the evidence base shows that the intervention is effective when implemented according to the manual, but it is unknown how effective the intervention might

be if it is not accurately applied. Thus, the accuracy of treatment implementation is likely a mediating factor in child outcome, with better outcome likely associated with more accurate treatment implementation (Durlak & DuPre, 2008; Gresham, MacMillan, Beebe-Frankenberger, & Bocian, 2000; Stahmer & Gist, 2001). NDBI provide specific assessment procedures and **mastery criteria** to allow trainers to assess the level of implementation accuracy by practitioners.

- Ongoing measurement of progress during treatment is an essential feature of good treatment and thus a feature of all NDBI.

Effective practice must be systematically and objectively verified through appropriate data collection (Simpson, 2005a, 2005b). Data must be collected to track child progress not only to ensure overall treatment effectiveness but also to allow for alterations in treatment procedures or treatment targets if necessary. Although all NDBI have specified procedures for tracking treatment progress, different NDBI emphasize different methods appropriate for their intervention. Data collection methods may include trial-by-trial recording of child responses to each learning opportunity, interval recording of progress during a treatment session, probes of specific behavior, or the use of curriculum-based assessments to examine progress at specific time periods (e.g., monthly, quarterly). Data collection is an essential feature of any intervention based on ABA and should be linked to the child's treatment goals. If necessary, it should be used to alter intervention to better serve the child's needs.

Common Instructional Strategies

Although NDBI vary in terminology and emphasis on each of these strategies, all NDBI share common instructional strategies that comprise the intervention application itself. These strategies are the individual component parts that make up the interventions.

- NDBI specify how the environment should be arranged to ensure that the child must initiate or interact with an adult in order to gain access to desired materials, favored activities, or familiar routines.

Environmental arrangement refers to how the adult structures the environment to facilitate and encourage child initiation of skills and learning of new target skills. Preferred materials may be visible but placed out of reach to encourage the child to initiate a request for the material (e.g., incidental teaching); in other interventions, a variety of toys or activities are placed in a room and the child is asked what he or she wants (e.g., PRT). Other types of environmental arrangement 1) control access to materials until the child initiates; 2) playfully obstruct where the child initiates to continue the activity; 3) introduce materials that require assistance so that the child must interact with the adult; 4) create expectant waiting, in which the adult looks at the child and waits for an initiative response; or 5) violate a routine, in which the adult changes a familiar sequence of events so that the child must correct the sequence. Some NDBI are quite specific on methods to structure the environment to promote child initiation, whereas others are less specific, dictating that the adult simply must gain the child's attention while controlling toy access. Adults do not need to arrange the child's environment in specific ways in NDBI. The variety of ways to promote

interaction with the child can be used extensively in the child's natural environment. Thus, if the child is playing in a community park where different objects are present, the treatment provider can use NDBI to promote initiation and interaction, allowing all of the child's environments to be potentially therapeutic.

- NDBI utilize **natural reinforcement** and other motivation-enhancing procedures.

NDBI give the child a good deal of control over a teaching episode, and the child's choice of stimuli or activities allows for the use of natural reinforcement as a consequence. **Reinforcement** refers to the strengthening of a behavior and making that behavior more likely to occur, as a result of what happens immediately following that behavior. A natural reinforcer is one that is directly related to the child's response. For example, if the child wishes to play with a car, access to the car would be contingent on a related response from the child, such as saying "car." This is in contrast to an indirect or unrelated reinforcer, which is not related to the response. The previous example would exhibit an indirect reinforcer if the child says "car" and the adult reinforces the child with a piece of candy. Candy and saying "car" are not related, whereas saying "car" and gaining access to a car are related. A related motivation-enhancing procedure involves the use of loose reinforcement contingencies, also referred to as **reinforcing attempts** or loose shaping. This strategy involves allowing for more variability around a correct response such that the child may receive reinforcement for reasonable attempts to respond correctly. Thus, the child receives reinforcement for trying. Overall this procedure typically leads to more reinforcement and thus higher motivation. Different NDBI vary in terms of how closely the child's response must be to the target response in order for a reinforcer to be delivered.

Another strategy used to keep the overall reinforcement level, and thus the child's motivation, high is interspersal of **maintenance tasks**. A maintenance task is a skill the child has already mastered (i.e., an easy task). When teaching a new skill, the adult will expect some maintenance (i.e., easier) tasks among **acquisition** (i.e., new, more difficult) **tasks**. To illustrate, a child is learning to say the phrase "I want the ball" (i.e., acquisition task). It is new, so it may be challenging at times. To increase the child's motivation while decreasing frustration, the adult would intersperse trials where the child is asked only to label the ball, a skill already mastered (i.e., maintenance task). This practice also serves to maintain learned skills through presentation of mastered skills while helping the child acquire more advanced skills. Several NDBI specifically require this strategy, whereas others achieve this effect via loose shaping by reinforcing a mastered or maintenance task as an attempt. Some NDBI also require the use of both procedures (e.g., PRT).

- All NDBI use prompting and prompt fading during acquisition of new skills.

Prompting involves presenting a cue (i.e., visual, verbal, auditory, physical) between an instruction (also referred to as a discriminative stimulus [S^D]) and the target behavior being taught in order to evoke the desired response and thus set the context for reinforcement. Prompt stimuli are used to support behaviors not yet in the child's repertoire or not yet under the control of the S^D so they can occur and be reinforced. Again, some NDBI are very specific about how prompts should be used, whereas others are less specific. However, all NDBI require the systematic use of adult prompts to promote new skills.

- NDBI use balanced turns within teaching routines.

This strategy (also known as turn taking, shared control, or reciprocal interactions) involves back-and-forth exchanges in activities or with objects between the child and the adult. Such interactions serve to increase and support the social reciprocity found in many typical social interactions. In addition, this strategy increases maintenance of social interactions as well as allows the adult to control access to materials. Because turn taking involves the back-and-forth structure that has been associated with early learning (Harris & Waugh, 2002), its inclusion in NDBI has intuitive merit. However, despite its inclusion in NDBI, its empirical validation as an individual component awaits more research. Not all NDBI emphasize turn taking to the same degree. Some require it as a specific, programmed component of their NDBI, and others emphasize that turn taking occurs within the context of building longer interactions and thus is not specifically programmed.

- NDBI use modeling.

In modeling, the adult demonstrates a behavior that follows the child's focus of interest and typically demonstrates the target skill the child should perform. Modeling is often used as a prompt strategy, specifically by the adult to evoke and support the child's imitation of a modeled action or language. Across NDBI, modeling is used in various ways. Some NDBI use it primarily as a prompt strategy, and others also incorporate it as a general strategy for promoting engagement and enhancing the learning environment outside of specific embedded teaching trials.

- NDBI utilize adult imitation of the child's language, play, or body movements.

This strategy is used to increase the child's responsivity to, and imitation of, an adult, as well as to promote continuation of the interaction. Research indicates that children with or without ASD respond with increased attentiveness when being systematically imitated by the adult (Dawson & Adams, 1984; Ingersoll 2010; Ingersoll & Schreibman, 2006). Again, different NDBI place different emphasis on reciprocal imitation as a specific component strategy, with some models using this strategy to systematically generate a context for embedding teaching trials (as in reciprocal imitation training) and others using it as a general strategy to enhance engagement and enrich the learning environment.

- NDBI work to broaden the attentional focus of the child.

Early research identified an attentional deficit in many children with ASD, wherein a child's behavior might only be affected by a small portion of a compound stimulus (e.g., Lovaas, Schreibman, Koegel, & Rehm, 1971). This attention phenomenon is called stimulus overselectivity to denote that the level of selective attention is excessive. For example, one child whose father wore glasses could not identify his father when the father removed the glasses. The child used only a very small portion (glasses) of the compound stimulus (father, made up of many component features) to identify him. It is easy to see how such restricted stimulus control might interfere with learning. More recent research has shown that overselectivity is highly related to developmental level and is not specific to ASD (Ploog, 2010; Reed, Stahmer, Suhrheinrich, &

Schreibman, 2013). In many cases, it can be modified (e.g., Koegel & Schreibman, 1977), and teaching with multiple examples seems to be key. Because NDBI emphasize teaching in natural and varied contexts with a variety of materials, this natural occurrence of multiple examples may likely help broaden, or normalize, the child's attentional focus (Dawson et al., 2012; Rieth, Stahmer, Suhrheinrich, & Schreibman, 2014).

- One of the most critical features of NDBI is that all NDBI involve some form of child-initiated teaching episodes.

This strategy may be called child choice or following the child's lead. It seeks to take advantage of increased motivation by presenting something highly desired to a child or providing an instruction or opportunity to respond within the context of a child-preferred activity or familiar routine. The child indicates interest in an object or activity by speaking, pointing to, reaching for, or spontaneously engaging in the desired activity, and the clinician provides a teaching opportunity within the activity. Because the child chooses the object or activity involved in the teaching interaction, the child's successful achievement of his or her goal is the positive consequence for the child's use of the target skill set up by the adult. The degree to which the child must initiate a teaching episode varies across NDBI, with some models focusing primarily on child initiations (e.g., incidental teaching) and other models balancing child initiations with adult-initiated teaching episodes (e.g., PRT, Project ImPACT).

CONCLUSION

ASD has historically been the focus of intense interest and intervention strategies. The development of treatments based on the science of ABA provided the first successful treatment for ASD. These behavioral interventions initially focused on a discrete trial model of implementation wherein skills were broken down into smaller components and taught via a successive series of discrete trials. Although effective, and indeed a substantial change for ASD intervention, subsequent research identified some important limitations of DTT treatments. In response to these limitations, behavioral treatments expanded and became more naturalistic. This included teaching in the child's everyday environments, teaching skills likely to be maintained in the child's everyday environment, and using the child's motivation. In addition, the ASD field changed as younger children began being diagnosed and the importance of developmental science became apparent when early social and other behavioral deficits became the focus of treatment. Thus, the fields of behavioral psychology and developmental psychology have joined to inform a set of interventions called NDBI.

NDBI are composed of a number of specific interventions that include required components and procedures. Thus, the concept of NDBI provides for parsimony of distinct intervention models (e.g., PRT, ESDM, JASPER) and allows for a clearer appreciation and understanding by families, professionals, insurance carriers, and others. It is essential that researchers and clinicians self-identify their particular intervention as one of the NDBI. To be identified as such, however, requires that the intervention has strong empirical support and incorporates the requirements described in this chapter.

Chapter 2 provides a short overview of NDBI models. Sections II–IV offer more specifics of NDBI concepts, requirements, and intervention procedures. This book focuses in detail on how NDBI are implemented and evaluated as treatment strategies for individuals with ASD and other developmental disabilities.

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