Application of Naturalistic Developmental Behavioral Intervention in Early Intervention for Autism Spectrum Disorder

Authors: Xiao Shihua, Jing Li, Li Jing

Date: 2023-07-20T00:00:00+00:00

Abstract

The escalating prevalence of autism spectrum disorder has intensified the demand for early intervention, yet traditional behavioral interventions possess inherent limitations. Naturalistic Developmental Behavioral Interventions (NDBI) constitute a category of early intervention approaches for autism that integrate behavioral principles with developmental theory and are implemented within naturalistic contexts. In recent years, NDBI has attracted extensive international attention, with its empirical research base continuing to expand. Representative NDBI intervention methods include Joint Attention, Symbolic Play, Engagement and Regulation (JASPER), Enhanced Milieu Teaching (EMT), Social Communication, Emotional Regulation, and Transactional Support (SCERTS), Pivotal Response Treatment (PRT), Early Start Denver Model (ESDM), and Improving Parents As Communication Teachers (ImPACT), among others. These approaches share common core elements and characteristics, though each emphasizes distinct target domains and demonstrates unique effect profiles. NDBI exhibits prominent advantages in facilitating the development of children with autism across social communication, language, and cognitive domains, as well as in reducing family economic burden and enhancing child initiations, thereby holding considerable application prospects within China. Future research should concentrate on enhancing intervention efficacy and expanding application scope, encompassing the clarification of predictive factors and moderating variables influencing intervention outcomes, exploration of effective parent training methodologies, investigation of integrative approaches combining different intervention methods and tools, while concurrently advancing the localization and indigenization of NDBI research and practice within China's cultural context.

Full Text

Abstract

The rising prevalence of autism spectrum disorder (ASD) has intensified the demand for early intervention, yet traditional behavioral interventions have notable limitations. Naturalistic Developmental Behavioral Interventions (NDBI) represent a class of early intervention approaches for ASD that integrate behavioral principles with developmental theory and are implemented in naturalistic settings. In recent years, NDBI has garnered widespread international attention, with a continuously expanding empirical research base. Representative NDBI methods include Joint Attention, Symbolic Play, Engagement and Regulation (JASPER), Enhanced Milieu Teaching (EMT), Social Communication, Emotional Regulation, and Transactional Support (SCERTS), Pivotal Response Training (PRT), Early Start Denver Model (ESDM), and Project ImPACT (PIT). While these approaches share common core elements and characteristics, they differ in their target domains and specific effectiveness profiles. NDBI demonstrates outstanding advantages in promoting development across social, language, and cognitive domains in children with ASD, reducing family economic burden, and enhancing child initiative. NDBI holds broad application prospects in China. Future research should focus on improving intervention outcomes and expanding application scope, including clarifying predictive factors and moderating variables that influence intervention effectiveness, exploring effective parent training methods, investigating combinations of different intervention methods and tools, and promoting the localization of NDBI research and practice within the Chinese cultural context.

Keywords: Naturalistic developmental behavioral interventions (NDBI); Autism spectrum disorder (ASD); Early intervention

2 Introduction to Naturalistic Developmental Behavioral Interventions

Naturalistic Developmental Behavioral Interventions emerged from reflections on the limitations of traditional behavioral approaches and the application of developmental science. Since the mid-1960s, Applied Behavior Analysis (ABA) has dominated autism intervention. Lovaas (1968) and other ABA pioneers introduced operant conditioning-based practices (Skinner, 1965) to the field of autism, demonstrating that behavioral principles of "stimulus-response-reinforcement" could effectively teach new skills to children with ASD. Lovaas and colleagues' (1987) study, which achieved significant outcomes through behavioral intervention for a group of children with autism, laid the foundation for the widespread application of behavioral interventions in autism treatment.

However, during implementation, traditional highly structured behavioral methods such as Discrete Trial Training (DTT) gradually revealed limitations, including difficulties with skill generalization, lack of spontaneity and flexibility in

children's responses, and over-reliance on prompting (Schreibman, 2007). Some research also indicated that such methods could lead to negative emotional responses in children with ASD, including anxiety, frustration, and adaptation difficulties, thereby inhibiting their learning and development (Kupferstein, 2018). These limitations accompanying the success of behavioral interventions prompted researchers to develop new intervention procedures based on ABA theory to improve and expand autism intervention methods. Simultaneously, developmental psychology research on atypical development revealed that typical and atypical development are mutually informative. Children with ASD follow developmental trajectories similar to those of typically developing children across various domains (Lifter et al., 1993; Mundy et al., 1987; Tager-Flusberg et al., 1990), which encouraged researchers to emphasize the integration of developmental principles and sequences in early intervention. Against this background, Naturalistic Developmental Behavioral Interventions (NDBI) emerged.

In 2015, Professor Schreibman and colleagues established a consensus statement on the empirical and theoretical foundations of NDBI, collectively referring to this class of autism intervention methods that combine ABA and developmental psychology principles as Naturalistic Developmental Behavioral Interventions (Schreibman et al., 2015). NDBI achieves developmentally appropriate goals by applying behavioral strategies in natural, play-based environments. Its core elements include (Schreibman et al., 2015): (1) **Instructional goals** that emphasize holistic developmental domains (language, cognition, play, social interaction, motor skills, etc.). Target skills are selected based on children's developmental patterns, with intervention goals determined by studying developmental sequences and prerequisites for specific skills. For example, joint attention, imitation, functional play, and joint engagement are critical prerequisites for language and social development (Poon et al., 2012; Tomasello, 2019). NDBI also emphasizes integration of knowledge and skills across developmental domains, ensuring that skill development in one area (e.g., learning a symbol such as a new word or gesture during an activity) is combined with skill development in other areas (e.g., using that word or gesture to maintain engagement with another person) to promote generalization. (2) **Instructional context** emphasizes implementing intervention within the context of naturally occurring social activities in natural environments. Specific features of the learning environment—including activities, materials, quality of adult-child interaction, and emotional value—help optimize learning and generalization of newly developed skills. (3) **Instructional strategies** employ various development-promoting strategies that combine developmental approaches with behavioral techniques, such as modeling, shaping, chaining, and prompting, to systematically expand children's communication, social, and play skills, as well as age-appropriate cognitive, motor, and adaptive abilities.

Intervention methods within the NDBI framework share common features, including: teaching within antecedent-behavior-consequence processes, establishing individualized instructional goals based on developmental science, having intervention manuals with clearly defined procedures, possessing systems for as-

sessing treatment fidelity, continuously measuring progress during instruction, having children initiate instructional events, arranging instructional environments, using natural reinforcement, imitating children, balancing turns (shared control), prompting, and modeling (Schreibman et al., 2015). Frost and colleagues (2020) identified eight common elements of NDBI: (1) face-to-face positioning at the child's level; (2) following the child's lead; (3) using positive affect; (4) modeling and expanding language; (5) being sensitive and appropriately responsive to children's communication cues; (6) creating communication opportunities; (7) frequency of direct teaching episodes (including adult use of prompting sequences to support children in acquiring new or emerging skills); and (8) quality of direct teaching episodes (explicit instruction, developmentally appropriate goals, reinforcing reasonable attempts, and using natural reinforcement).

In recent years, NDBI has received widespread international attention. In the United States, the National Professional Development Center on Autism Spectrum Disorder has identified NDBI (including Pivotal Response Training and naturalistic teaching strategies) as evidence-based practices for children with ASD. The American Academy of Pediatrics also recommends using NDBI for children with ASD. In Europe, NDBI has been recognized as a promising approach for ASD intervention. For example, in France, the Haute Autorité de Santé (HAS) recommends NDBI such as the Early Start Denver Model as effective interventions for children with ASD. In the United Kingdom, the National Institute for Health and Care Excellence (NICE) identifies NDBI (including the Early Start Denver Model and Pivotal Response Training) as evidence-supported interventions. As NDBI gains increasing global recognition, its empirical research base continues to expand. Numerous studies and practices have gradually accumulated evidence supporting NDBI effectiveness and further explored its applicability and outcomes across different populations and settings. This growing and deepening research foundation provides a basis for broader application in practice.

3 Main Methods of Naturalistic Developmental Behavioral Interventions

Based on the aforementioned core elements and common features, multiple specific intervention methods have been incorporated into the NDBI system, with the number continuing to grow (Schreibman et al., 2020; Schreibman et al., 2015; Vivanti et al., 2020). These methods share NDBI's common characteristics while each possessing unique features. They include both focused interventions targeting specific domains such as language or social interaction, and comprehensive interventions emphasizing overall development. Some methods involve implementation by both professional therapists and parents, while others are implemented entirely by parents. The most representative methods with extensive practice and multiple empirical studies are as follows:

3.1 Joint Attention, Symbolic Play, Engagement and Regulation (JASPER)

JASPER was developed by Dr. Kasari and colleagues at the University of California, Los Angeles, and is applicable to infants and toddlers with ASD and older children with ASD who have low language abilities (Kasari et al., 2006). JASPER's core target domain is children's social communication, with particular emphasis on nonverbal communication. Its core instructional components are four interconnected target skills: joint attention, symbolic play, engagement (referring to children's involvement in social activities), and regulation (including self-regulation and emotional regulation). These target skills are enhanced to promote social behavior development (Kasari et al., 2015).

JASPER emphasizes a naturalistic and developmental framework, achieving target skills by integrating a series of naturalistic developmental behavioral strategies into play activities. These instructional strategies include: (1) environmental arrangement; (2) following the child's lead and responding to the child's communication bids; (3) imitation and modeling; (4) expanding children's joint attention, requesting, and play behaviors; (5) communication strategies: adults adjust language and play behaviors to match the child's abilities; and (6) using prompting procedures (from least to most) to elicit joint attention, language, and play engagement (Kasari et al., 2015). Interventionists flexibly employ these strategies to achieve improvement in children's four target skills. The intervention steps of JASPER are shown in Figure 1 [Figure 1: see original paper].

Multiple randomized controlled trials support JASPER's effectiveness in improving joint attention, engagement, play, and language in children with ASD. For example, in an early randomized controlled trial, Kasari et al. (2006) randomly assigned 58 children with ASD aged 3-4 years to a joint attention group (20 children), a symbolic play group (21 children), or a control group (17 children). Each child received 30 minutes of intervention daily from professional therapists for an average of 5-6 weeks. Children were assessed pre- and post-intervention using the Early Social-Communication Scales (ESCS), Structured Play Assessment (SPA), and 15-minute caregiver-child interaction videos. Results showed that compared to the control group, children in both the joint attention and symbolic play groups showed significant improvements in joint attention. The joint attention group demonstrated more child-initiated joint engagement than the control group, and the symbolic play group exhibited more diverse play types and higher-level play skills. Furthermore, longitudinal follow-up studies conducted 1 year (Kasari et al., 2008) and 5 years (Kasari et al., 2012) after intervention revealed that most children maintained their skills, and expressive language abilities continued to improve in the verbal communication domain. This study has been replicated with different implementers, producing the same benefits (Kaale et al., 2014; Kasari et al., 2010).

JASPER can be implemented by individuals who frequently interact with chil-

dren in natural environments, such as parents and teachers. Kasari, Lawton, et al. (2014) compared the effects of JASPER implemented by parents (who received either group training or one-on-one coaching) on preschool children with ASD. Results showed that participating children with ASD improved in joint engagement, initiations of joint attention, and symbolic play, with one-on-one parent coaching demonstrating superior effects compared to group parent training. JASPER also showed clear advantages when compared to other parent-mediated interventions, such as psychoeducational intervention (PEI) (Kasari et al., 2015). Chang et al. (2016) and Gulsrud et al. (2019) examined JASPER's implementation effectiveness in public kindergartens and urban low-income community childcare centers, respectively. Both community-based studies, implemented by regular teachers, reported significant improvements in joint attention, play skills, and language abilities in children with ASD. In a meta-analysis of 29 group design studies on NDBIs, Tiede and Walton (2019) included 13 empirical studies on JASPER. Among them, 11 studies reported JASPER's impact on social engagement, with 8 showing "medium to large" effect sizes (g = 0.41-1.62); 7 studies reported effects on play skills, with 5 showing "small to medium" effect sizes (g = 0.22-0.84); and 10 studies reported joint attention outcomes, with 8 showing "small to medium" effect sizes (g = 0.06-0.63).

As a targeted NDBI method, JASPER primarily focuses on core social communication deficits in children with ASD. JASPER demonstrates significant intervention effects on its target skills—joint attention, engagement, and play skills—and can also lead to improvements in language abilities. However, research on JASPER's effectiveness in regulation skills is limited. Additionally, since JASPER targets the social communication domain, whether it can produce broader positive outcomes in other domains such as cognition and adaptive behavior requires further investigation.

The JASPER method emphasizes strategies and target skills rather than including a specific list of target activities, making it highly flexible in practice. However, JASPER's target skills, such as joint attention, are not intuitive, meaning that implementers require high levels of expertise and sensitivity to accurately and dynamically assess children's developmental levels, design appropriate intervention activities, and make real-time adjustments during implementation. Therefore, JASPER is commonly implemented by professionals in practice. While JASPER has extensive clinical research and practice, most studies have been conducted in the United States. Furthermore, JASPER requires professional therapists to obtain certification training from UCLA before providing JASPER interventions.

3.2 Enhanced Milieu Teaching (EMT)

Enhanced Milieu Teaching (EMT) is a naturalistic, child-directed early language intervention method. EMT primarily targets children with language impairments and is widely applied to children with ASD (Kaiser & Hampton,

2016). Its core target domain is children's language and verbal communication. This intervention method integrates core strategies from earlier intervention models—Responsive Interaction and Milieu Teaching—using specific prompting and modeling techniques to promote children's language development and improve social communication skills (Hancock et al., 2016). EMT implementation consists of three modules (as shown in Figure 2 [Figure 2: see original paper]): (1) **Environmental arrangement**, where adults establish a language learning environment that makes children more likely to engage and communicate; (2) **Responsive interaction**, where adults build emotional connections with children by following their interests, imitating their actions and language, taking turns, and responding to their communication bids, thereby improving the quality of social interaction; and (3) **Milieu teaching strategies**, where adults model and expand language and use specific prompting procedures to reinforce and shape verbal behavior (Kaiser & Hampton, 2016). Milieu teaching procedures include modeling target-level language, expansion, time delay (e.g., pausing during routines to elicit communication), and prompting.

Kaiser and colleagues have confirmed through a series of experiments that EMT implemented by therapists or trained parents produces significant effects on language development in children with ASD (Hampton et al., 2019; Hampton et al., 2021; Quinn et al., 2021; Wright & Kaiser, 2017). In one therapist-implemented study, four children with ASD aged 3-5 years received 24 EMT intervention sessions (twice weekly, 15 minutes each). Assessment tools included standardized tests such as the PLS-4 Language Assessment Scale, Peabody Picture Vocabulary Test (PPVT), Expressive Vocabulary Test (EVT), and MacArthur Communication Development Inventory-Words and Sentences (MCDI). Results showed significant improvements in all participating children's receptive and expressive language, mean length of utterance, lexical diversity, and use of target vocabulary relative to baseline, with skills maintained and continuing to develop at 6-month follow-up (Hancock & Kaiser, 2002). Parent-implemented EMT after parent training showed similarly positive effects (Kaiser et al., 2000). Further randomized controlled experiments indicated that parent-therapist co-implementation of EMT was more effective in promoting children's oral language development than therapist-only implementation and generalized better to the home environment (Kaiser & Roberts, 2013).

As an NDBI model targeting language development, EMT can effectively promote language and verbal communication development in children with ASD. Since EMT largely integrates milieu teaching techniques and its developers emphasize parent training, it is particularly suitable for implementation by parents and family members in everyday contexts. Additionally, combining EMT (which focuses on language development) with JASPER (which focuses on non-verbal communication) can produce better overall intervention effects on children's social communication domain (Hampton et al., 2021).

However, it is important to note that EMT requires children to have echoic abilities and is suitable for children with mean length of utterance between

1.0-3.5. A certain level of echoic ability is a prerequisite because EMT's core module—milieu teaching techniques—relies on adult modeling and child imitation (in fact, all teaching requires modeling and imitation, but echoic behavior formation is more complex in children with ASD and may be difficult to initiate through milieu teaching strategies alone for some children). Therefore, EMT cannot completely replace professional speech therapy for preverbal children with ASD.

3.3 Social Communication, Emotional Regulation, and Transactional Support (SCERTS) Model

The SCERTS model was developed in the United States in 2003 by Prizant and Wetherby's research group as a comprehensive intervention method targeting core deficits in children with ASD (Prizant et al., 2003). SCERTS is a support provision model rather than a specific therapeutic technique, aiming to enhance children's core competencies in social communication and emotional regulation by providing strategic support in natural environments (Prizant et al., 2003, 2006). SCERTS target domains include: social communication (joint attention, symbol use), emotional regulation (self-regulation, mutual regulation, recovery from dysregulated states), and transactional support (interpersonal support, learning support, family support, and professional support) (Prizant et al., 2003).

In a cluster randomized controlled trial conducted in the United States by Morgan et al. (2018), researchers observed 197 students with ASD with a mean age of 6.76 years across 129 classrooms in 66 schools. The experimental group received SCERTS intervention (CSI), while the control group maintained regular teaching methods. Researchers used multiple assessment tools including the Classroom Measure of Active Engagement (CMAE), Peabody Picture Vocabulary Test-4th Edition (PPVT-4), Expressive One-Word Picture Vocabulary Test-4th Edition (EOWVPT-4), Vineland Adaptive Behavior Scales-II (VABS-II), Social Responsiveness Scale (SRS), Social Skills Improvement System (SSRS), and Behavior Rating Inventory of Executive Function (BRIEF) to evaluate students' classroom active engagement, vocabulary abilities, adaptive behavior, social skills, and executive function. Results showed that compared to the control group, the experimental group performed better in social interaction during classroom active engagement. Additionally, the experimental group showed improvements in adaptive communication, social skills, and executive function, with Cohen's d effect sizes ranging from 0.31 to 0.45.

A recent systematic review of SCERTS effectiveness by Yi et al. (2022) summarized five empirical studies on SCERTS effectiveness for children with ASD published between 2014-2021. All five studies reported positive outcomes for social interaction, further confirming SCERTS effectiveness in this domain. However, notably, two studies did not report positive outcomes for emotional regulation or reduction of repetitive and stereotyped behaviors. As a comprehensive NDBI model, although SCERTS has positive effects on social interaction in children

with ASD, its impact on emotional regulation—a core target of the model—requires further investigation.

Since 2006, the SCERTS model has been applied in multiple countries, including the United Kingdom, New Zealand, and Japan. The SCERTS application manual has been translated into Japanese, Korean, and Spanish, among other languages. Additionally, Hong Kong, China has conducted localized practice of the SCERTS model (Yu & Zhu, 2018). However, SCERTS training resources are limited. Currently, only the founding collaborators of SCERTS (Barry, Emily, and Amy L) are authorized to provide formal SCERTS training. This indicates that SCERTS application and empirical research remain relatively limited, partly because SCERTS emphasizes support across environments, making implementation more challenging.

3.4 Pivotal Response Training (PRT)

Pivotal Response Training (PRT), developed by Koegel et al. (1987) in the 1980s, is a comprehensive intervention method based on applied behavior analysis combined with developmental principles, applicable to children with ASD of different ages. PRT's core targets are four "pivotal areas": motivation, response to multiple cues, self-initiation, and self-management. PRT aims to promote overall development in social skills, language communication, behavior, and even academic performance in children with ASD by improving these four pivotal areas. The ultimate goal is to enable individuals to independently participate in rich and meaningful lives in inclusive environments (L. K. Koegel, Ashbaugh, & R. L. Koegel, 2016). PRT posits that these four pivotal areas are foundational skills that enable broad improvements and generalization of abilities in other domains for children with ASD. Among them, motivation is considered the most important capacity for improving core deficits and engaging children in meaningful learning. PRT intervention strategies for motivation include: (1) following the child's lead; (2) reinforcing attempts; (3) interspersing maintenance and acquisition tasks; (4) varying tasks; and (5) using natural reinforcement (R. L. Koegel & L. K. Koegel, 2012). PRT instructional steps are shown in Table 1 .

PRT implementation can effectively improve language communication, social interaction, and play skills in children with ASD. A series of single-case and group comparison studies show that PRT not only enables children with ASD to learn to ask questions spontaneously (Popovic et al., 2020), increase utterance frequency and length (Mohammadzaheri et al., 2022; Voos et al., 2012), develop spontaneous language (Schwartzman et al., 2021), and increase lexical diversity and functional communication language (Hardan et al., 2015), but also promotes peer interaction (Boudreau et al., 2015) and social engagement (Boudreau et al., 2021), alleviates anxiety, and reduces problem behaviors (Lei et al., 2017). Comprehensive application of specific PRT motivation strategies can also enhance academic motivation in school-aged children with ASD, thereby improving academic performance, engagement, and enthusiasm for learning (Koegel et

al., 2010; Mancil & Pearl, 2008). Additionally, adapted PRT models have expanded its applicable age range to include younger infants at high risk for ASD (Steiner et al., 2013) and older adolescents and adults (L. K. Koegel, Ashbaugh, Navab, & R. L. Koegel, 2016). PRT instructional steps are shown in Table 1.

PRT advocates for intervention in natural life contexts, and close contacts of children with ASD can all participate in intervention. It emphasizes that parents should serve as primary implementers in intervention for children with ASD and has developed various parent education models, including individualized models, group models, and self-learning programs (Horner et al., 2010). These models have shown positive impacts on improving outcomes for both children with ASD and their parents. For example, Bradshaw et al. (2017) evaluated an individualized parent education program for toddlers with ASD. The study provided 12 weeks of PRT training (one hour per week) to parents of children with ASD aged 15-21 months, guiding parents to implement PRT at home. Results showed that parent-implemented PRT effectively improved expressive communication skills in toddlers with ASD, reduced autism symptoms, and decreased parental stress. PRT also provides effective modeling and inclusive interactive environments for children with ASD by training their peers. For instance, Boudreau et al. (2021) demonstrated that training peers as interventionists through brief training, who then provided PRT to children with ASD, significantly improved social engagement behaviors. Bryson et al. (2007) promoted PRT to the community by training PRT intervention teams, with results showing significant improvements in functional language among children participating in community intervention. In school settings, training paraprofessionals to implement PRT effectively promoted social interaction abilities in school-aged children with ASD (Koegel et al., 2014). However, a recent meta-analysis by Uljarević et al. (2022) of 10 PRT randomized controlled trials reported more complex results: while most PRT studies showed medium to large effect sizes in the verbal communication domain, PRT did not demonstrate significant effects in other domains including social skills, cognitive abilities, and adaptive functioning.

PRT is a relatively mature NDBI model. Its strategy of promoting overall development through four pivotal areas is simple and clear, and implementation is relatively convenient. Parents and peers can master basic PRT techniques through training or even video self-learning. Moreover, PRT learning resources are readily accessible; for example, the National Professional Development Center on Autism Spectrum Disorder in the United States has publicly released PRT implementation steps, making PRT less subject to copyright restrictions in practice. These advantages have led to relatively broad application of PRT. Additionally, PRT can be applied to adolescents and adults, offering the significant advantage of a wide age range of applicability.

However, current PRT intervention research has focused primarily on social interaction and verbal communication domains, with limited empirical research on other domains that affect long-term outcomes for children with ASD, such as adaptive functioning, cognition, and autism severity—evidence in these areas

remains limited. Additionally, as a comprehensive intervention method, PRT differs in comprehensiveness and systematicity compared to more comprehensive and structured interventions such as the Early Start Denver Model.

3.5 Early Start Denver Model (ESDM)

The Early Start Denver Model (ESDM), developed in 2008 by Professors Rogers and Dawson at the University of California, Davis, is a comprehensive intervention method for children with ASD aged 12-60 months (Rogers & Dawson, 2009). ESDM is considered the most representative comprehensive NDBI model (Minjarez et al., 2020). It aims to improve core deficits in children with ASD and accelerate children's developmental pace across all domains, including language, play, social interaction, attention, imitation, motor skills, daily living skills, and behavior, with emphasis on cognitive, social-emotional, and language domains (Rogers & Dawson, 2010; Xu Xiu, 2015).

ESDM is based on developmental theory and behavioral principles, extracting strategies and frameworks from multiple intervention models. Its core instructional strategies integrate applied behavior analysis, pivotal response training, and the original Denver model (Rogers & Dawson, 2010). During instruction, it uses applied behavior analysis to teach new skills, employs pivotal response training strategies such as reinforcing attempts, interspersing tasks, using natural reinforcement, following the child's lead, and shared control to enhance children's motivation, and combines Denver model-developed teaching techniques to develop positive relationships with children and increase the rewarding value of social interaction (Dawson, 2008). These techniques include: (1) using positive affect; (2) imitating children's actions and language; (3) emphasizing the joy of playing with people; and (4) two-way interaction and shared control.

Dawson et al. (2010) conducted the first randomized controlled trial of ESDM. In this study, 48 toddlers with ASD aged 18-30 months were randomly assigned to either an ESDM intervention group or a community treatment-as-usual group. The ESDM group received high-intensity intervention (20 hours per week on average for 2 years) in a one-to-one format implemented by therapists. The community treatment group received community-based standard treatment. Children were assessed pre- and post-intervention using the Mullen Scales of Early Learning (MSEL), Vineland Adaptive Behavior Scales (VABS), Repetitive Behavior Scale (RBS), and Autism Diagnostic Observation Schedule (ADOS). Results showed that compared to community treatment, ESDM intervention significantly improved children's cognitive, language, and adaptive behavior abilities, and also reduced symptoms in toddlers with ASD. Moreover, unlike the community treatment group, improvements in social behavior in the ESDM group were associated with normalized patterns of brain activity (Dawson et al., 2012). Additionally, follow-up data on the same group of children 2 years post-treatment showed that the ESDM intervention group not only maintained initial treatment gains across multiple functional domains but also showed significantly greater improvements in autism severity (Estes et al.,

2015). Comparative studies with early intensive behavioral intervention found that ESDM showed better effects in improving children's intellectual development (Shi et al., 2021). A recent meta-analysis showed that ESDM intervention produced moderate significant improvements in cognitive ability (g = 0.28), autism symptoms (g = 0.27), and language (g = 0.29) in children with ASD (Wang et al., 2022).

Furthermore, consistent evidence from ESDM delivered in classrooms, communities, and homes demonstrates the feasibility of implementing ESDM across different settings and its effectiveness in improving early symptoms of ASD. For example, Vivanti, Paynter, et al. (2014) investigated the feasibility of group-based ESDM in childcare centers delivered by ESDM-certified preschool staff. Holzinger et al. (2019) studied the feasibility of low-intensity ESDM implemented in children's home environments. Finally, Abouzeid et al. (2020) investigated the feasibility of low-intensity parent-implemented Early Start Denver Model (P-ESDM) conducted in community centers. All three studies confirmed the feasibility and acceptability of ESDM intervention and found improvements in parent (Abouzeid et al., 2020) or child outcomes (Holtzinger et al., 2019; Vivanti, Paynter, et al., 2014). A recent systematic review by Jhuo and Chu (2022) of 13 empirical studies on P-ESDM published between 2012-2022 showed that parent-implemented ESDM improved cognitive, language, imitation, attention, and social engagement in children with ASD, enhanced parental parenting skills and parent-child interaction quality, and reduced parenting stress. However, short-term, low-intensity P-ESDM interventions reported inconsistent results compared to long-term, high-intensity interventions. Two randomized controlled trials indicated that short-term, low-intensity P-ESDM interventions did not show significant intervention effects on children with ASD (Rogers et al., 2019; Vismara et al., 2018). This is partly because ESDM requires relatively high levels of understanding and operational ability from implementers. Due to short training duration, parents may not adequately master ESDM theoretical knowledge and strategy application or accumulate sufficient experience (Gao Di et al., 2020).

As a comprehensive NDBI model, ESDM emphasizes all developmental skills in early childhood. The model uses all core instructional strategies of NDBI and has a comprehensive, detailed, and operationally strong teaching system with teaching fidelity assessment and continuous data collection methods, facilitating high-quality implementation across environments. ESDM promotes overall development and improvement of core symptoms in children with ASD, particularly showing significant effects on improving intelligence, language, imitation, and social engagement, and can positively impact children's brain development. However, ESDM requires relatively high levels of understanding and operational ability from implementers. Parents may struggle to master ESDM theoretical knowledge through short, low-intensity training, affecting intervention outcomes. Future research should strengthen evaluation of the effectiveness and standardization of parent training based on ESDM. Additionally, it is important to note that the ESDM curriculum is only applicable to children with

ASD aged 12-60 months and is not suitable for children whose chronological age exceeds 60 months, even if their developmental age falls within 12-60 months (Xu Xiu, 2015).

Currently, ESDM has been promoted and applied in many countries, with the ESDM intervention manual translated into German, Japanese, French, Chinese, and other languages. However, ESDM's teaching and assessment systems are relatively complex. Professionals wishing to master professional ESDM intervention techniques can receive training and certification through the ESDM training program provided by the UC Davis MIND Institute.

3.6 Project ImPACT (PIT)

Project ImPACT (PIT) is an evidence-based parent training program developed by Ingersoll et al. in 2009 for children with autism and social impairments aged 18 months to 6 years. PIT's target domain is social communication, aiming to teach parents to implement interventions that promote children's language, social, and play skill development (Ingersoll & Dvortcsak, 2009). PIT organizes multiple naturalistic interactive teaching techniques and direct teaching techniques into a three-tiered pyramid structure that is taught to parents hierarchically, as shown in Figure 3 [Figure 3: see original paper] (Ingersoll & Dvortcsak, 2009). The four interactive teaching techniques at the pyramid's base—following the child's lead, imitating the child, adult animation, and modeling and expanding language—form the foundation of treatment, helping to increase children's motivation and engagement and adults' responsiveness. After parents master these skills, interactive teaching techniques at the middle level are introduced, including fun obstacles and communication elicitation, to promote spontaneous communication. Finally, at the pyramid's top are direct teaching techniques, including using prompting and reinforcement to achieve more advanced social communication goals.

Since PIT is implemented through parents, its ultimate effectiveness is influenced by multiple factors from clinicians (trainers) to parents (interventionists) to children. Pellecchia et al. (2020) designed a comprehensive evaluation method for PIT including three research targets: clinician fidelity to PIT, parent usage and impact of PIT, and PIT's improvement of children's social communication skills. Published research has focused primarily on the latter two. Stadnick et al. (2015) conducted a multiple-baseline randomized controlled experiment including 30 children with ASD aged 18 months to 8 years and their parents, with 16 assigned to the intervention group and 14 to the control group. After receiving 12 weeks of PIT intervention, children in the intervention group showed significantly greater improvements in social and communication skills than the control group. Additionally, the study found that improvements in children's social and communication skills were significantly positively correlated with parent intervention adherence and negatively correlated with baseline parental stress levels, suggesting that high parental stress may adversely affect PIT implementation.

Parent-implemented PIT strategies can improve parent-child interaction patterns and create a family environment conducive to learning and development for children with ASD. This is particularly important for high-risk siblings of children with ASD. Stahmer, Rieth, et al. (2020) conducted a 12-week randomized controlled study of PIT with 25 children under 30 months showing high-risk symptoms for ASD and similarly observed greater language and social communication progress in the intervention group, though differences were not statistically significant. One reason may be that the toddlers in this study were relatively young (mean age 22.67 months) and many had not yet received an ASD diagnosis. An important finding by Stahmer, Rieth, et al. was that PIT intervention produced long-term changes in parent-child interaction patterns, which may help establish a long-term environment more suitable for children with ASD to learn. Long-term follow-up studies indicate that toddlers with ASD who received early PIT intervention showed sustained reductions in autism symptoms during school age (Pickles et al., 2016).

Further research has revealed possible mechanisms for PIT's long-term effects. The effectiveness of parent-implemented PIT stems not only from direct skill instruction to children with ASD but also from parents' implementation of PIT strategies potentially promoting development of certain key child competencies, thereby bringing about longer-term improvements in language and social communication. Yoder et al. (2021) conducted a randomized controlled experiment examining the impact of parent-implemented Project ImPACT on various social communication abilities in high-risk siblings of children with ASD. The study used a longitudinal design, tracking changes in high-risk children's abilities at four time points. The study found that the frequency of parents' ImPACT strategy use did not have significant direct effects on children's social skills including intentional communication, expressive vocabulary level, action imitation, and object play. However, sequential mediation model analysis revealed significant indirect effects: parents' use of ImPACT strategies could produce significant positive indirect effects on distal social communication and expressive language abilities by enhancing children's proximal action imitation, and on distal social communication abilities by enhancing children's proximal intentional communication.

As a representative parent-mediated NDBI model, PIT targets core skill deficits and effectively promotes development of social engagement, language, and play skills in children with ASD, while showing positive impacts on long-term developmental outcomes. As a parent intervention model with strong empirical support, PIT has significant social importance. It improves parent-child interaction patterns, enhances parental parenting skills, helps establish a family environment more suitable for children's long-term living and learning, and helps reduce the economic burden on families with ASD. However, during implementation, it is important to address parental stress and anxiety, as these factors affect PIT implementation effectiveness. Currently, there is no research on Project ImPACT in China, and future research urgently needs to conduct localized studies and practice of Project ImPACT.

4 Advantages of Naturalistic Developmental Behavioral Interventions

4.1 Effectiveness of Naturalistic Developmental Behavioral Interventions

The primary goals of early intervention for children with ASD are: (1) to minimize core deficits and improve co-occurring conditions; (2) to enhance independent living skills by promoting development and acquisition of adaptive skills; and (3) to reduce maladaptive behaviors (Kasari, 2015). The aforementioned research on different intervention methods demonstrates the short-term effectiveness of NDBI in these target domains, including social interaction (Brian et al., 2017; Dawson et al., 2010; Kasari, 2008; Lawton & Kasari, 2012; Shire, 2017), adaptive behavior (Dawson et al., 2010; Estes et al., 2015; Ingersoll et al., 2017), cognition (Kasari et al., 2008; Zhou et al., 2018), language (Chang et al., 2016; Dawson et al., 2010; Hardan et al., 2015), and play skills (Chang et al., 2016; Kasari et al., 2008). These different intervention methods also have distinct characteristics and advantages. For example, JASPER primarily targets core deficits in nonverbal communication in children with ASD, improving joint attention, symbolic play, and joint engagement while also promoting language development (Kasari et al., 2015; Waddington et al., 2021). EMT focuses on the language domain, effectively improving language and verbal communication abilities while promoting overall development in children's social communication domain (Hancock et al., 2016). SCERTS targets core deficits in social communication and emotional regulation, constructing a cross-environmental support system that promotes improvements in social interaction, particularly active engagement in social activities (Yi et al., 2022). As a comprehensive intervention method, PRT targets four "pivotal areas," particularly emphasizing the role of motivation in overall child development, and shows good effects in social interaction and language communication domains (Mohammadzaheri et al., 2022; Boudreau et al., 2021). ESDM provides a comprehensive and systematic teaching system to promote overall development and improvement of core symptoms in children with ASD, particularly showing significant effects on improving cognition, language, and social engagement (Wang et al., 2022). PIT's characteristic is training parents in teaching strategies, with parents implementing interventions to improve children's social communication abilities while helping establish a family environment more conducive to child development. Additionally, PIT has positive effects on high-risk siblings of children with ASD (Yoder et al., 2021).

NDBI also shows positive impacts on long-term developmental outcomes for children with ASD. For example, a 6-year follow-up study of 121 children with ASD who participated in early PIT intervention showed significant improvements in autism symptoms at both treatment completion and follow-up (Pickles et al., 2016). Moreover, many studies indicate that compared to traditional behavioral intervention methods, NDBI has clear advantages in skill generalization and evidence base. Crank et al. (2021) showed that NDBI has good gener-

alization effects, enabling learned skills to transfer to different environments. Comparative studies between NDBI and traditional behavioral methods also found that NDBI methods facilitate greater maintenance and generalization of learned skills and are more conducive to improving children's spontaneity (LeBlanc et al., 2006; Mohammadzaheri et al., 2014). Sandbank et al. (2020) conducted a comprehensive meta-analysis of NDBI, applied behavior analysis methods, sensory integration therapy, structured teaching, animal-assisted therapy, and other non-pharmacological early intervention models for children with ASD under 8 years old. NDBI showed significant positive effects on social communication, language, cognition, and play skills in children with ASD, along with the best overall research quality.

In summary, NDBI is effective in promoting overall development and improving core symptoms in children with ASD. Compared to traditional behavioral interventions, NDBI better facilitates skill maintenance and generalization and has a stronger evidence base. Additionally, early participation in NDBI can improve medium- to long-term developmental outcomes in certain domains.

4.2 Economic Efficiency of Naturalistic Developmental Behavioral Interventions

Receiving appropriate early intervention during childhood can effectively improve core symptoms of ASD and produce positive long-term outcomes. However, due to limited intervention resources, many children fail to receive timely treatment. Surveys show that even in the United Kingdom, where autism intervention began relatively early, only about 33% of children receive professional intervention services for at least one hour per day (McConachie & Robinson, 2006). In China, less than one-third of children with ASD receive timely diagnosis and treatment, and less than one-third can begin intervention before age 3, while one-fifth of children cannot start rehabilitation training until age 6 (Wu Liang & Li Hongxia, 2018). This supply-demand gap reduces effective intervention time and effectiveness for children with ASD. Many behavioral interventions are also long-term, high-density, and expensive in one-to-one treatment formats. From a time and economic cost perspective, family intervention for children with ASD can effectively help families reduce time and economic costs and support long-term rehabilitation.

NDBI emphasizes implementing intervention in natural daily life and positive play interactions, making it particularly suitable for use by parents and family members. Parent involvement is central to NDBI, with most NDBI models including some form of parent intervention for core ASD symptoms. In some models, parents can be the primary implementers, including PIT, PRT, and EMT. In other models, parents are active assistants who receive training and guidance to implement training in daily life to augment therapist-provided intervention, such as in ESDM. NDBI has developed different forms of parent training, including individualized coaching, group training, and remote online education (Rogers et al., 2022; Vismara et al., 2019). Research shows that

parent-mediated NDBI improves parent-child joint attention, communication, and engagement, and has positive effects on reducing autism symptoms and improving language and cognition (Estes et al., 2015; Hardan et al., 2015; Kasari et al., 2010). In summary, NDBI increases the proportion of parent implementation in intervention practice, saving expensive economic costs associated with high-density professional intervention. Additionally, because parents can use appropriate NDBI strategies anytime during daily interactions with their children, intervention density is effectively increased. Therefore, NDBI can provide the most cost-effective intervention method for parents of children with ASD.

4.3 Child-Directed Nature of Naturalistic Developmental Behavioral Interventions

Many traditional interventions are coercive interventions that violate individual will, forcing both parents and children to face varying degrees of pain and challenges (Liu Yaping et al., 2018). NDBI, based on naturalistic and developmental principles, intentionally changes the traditionally hierarchical power structure between adults and children in treatment environments. This orientation views children as more constructivist, child-led active participants, with child preferences and sustained intrinsic motivation as core considerations.

NDBI encourages and cultivates children's initiative and spontaneous communication attempts. The adult's role is to establish and nurture children's motivation to engage and communicate, rather than imposing a therapeutic agenda that may run counter to children's interests and desires (Vivanti & Zhong, 2020). This allows children to learn through experiences that are personally relevant and meaningful to them, while also motivating them to acquire functional skills rather than mechanical repetitive training (Gengoux et al., 2020).

NDBI allows children with ASD to interact with the surrounding world in ways that match their personal preferences and cognitive functioning, ultimately improving their quality of life through increased experiences and autonomy. These child-directed naturalistic methods align with the neurodiversity perspective that emphasizes building on personal strengths and respecting individual autonomous decision-making (Schuck et al., 2021).

4.4 Ecological Validity of Naturalistic Developmental Behavioral Interventions

The ecological validity of NDBI is reflected in its intervention strategies being closely integrated with children's daily life contexts. Interventions are conducted in positive, fun play activities or family daily routines rather than highly structured scenarios, content, and procedures, enabling children to learn and develop in more natural and authentic environments. By integrating intervention with children's preferred activities, NDBI can better capture children's attention, increase their active participation, and enhance learning outcomes.

Furthermore, NDBI emphasizes close collaboration with parents and others concerned with child development to improve intervention generalization and durability. As primary caregivers in children's lives, parents can continuously apply NDBI strategies in daily life, providing support for children across various contexts. This ecological intervention approach helps children transfer learned skills to different environments and improves their adaptive abilities in real-life situations.

5 Summary and Outlook

The rising prevalence of ASD has intensified the demand for early intervention, and high-quality early intervention is key to improving long-term quality of life for children with ASD. NDBI, which combines developmental psychology with applied behavior analysis principles, is considered best practice for early intervention in children with ASD (Frost et al., 2020). NDBI has a strong research base confirming its effectiveness in improving autism symptoms and promoting development in children with ASD. Implementing intervention in natural environments, adopting a child-directed approach that views children as more constructivist active participants, and including parents in intervention by teaching them to use NDBI strategies during interactions with their children provides cost-effective intervention for families with ASD. NDBI application in treatment for children with ASD achieves and accelerates changes in learning and behavior.

Although existing research provides empirical support for NDBI effectiveness, continued in-depth exploration of the following aspects is necessary to promote widespread implementation of NDBI in early intervention for children with ASD.

5.1 Improving and Developing New Research Designs to Clarify Predictive Factors and Moderating Variables Affecting Intervention Outcomes

The etiology of ASD is complex, with substantial internal heterogeneity among affected individuals. Although numerous studies support NDBI's positive impact on development in children with ASD, significant individual differences in intervention outcomes remain (Mandell et al., 2013; Vivanti, Prior, et al., 2014). Research on which individual factors can influence NDBI intervention outcomes is of great significance.

Vivanti et al. (2013) found that individual differences in skills such as play, joint attention, and imitation affect ESDM intervention outcomes. Additionally, preliminary evidence suggests that PRT may be particularly beneficial for children who have more contact with toys, more frequently approach others, and more frequently display positive affect (Fossum et al., 2018). Hardan and colleagues (2015) reported that children with stronger visual reception abilities at baseline showed greater improvements after PRT treatment. Yang and colleagues (2016) completed a non-randomized controlled trial and found an association

between brain responses to biological motion in functional magnetic resonance imaging (fMRI) and response to PRT. These studies suggest that deficit characteristics, skill characteristics, and interest characteristics of children with ASD may be potential predictive factors worthy of further investigation. These individual characteristics may also be potential moderating variables. For example, Vivanti and colleagues (2016) confirmed that language ability at treatment onset moderated treatment response in toddlers receiving ESDM. Future research should also examine other potential moderating factors such as children's age and symptom severity.

Additionally, because different types of NDBI methods have different emphases in target skills and domains, future research can explore how to flexibly use different NDBI methods or even combine NDBI with traditional intervention methods to adapt to children's individual characteristics and achieve personalized intervention for optimal treatment effects. For example, Kasari, Kaiser, et al. (2014) combined EMT with JASPER specifically for children with ASD with lower language abilities to promote their language development. We look forward to future development of more theoretically grounded and evidence-supported intervention method combinations. Ideally, such combinations may produce better treatment effects than simply increasing the intensity of a single method.

5.2 Exploring Effective Parent Training Methods

Parent and family involvement is an essential component of NDBI. Making parents "quasi-experts" in the intervention methods used for their children can ensure continuous and natural implementation of intervention, enabling children to make more rapid and robust progress in intervention to achieve optimal prognostic outcomes across domains (Zwaigenbaum et al., 2015). Family intervention plays a particularly important role for families with ASD in low socioeconomic status and resource-scarce regions (Hampton et al., 2019). Research shows that parent training can effectively support parents in implementing NDBI strategies in daily life, improve parent-child interaction quality, alleviate parenting stress, promote skill generalization, and improve social development outcomes in children with ASD (Estes et al., 2013; Vibert et al., 2020). However, only a very small number of published studies have examined the implementation fidelity of parent training programs, the relative effectiveness of group versus individual parent training, and the optimal number of hours required for parent training programs. For example, Stadnick et al. (2015) examined the impact of parent treatment fidelity on outcomes and found that parent treatment fidelity was positively correlated with improvements in children's spontaneous language and social communication skills. Kasari, Lawton, et al. (2014) found that parent-implemented JASPER improved joint engagement, joint attention, and play skills in children with ASD, but one-on-one parent coaching was more effective than group training.

Although we recognize the importance of training parents to implement inter-

vention as the best method for early intervention in children with ASD, these methods have not yet been fully researched. Future research in parent training is needed. For example, what methods are optimal for accuracy and ease of operation when parents implement NDBI? Are remote education and face-to-face teaching equally effective? How many hours per week of parent training are needed to achieve optimal outcomes, and how long should parent education programs last? What is the optimal setting for parent training? Additionally, when designing parent training programs, researchers should pay special attention to cultural elements, parent needs and learning styles, parental stress levels, and limited family resources.

5.3 Expanding Applications of Naturalistic Developmental Behavioral Interventions

NDBI has a strong and continuously growing evidence base. However, NDBI has not yet been widely implemented on a large scale in early intervention for children with ASD (D'Agostino et al., 2023). Hampton and Sandbank (2022) surveyed early intervention therapists for autism and found that most traditional behavioral intervention therapists held positive attitudes toward NDBI practice and effects and hoped to receive more NDBI training, but only a minority of respondents had actually received training, and very few could accurately describe NDBI models. Potential reasons for slow progress in NDBI application may include the theoretical foundations of NDBI—the different theoretical orientations of cognitive developmental theory and behaviorism—and the lack of NDBI training and support in the field of autism intervention, which is dominated by behavior analysis. Research and application of NDBI in China are even more limited, with only exploratory studies of a few specific intervention methods. For example, Cheng Zhijun (2017) applied PRT to conduct a single-case study on social skills in children with ASD, and Wang Shihuan et al. (2021) explored the effects of ESDM on infants and toddlers with ASD. However, existing studies are few in number and sample size, lack large-scale randomized controlled trials, and focus on verifying therapist-implemented intervention effectiveness, with insufficient research on caregiver-implemented intervention, combinations of intervention methods, factors influencing intervention effects, and localization.

Given NDBI's effectiveness, economic efficiency, and characteristics of being implementable by non-professionals such as parents, it is particularly suitable for China's reality of large population base, rapid growth in the number of children with ASD, and high proportions of family income spent on education and care costs for children with ASD. However, NDBI was primarily developed in the United States. Promoting NDBI application in China requires localized application and practice combined with China's cultural and social environment and education system for children with ASD. First, cultivate local professionals. Currently, early intervention for children with ASD in China mainly relies on rehabilitation institutions (Wang Fang & Yang Guangxue, 2017). To promote

NDBI application in China, rehabilitation institution teachers should receive professional training and support to understand NDBI core elements and select optimal intervention methods and strategies based on children's individual characteristics. Second, be family-centered and encourage family participation. Chinese culture values family education, with families playing a central role in children's education and growth. Encouraging parent participation in intervention processes can help parents integrate NDBI strategies into family daily life, making parents the best guides for their children. Additionally, build an inclusive social environment. Inclusive environments can provide more natural contexts and social interaction opportunities for children with ASD, which is more conducive to NDBI implementation (Stahmer, Wong, et al., 2020). In recent years, China's inclusive education policies, support for inclusive education for children with ASD, and increased public understanding and awareness of ASD through social media information dissemination are creating more positive social and cultural soil for NDBI localization. Finally, with rapid modern technological advancement, an increasing number of smart devices have emerged and demonstrated potential as rehabilitation assistive tools (Bravou et al., 2022; Shemy, 2022). Prospective exploratory research on the impact of combining NDBI methods with virtual/augmented reality devices, artificial intelligence interactive devices (such as robots), and brain-computer devices on intervention effects is important for expanding NDBI applications.

References

程靖益, 王可, 杨亭, 陈洁, 陈立, 代英, ... 李廷玉. (2021). 学龄前孤独症谱系障碍儿童家庭疾病负担全国多中心调查. 教育生物学杂志, 9(4), 266–271.

程志军. (2017). 关键反应训练对孤独症儿童社交技能的干预研究 (硕士学位论文). 杭州师范大学.

高迪, 于婷, 李春丽, 贾飞勇, 李洪华. (2020). 早期介入丹佛模式的密集训练结合家长培训对孤独症谱系障碍儿童疗效及其对父母育儿压力的影响. Chinese Journal of Contemporary Pediatrics, 22(2), 158.

刘亚萍, 陈文锋, 傅小兰. (2018). 孤独症儿童生活和学习能力的正向干预模式. 科学通报, 63(15), 王芳, 杨广学. (2017). 国内自闭症干预与康复现状调查与分析. 医学与哲学: B, 38(10), 49–54.

王石换, 邹小兵, 邹园园, 张海涛, 陈凯云. (2021). 早期介入丹佛模式对孤独症谱系障碍婴幼儿的疗效分析. 中国儿童保健杂志, 29(12), 1300–1303.

吴亮, 李红霞. (2018). 中国孤独症谱系障碍儿童及其康复状况研究. 国外医学: 医学地理分册, 39(2), 徐秀. (2015). 孤独症婴幼儿早期介入丹佛干预模式. 中华实用儿科临床杂志, 30(11), 801–802.

Abouzeid, N., Rivard, M., Mello, C., Mestari, Z., Boulé, M., & Guay, C. (2020). Parent coaching intervention program based on the Early Start Denver Model for children with autism spectrum disorder: Feasibility and accept-

ability study. Research in Developmental Disabilities, 105, Article 103747. https://doi.org/10.1016/j.ridd.2020.103747

Boudreau, A. M., Corkum, P., Meko, K., & Smith, I. M. (2015). Peer-mediated pivotal response treatment for young children with autism spectrum disorders: A systematic review. Canadian Journal of School Psychology, 30(3), 218–235.

Boudreau, A. M., Lucyshyn, J. M., Corkum, P., Meko, K., & Smith, I. M. (2021). Peer-mediated pivotal response treatment at school for children with autism spectrum disorder. Canadian Journal of School Psychology, 36(1), 34–50.

Bradshaw, J., Koegel, L. K., & Koegel, R. L. (2017). Improving functional language and social motivation with a parent-mediated intervention for toddlers with autism spectrum disorder. Journal of Autism and Developmental Disorders, 47(8), 2443–2458.

Bravou, V., Oikonomidou, D., & Drigas, A. S. (2022). Applications of virtual reality for autism inclusion. A review. Retos: nuevas tendencias en educación física, deporte y recreación, (45), 779–785.

Brian, J. A., Smith, I. M., Zwaigenbaum, L., & Bryson, S. E. (2017). Cross-site randomized control trial of the social ABCs caregiver-mediated intervention for toddlers with autism spectrum disorder. Autism Research, 10(10), 1700–1711.

Bryson, S. E., Koegel, L. K., Koegel, R. L., Openden, D., Smith, I. M., & Nefdt, N. (2007). Large scale dissemination and community implementation of pivotal response treatment: Program description and preliminary data. Research and Practice for Persons with Severe Disabilities (RPSD), 32(2), 142–153.

Chang, Y. C., Shire, S. Y., Shih, W., Gelfand, C., & Kasari, C. (2016). Preschool deployment of evidence-based social communication intervention: JASPER in the classroom. Journal of Autism and Developmental Disorders, 46(6), 2211–2223.

Crank, J. E., Sandbank, M., Dunham, K., Crowley, S., Bottema-Beutel, K., Feldman, J., & Woynaroski, T. G. (2021). Understanding the effects of naturalistic developmental behavioral interventions: A project AIM meta-analysis. Autism Research, 14(4), 817–834.

Dawson, G., Jones, E. J. H., Merkle, K., Venema, K., Lowy, R., Faja, S., … Webb, S. J. (2012). Early behavioral intervention is associated with normalized brain activity in young children with autism. Journal of the American Academy of Child & Adolescent Psychiatry, 51(11), 1150–1159.

Dawson, G., Rogers, S., Munson, J., Smith, M., Winter, J., Greenson, J., … & Varley, J. (2010). Randomized, controlled trial of an intervention for toddlers with autism: The Early Start Denver Model. Pediatrics, 125(1), D'Agostino, S. R., Dueñas, A. D., Bravo, A., Tyson, K., Straiton, D., Salvatore, G. L., … & Pellecchia, M. (2023). Toward deeper understanding and wide-scale implemen-

tation of naturalistic developmental behavioral interventions. Autism, 27(1), 253–258.

El Shemy, I. (2022, June). Language Learning with Mobile Augmented Reality and Artificial Intelligence for Children with Autism Spectrum Disorder. In Interaction Design and Children (pp. 658–661).

Estes, A., Munson, J., Rogers, S. J., Greenson, J., Winter, J., & Dawson, G. (2015). Long-term outcomes of early intervention in 6-year-old children with autism spectrum disorder. Journal of the American Academy of Child & Adolescent Psychiatry, 54(7), 580–587.

Estes, A., Vismara, L., Mercado, C., Fitzpatrick, A., Elder, L., Greenson, J., … Rogers, S. (2013). The impact of parent-delivered intervention on parents of very young children with autism. Journal of Autism and Developmental Disorders, 44(2), 353–365.

Fossum, K. L., Williams, L., Garon, N., Bryson, S. E., & Smith, I. M. (2018). Pivotal response treatment for preschoolers with autism spectrum disorder: Defining a predictor profile. Autism Research, 11(1), 153–165.

Frost, K. M., Brian, J., Gengoux, G. W., Hardan, A., Rieth, S. R., Stahmer, A., & Ingersoll, B. (2020). Identifying and measuring the common elements of naturalistic developmental behavioral interventions for autism spectrum disorder: Development of the NDBI-Fi. Autism, 24(8), 2285–2297.

Gengoux, G. W., McNerney, E., & Minjarez, M. B. (2020). Selecting meaningful skills for teaching in the natural environment. In Y. Bruinsma, M. B. Minjarez, L. Schreibman, & A. C. Stahmer (Eds.), Naturalistic developmental behavioral interventions for autism spectrum disorder (pp. 77–98). Brookes Publishing.

Gulsrud, A., Carr, T., Williams, J., Panganiban, J., Jones, F., Kimbrough, J., … Kasari, C. (2019). Developmental screening and early intervention in a childcare setting for young children at risk for autism and other developmental delays: A feasibility trial. Autism Research, 12(9), 1423–1433.

Hampton, L. H., Harty, M., Fuller, E. A., & Kaiser, A. P. (2019). Enhanced milieu teaching for children with autism spectrum disorder in South Africa. International Journal of Speech-Language Pathology, 21(6), Hampton, L. H., Kaiser, A. P., Nietfeld, J. P., & Khachoyan, A. (2021). Generalized effects of naturalistic social communication intervention for minimally verbal children with autism. Journal of Autism and Developmental Disorders, 51(1), 75–87.

Hampton, L. H., & Sandbank, M. P. (2022). Keeping up with the evidence base: Survey of behavior professionals about Naturalistic Developmental Behavioral Interventions. Autism, 26(4), 875–888.

Hancock, T. B., & Kaiser, A. P. (2002). The effects of trainer-implemented enhanced milieu teaching on the social communication of children with autism. Topics in Early Childhood Special Education, 22(1), 39–54.

Hancock, T. B., Ledbetter-Cho, K., Howell, A., & Lang, R. (2016). Enhanced milieu teaching. In R. Lang, T. B. Hancock & N. N. Singh (Eds.), Early intervention for young children with autism spectrum disorder (pp. 177–218). Springer.

Hardan, A. Y., Gengoux, G. W., Berquist, K. L., Libove, R. A., Ardel, C. M., Phillips, J., … Minjarez, M. B. (2015). A randomized controlled trial of pivotal response treatment group for parents of children with autism. Journal of Child Psychology and Psychiatry, 56(8), 884–892.

Harris, S. L., & Handleman, J. S. (2000). Age and IQ at intake as predictors of placement for young children with autism: A four-to six-year follow-up. Journal of Autism and Developmental Disorders, 30(2), 137–142.

Havdahl, A., & Bishop, S. (2019). Heterogeneity in prevalence of co-occurring psychiatric conditions in autism. The Lancet. Psychiatry, 6(10), 794–795.

Holzinger, D., Laister, D., Vivanti, G., Barbaresi, W. J., & Fellinger, J. (2019). Feasibility and outcomes of the Early Start Denver Model implemented with low intensity in a community setting in Austria. Journal of Developmental & Behavioral Pediatrics, 40(5), 354–363.

Horner, R. H., Nefdt, N., Koegel, R., Singer, G., & Gerber, M. (2010). The use of a self-directed learning program to provide introductory training in pivotal response treatment to parents of children with autism. Journal of Positive Behavior Interventions, 12(1), 23–32.

Ingersoll, B., & Dvortcsak, A. (2009). Teaching social communication to children with autism: A practitioner's guide to parent training and a manual for parents. Guilford Press.

Ingersoll, B. R., & Wainer, A. L. (2013). Pilot study of a school-based parent training program for preschoolers with ASD. Autism, 17(4), 434–448.

Ingersoll, B. R., Wainer, A. L., Berger, N. I., & Walton, K. M. (2017). Efficacy of low intensity, therapist-implemented Project ImPACT for increasing social communication skills in young children with ASD. Developmental Neurorehabilitation, 20(8), 502–510.

Jhuo, R. A., & Chu, S. Y. (2022). A review of parent-implemented Early Start Denver Model for children with autism spectrum disorder. Children, 9(2), Article 285. https://doi.org/10.3390/children9020285

Kaale, A., Fagerland, M. W., Martinsen, E. W., & Smith, L. (2014). Preschool-based social communication treatment for children with autism: 12-month follow-up of a randomized trial. Journal of the American Academy of Child & Adolescent Psychiatry, 53(2), 188–198.

Kaiser, A. P., Hancock, T. B., & Nietfeld, J. P. (2000). The effects of parent-implemented enhanced milieu teaching on the social communication of children who have autism. Early Education and Development, 11(4), Kaiser, A. P., &

Hampton, L. H. (2016). Enhanced milieu teaching. In R. McCauley, M. Fey & R. Gilliam (Eds.), Treatment of language disorders in children (2nd ed., pp. 87–120). Brookes Publishing.

Kaiser, A. P., & Roberts, M. Y. (2013). Parent-implemented enhanced milieu teaching with preschool children who have intellectual disabilities. Journal of Speech, Language, and Hearing Research, 56(1), 295–309.

Kasari, C. (2015). Update on behavioral interventions for autism and developmental disabilities. Current Opinion in Neurology, 28(2), 124–129.

Kasari, C., Freeman, S., & Paparella, T. (2006). Joint attention and symbolic play in young children with autism: A randomized controlled intervention study. Journal of Child Psychology and Psychiatry, 47(6), 611–620.

Kasari, C., Gulsrud, A. C., Wong, C., Kwon, S., & Locke, J. (2010). Randomized controlled caregiver mediated joint engagement intervention for toddlers with autism. Journal of Autism and Developmental Disorders, 40(9), 1045–1056.

Kasari, C., Gulsrud, A., Freeman, S., Paparella, T., & Hellemann, G. (2012). Longitudinal follow-up of children with autism receiving targeted interventions on joint attention and play. Journal of the American Academy of Child & Adolescent Psychiatry, 51(5), 487–495.

Kasari, C., Gulsrud, A., Paparella, T., Hellemann, G., & Berry, K. (2015). Randomized comparative efficacy study of parent-mediated interventions for toddlers with autism. Journal of Consulting and Clinical Psychology, 83(3), 554–563.

Kasari, C., Kaiser, A., Goods, K., Nietfeld, J., Mathy, P., Landa, R., … Almirall, D. (2014). Communication interventions for minimally verbal children with autism: A sequential multiple assignment randomized trial. Journal of the American Academy of Child & Adolescent Psychiatry, 53(6), 635–646.

Kasari, C., Lawton, K., Shih, W., Barker, T. V., Landa, R., Lord, C., … & Senturk, D. (2014). Caregiver-mediated intervention for low-resourced preschoolers with autism: An RCT. Pediatrics, 134(1), 72–79.

Kasari, C., Paparella, T., Freeman, S., & Jahromi, L. B. (2008). Language outcome in autism: Randomized comparison of joint attention and play interventions. Journal of Consulting and Clinical Psychology, 76(1), Kern Koegel, L., Ashbaugh, K., Navab, A., & Koegel, R. L. (2016). Improving empathic communication skills in adults with autism spectrum disorder. Journal of Autism and Developmental Disorders, 46(3), 921–933.

Koegel, L. K., Ashbaugh, K., & Koegel, R. L. (2016). Pivotal response treatment. In R. Lang, T. B. Hancock & N. N. Singh (Eds.), Early intervention for young children with autism spectrum disorder (pp. 85–112). Springer.

Koegel, L. K., Singh, A. K., & Koegel, R. L. (2010). Improving motivation

for academics in children with autism. Journal of Autism and Developmental Disorders, 40(9), 1057–1066.

Koegel, R. L., Kim, S., & Koegel, L. K. (2014). Training paraprofessionals to improve socialization in students with ASD. Journal of autism and developmental disorders, 44, 2197–2208.

Koegel, R. L., & Koegel, L. K. (2006). Pivotal response treatments for autism: Communication, social, & academic development. Brookes Publishing.

Koegel, R. L., & Koegel, L. K. (2012). The PRT pocket guide: Pivotal response treatment for autism spectrum disorders. Brookes Publishing.

Koegel, R. L., O'Dell, M. C., & Koegel, L. K. (1987). A natural language teaching paradigm for nonverbal autistic children. Journal of Autism and Developmental Disorders, 17(2), 187–200.

Kupferstein, H. (2018). Evidence of increased PTSD symptoms in autistics exposed to applied behavior analysis. Advances in Autism, 4(1), 19–29.

Lawton, K., & Kasari, C. (2012). Brief report: Longitudinal improvements in the quality of joint attention in preschool children with autism. Journal of Autism and Developmental Disorders, 42(2), 307–312.

LeBlanc, L. A., Esch, J., Sidener, T. M., & Firth, A. M. (2006). Behavioral language interventions for children with autism: Comparing applied verbal behavior and naturalistic teaching approaches. The Analysis of Verbal Behavior, 22(1), 49–60.

Lei, J., Sukhodolsky, D. G., Abdullahi, S. M., Braconnier, M. L., & Ventola, P. (2017). Reduced anxiety following pivotal response treatment in young children with autism spectrum disorder. Research in Autism Spectrum Disorders, 43, 1–7.

Leigh, J. P., & Du, J. (2015). Brief report: Forecasting the economic burden of autism in 2015 and 2025 in the United States. Journal of Autism and Developmental Disorders, 45(12), 4135–4139.

Lifter, K., Sulzer-Azaroff, B., Anderson, S. R., & Cowdery, G. E.(1993). Teaching play activities to preschool children withdisabilities: The importance of developmental considerations.Journal of Early Intervention, 17, 139–159.

Lord, C., Brugha, T. S., Charman, T., Cusack, J., Dumas, G., Frazier, T., … & Veenstra-VanderWeele, J. (2020). Autism spectrum disorder. Nature Reviews Disease Primers, 6(1), Article https://doi.org/10.1038/s41572-019-0138-4

Lovaas, O. I. (1968). Some studies on the treatment of childhood schizophrenia. In J. M. Shlien (Ed.), Research in psychotherapy (pp. 103–121). American Psychological Association.

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. Journal of consulting and clinical

psychology, 55(1), 3.

Maenner, M. J., Warren, Z., Williams, A. R., Amoakohene, E., Bakian, A. V., Bilder, D. A., … & Shaw, K. A. (2023). Prevalence and characteristics of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 sites, United States, 2020. MMWR Surveillance Summaries, 72(2), 1.

Magiati, I., Tay, X. W., & Howlin, P. (2014). Cognitive, language, social and behavioural outcomes in adults with autism spectrum disorders: A systematic review of longitudinal follow-up studies in adulthood. Clinical Psychology Review, 34(1), 73–86.

Mancil, G. R., & Pearl, C. E. (2008). Restricted interests as motivators: Improving academic engagement and outcomes of children on the autism spectrum. TEACHING Exceptional Children Plus, 4(6), Article 7. https://files.eric.ed.gov/fulltext/EJ967728.pdf

Mandell, D. S., Stahmer, A. C., Shin, S., Xie, M., Reisinger, E., & Marcus, S. C. (2013). The role of treatment fidelity on outcomes during a randomized field trial of an autism intervention. Autism, 17(3), 281–295.

McConachie, H., & Robinson, G. (2006). What services do young children with autism spectrum disorder receive?. Child: Care, Health and Development, 32(5), 553–557.

Minjarez, M. B., Bruinsma, Y., & Stahmer, A. C. (2020). Considering NDBI Models. In Y. Bruinsma, M. B. Minjarez, L. Schreibman, & A. C. Stahmer (Eds.), Naturalistic developmental behavioral interventions for autism spectrum disorder (pp. 21–42). Brookes Publishing.

Mohammadzaheri, F., Koegel, L. K., Soleymani, Z., Khosrowabadi, R., & Bakhshi, E. (2022). Neural correlates of enhancing question asking and initiations in children with autism spectrum disorders: A randomized clinical trial. Social Neuroscience, 17(2), 181–192.

Mohammadzaheri, F., Koegel, L. K., Rezaee, M., & Rafiee, S. M. (2014). A randomized clinical trial comparison between pivotal response treatment (PRT) and structured applied behavior analysis (ABA) intervention for children with autism. Journal of autism and developmental disorders, 44, 2769–2777.

Mundy, P., Sigman, M., Ungerer, J., & Sherman, T. (1987). Nonverbal communication and play correlates of language development in autistic children. Journal of Autism and Developmental Disorders, 17(3), 349–364.

Pellecchia, M., Beidas, R. S., Mandell, D. S., Cannuscio, C. C., Dunst, C. J., & Stahmer, A. C. (2020). Parent empowerment and coaching in early intervention: Study protocol for a feasibility study. Pilot and Feasibility Studies, 6(1), Article 22. https://doi.org/10.1186/s40814-020-00568-3

Pickles, A., Le Couteur, A., Leadbitter, K., Salomone, E., Cole-Fletcher, R.,

Tobin, H., … & Green, J. (2016). Parent-mediated social communication therapy for young children with autism (PACT): Long-term follow-up of a randomised controlled trial. The Lancet, 388(10059), 2501–2509.

Poon, K. K., Watson, L. R., Baranek, G. T., & Poe, M. D. (2012). To what extent do joint attention, imitation, and object play behaviors in infancy predict later communication and intellectual functioning in ASD?. Journal of autism and developmental disorders, 42(6), 1064–1074.

Popovic, S. C., Starr, E. M., & Koegel, L. K. (2020). Teaching initiated question asking to children with autism spectrum disorder through a short-term parent-mediated program. Journal of Autism and Developmental Disorders, 50(10), 3728–3738.

Prizant, B. M., Wetherby, A. M., Rubin, E., Laurent, A. C., & Rydell, P. J. (2006). The SCERTS model: A comprehensive educational approach for children with autism spectrum disorders (Vol. 1). Brookes Publishing.

Prizant, B. M., Wetherby, A. M., Rubin, E., & Laurent, A. C. (2003). The SCERTS model: A transactional, family-centered approach to enhancing communication and socioemotional abilities of children with autism spectrum disorder. Infants and Young Children, 16(4), 296–316.

Quinn, E. D., Kaiser, A. P., & Ledford, J. (2021). Hybrid telepractice delivery of enhanced milieu teaching: Effects on caregiver implementation and child communication. Journal of Speech, Language, and Hearing Research, 64(8), 3074–3099.

Rogers, S. J., & Dawson, G. (2009). Early Start Denver Model curriculum checklist for young children with autism. Guilford Press.

Rogers, S. J., & Dawson, G. (2010). Early Start Denver Model for young children with autism: Promoting language, learning, and engagement. New York, NY: The Guilford Press.

Rogers, S. J., Estes, A., Vismara, L., Munson, J., Zierhut, C., Greenson, J., … Talbott, M. (2019). Enhancing low-intensity coaching in parent implemented Early Start Denver Model intervention for early autism: A randomized comparison treatment trial. Journal of Autism and Developmental Disorders, 49(2), 632–646.

Rogers, S. J., Stahmer, A., Talbott, M., Young, G., Fuller, E., Pellecchia, M., … & Griffith, E. (2022). Feasibility of delivering parent-implemented NDBI interventions in low-resource regions: A pilot randomized controlled study. Journal of Neurodevelopmental Disorders, 14, 1-14.

Rogge, N., & Janssen, J. (2019). The economic costs of autism spectrum disorder: A literature review. Journal of Autism and Developmental Disorders, 49(7), 2873–2900.

Sandbank, M., Bottema-Beutel, K., Crowley, S., Cassidy, M., Dunham, K.,

Feldman, J. I., … & Woynaroski, T. G. (2020). Project AIM: Autism intervention meta-analysis for studies of young children. Psychological Bulletin, 146(1), 1–29

Schreibman, L. (2007). The science and fiction of autism. Harvard University Press..

Schreibman, L., Dawson, G., Stahmer, A. C., Landa, R., Rogers, S. J., McGee, G. G., … Halladay, A. (2015). Naturalistic developmental behavioral interventions: Empirically validated treatments for autism spectrum disorder. Journal of Autism and Developmental Disorders, 45(8), 2411–2428.

Schreibman, L., Jobin, A. B., & Dawson, G. (2020). Understanding NDBI. In Y. Bruinsma, M. B. Minjarez, L. Schreibman, & A. C. Stahmer (Eds.), Naturalistic developmental behavioral interventions for autism spectrum disorder (pp. 3–20). Brookes Publishing.

Schuck, R. K., Tagavi, D. M., Baiden, K. M., Dwyer, P., Williams, Z. J., Osuna, A., … & Vernon, T. W. (2021). Neurodiversity and autism intervention: Reconciling perspectives through a naturalistic developmental behavioral intervention framework. Journal of Autism and Developmental Disorders, 1-21.

Schwartzman, J. M., Strong, K., Ardel, C. M., Schuck, R. K., Millan, M. E., Phillips, J. M., … & Gengoux, G. W. (2021). Language improvement following pivotal response treatment for children with developmental disorders. American Journal on Intellectual and Developmental Disabilities, 126(1), 45–57.

Shi, B., Wu, W., Dai, M., Zeng, J., Luo, J., Cai, L., … & Jing, J. (2021). Cognitive, language, and behavioral outcomes in children with autism spectrum disorders exposed to early comprehensive treatment models: a meta-analysis and meta-regression. Frontiers in psychiatry, 12, 691148.

Shire, S. Y., Chang, Y. C., Shih, W., Bracaglia, S., Kodjoe, M., & Kasari, C. (2017). Hybrid implementation model of community-partnered early intervention for toddlers with autism: A randomized trial. Journal of Child Psychology and Psychiatry, 58(5), 612–622.

Skinner, B. F. (1965). Science and human behavior (No. 92904). Simon and Schuster.

Stadnick, N. A., Stahmer, A., & Brookman-Frazee, L. (2015). Preliminary effectiveness of Project ImPACT: A parent-mediated intervention for children with autism spectrum disorder delivered in a community program. Journal of Autism and Developmental Disorders, 45(7), 2092–2104.

Stahmer, A. C., Rieth, S. R., Dickson, K. S., Feder, J., Burgeson, M., Searcy, K., & Brookman-Frazee, L. (2020). Project ImPACT for Toddlers: Pilot outcomes of a community adaptation of an intervention for autism risk. Autism, 24(3), 617–632.

Stahmer, A. C., Wong, C., Segall, M. J., & Reinehr, J. (2020). Fostering inclusion with peers and in the community. In Y. Bruinsma, M. B. Minjarez,

L. Schreibman, & A. C. Stahmer (Eds.), Naturalistic developmental behavioral interventions for autism spectrum disorder (pp. 99–114). Brookes Publishing.

Steiner, A. M., Gengoux, G. W., Klin, A., & Chawarska, K. (2013). Pivotal response treatment for infants at-risk for autism spectrum disorders: A pilot study. Journal of Autism and Developmental Disorders, 43(1), 91–102.

Tager-Flusberg, H., Calkins, S., Nolin, T., Baumberger, T., Anderson, M., & Chadwick-Dias, A. (1990). A longitudinal study of language acquisition in autistic and Down syndrome children. Journal of autism and developmental disorders, 20(1), 1–21.

Tiede, G., & Walton, K. M. (2019). Meta-analysis of naturalistic developmental behavioral interventions for young children with autism spectrum disorder. Autism : The International Journal of Research and Practice, 23(8), Tomasello, M. (2019). Becoming human. In Becoming Human. Harvard University Press.

Tupou, J. (2020). Meta-analysis supports naturalistic developmental behavioral interventions as a promising approach for improving a range of outcomes for children with autism spectrum disorder. Evidence-Based Communication Assessment and Intervention, 14(4), 206–210.

Uljarević, M., Billingham, W., Cooper, M. N., Condron, P., & Hardan, A. Y. (2022). Examining effectiveness and predictors of treatment response of pivotal response treatment in autism: an umbrella review and a meta-analysis. Frontiers in Psychiatry, 12, Article 766150. https://doi.org/10.3389/fpsyt.2021.766150

Vibert, B. A., Dufek, S., Klein, C. B., Choi, Y. B., Winter, J., Lord, C., & Kim, S. H. (2020). Quantifying caregiver change across early autism interventions using the measure of NDBI strategy implementation: caregiver change (MONSI-CC). Journal of Autism and Developmental Disorders, 50(4), 1364–1379.

Vismara, L. A., McCormick, C. E., Shields, R., & Hessl, D. (2019). Extending the parent-delivered Early Start Denver Model to young children with fragile X syndrome. Journal of Autism and Developmental Disorders, 49(3), 1250–1266.

Vismara, L. A., McCormick, C. E. B., Wagner, A. L., Monlux, K., Nadhan, A., & Young, G. S. (2018). Telehealth parent training in the Early Start Denver Model: Results from a randomized controlled study. Focus on Autism and Other Developmental Disabilities, 33(2), 67–79.

Vivanti, G., Dissanayake, C., & Victorian ASELCC Team. (2016). Outcome for children receiving the Early Start Denver Model before and after 48 months. Journal of autism and developmental disorders, 46, 2441-2449.

Vivanti, G., Dissanayake, C., Zierhut, C., & Rogers, S. J. (2013). Brief report: Predictors of outcomes in the Early Start Denver Model delivered in a group setting. Journal of Autism and Developmental Disorders, 43(7), Vivanti, G., Paynter, J., Duncan, E., Fothergill, H., Dissanayake, C., Rogers, S. J., & the Victorian ASELCC Team. (2014). Effectiveness and feasibility of the Early

Start Denver Model implemented in a group-based community childcare setting. Journal of Autism and Developmental Disorders, 44(12), 3140–3153.

Vivanti, G., Prior, M., Williams, K., & Dissanayake, C. (2014). Predictors of outcomes in autism early intervention: why don't we know more? Frontiers Pediatrics, 2, Article https://doi.org/10.3389/fped.2014.00058

Vivanti, G., & Zhong, H. N. (2020). Naturalistic developmental behavioral interventions for children with autism. In G. Vivanti, K. Bottema-Beutel & L. Turner-Brown (Eds.), Clinical guide to early interventions for children with autism (pp. 93–130). Springer.

Voos, A. C., Pelphrey, K. A., Tirrell, J., Bolling, D. Z., Wyk, B. V., Kaiser, M. D., … Ventola, P. (2012). Neural mechanisms of improvements in social motivation after pivotal response treatment: Two case studies. Journal of Autism and Developmental Disorders, 43(1), 1–10.

Waddington, H., Reynolds, J. E., Macaskill, E., Curtis, S., Taylor, L. J., & Whitehouse, A. J. O. (2021). The effects of JASPER intervention for children with autism spectrum disorder: A systematic review. Autism, 25(8), 2370–2385.

Wang, Z., Loh, S. C., Tian, J., & Chen, Q. J. (2022). A meta-analysis of the effect of the Early Start Denver Model in children with autism spectrum disorder. International Journal of Developmental Disabilities, 68(5), Wright, C. A., & Kaiser, A. P. (2017). Teaching parents enhanced milieu teaching with words and signs using the teach-model-coach-review model. Topics in Early Childhood Special Education, 36(4), 192–204.

Yang, D., Pelphrey, K. A., Sukhodolsky, D. G., Crowley, M. J., Dayan, E., Dvornek, N. C., … & Ventola, P. (2016). Brain responses to biological motion predict treatment outcome in young children with autism. Translational Psychiatry, 6(11), e948-e948.

Yi, J., Kim, W., & Lee, J. (2022). Effectiveness of the SCERTS model–based interventions for autistic children: A systematic review. Journal of Speech, Language, and Hearing Research, 65(7), 2662–2676.

Yoder, P. J., Stone, W. L., & Edmunds, S. R. (2021). Parent utilization of ImPACT intervention strategies is a mediator of proximal then distal social communication outcomes in younger siblings of children with ASD. Autism, 25(1), 44–57.

Yu, L., & Zhu, X. (2018). Effectiveness of a SCERTS model-based intervention for children with autism spectrum disorder (ASD) in Hong Kong: A pilot study. Journal of Autism and Developmental Disorders, 48, Zhou, B., Xu, Q., Li, H., Zhang, Y., Wang, Y., Rogers, S. J., & Xu, X. (2018). Effects of parent-implemented Early Start Denver Model intervention on Chinese toddlers with autism spectrum disorder: A non-randomized controlled trial. Autism Research, 11(4), 654–666.

Zhou, H., Xu, X., Yan, W., Zou, X., Wu, L., Luo, X., … Wang, Y. (2020). Prevalence of autism spectrum disorder in China: A nationwide multi-center population-based study among children aged 6 to 12 years. Neuroscience Bulletin, 36(9), 961–971.

Zwaigenbaum, L., Bauman, M. L., Choueiri, R., Kasari, C., Carter, A., Granpeesheh, D., … & Natowicz, M. R. (2015). Early intervention for children with autism spectrum disorder under 3 years of age: Recommendations for practice and research. Pediatrics, 136(Suppl. 1), 60–81.

Note: Figure translations are in progress. See original paper for figures.