Chapter

What Therapy for My Child? Features, Strengths, and Gaps to Fill for the Implementation of Early Autism Interventions

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Abstract

Scientific literature suggests the neurobiological value of early intervention for children at risk of ASD and of other neurodevelopmental disorders, because it is based on the promotion of brain plasticity mechanisms in an ecological, noninvasive, and evidence-based way. Moreover, several authors suggest the greatest efficacy of early rehabilitation programs, involving both the parents and the children, is to improve not only sensory-motor and cognitive outcomes but also child-parent interactions and the wellness of the familiar system. In this chapter, the neurobiological fundaments and features for the early intervention and the most recent early approaches for children at risk of ASD (behavioral, developmental, naturalistic developmental behavioral, and parent-mediated interventions) will be explained.

Keywords: autism spectrum disorder, early intervention, behavioral interventions, developmental interventions, naturalistic developmental behavioral interventions, parent-mediated interventions

1. Introduction

During the last two decades, new findings and data about neurobiological features, clinical characteristics, and impact on quality of life of autism spectrum disorder (ASD) were incredibly bloomed and these new pieces of knowledge also influenced the idea of taking charge and rehabilitation of children, adolescents, and adults with ASD. Moreover, the biopsychosocial ICF-CY perspective contributed to a change of view on this topic because it was demonstrated as this perspective can efficiently capture functional abilities and disabilities in developing individuals for tailored intervention planning [1].

About this, Palisano and colleagues [2] marked the importance of considering the health of individuals with childhood-onset neurodevelopmental conditions as an emergent set of capacities that develop over a lifetime to enable them to interact successfully within their biological, physiological, psychological, and social environments and realize their potential and well-being. According to these authors, rehabilitation

programs must take into consideration that health development is a nonlinear adaptive process. It occurs through person-environment transactions that can be transformative in enabling individuals with neurodevelopmental conditions to actively participate in their social environment. In this way, every different period of life can contribute in different ways to the construction of a developmental trajectory, in line with the needs, priorities, concerns, opportunities, and experiences of the individual with a disability and his/her family in order to reach desired social roles [2, 3].

Obviously, the first periods of life are particularly important and difficult in this process; parents must cope with a series of unforeseen stresses and readapt their life on the basis of ASD, from the diagnosis to the choice of the rehabilitation program. If on one hand, the great growth of pieces of knowledge allowed a big improvement of early and specific approaches for children at risk of ASD, on the other hand, the parents are often confused and isolated in the understanding of what is the best type of intervention for their child.

As a matter of fact, the presence of high levels of stress in parents of children with ASD was widely demonstrated [4, 5], and also for these reasons early interventions could have the potential value, as well as exploiting the greater predisposition to modify itself of the brain during developmental age, also of ensuring parents have the resources they need to manage stress associated with caring for their child.

The developmental process occurring in the human brain during fetal life and during early childhood is the result of an intricate continuous interaction between genes and environment, activity, and experiences [6]. In particular, in early childhood, individuals go through the most complex, dramatic, and important phases of maturation, although brain changes and adaptation are part of a long-lasting process that continues throughout the whole life [7]. During this stage of neurodevelopment, cognitive and social behaviors cannot be understood in isolation, but their development is strictly interlinked to sensory-motor systems and motives and opportunities of the child in their environment [8]. So, in line with these points, in this chapter, the neurobiological fundaments and features for the early intervention and the most recent early approaches for children at risk of ASD will be explained.

2. Neurobiology of early intervention in ASD

The term "early intervention" includes all measures aimed at preventing developmental disabilities, ensuring neuroprotection, and providing optimal environmental conditions [9].

Their implementation is strongly related to the concept of neural plasticity which is a fundamental property of the central nervous system (CNS) and denotes several capacities including the ability to adapt to changes in the environment and to store information in memory associated with learning [10]. For this reason, experience-dependent neural plasticity is increased in the developing brain than in the adult brain, and it is usually adaptive and beneficial for permitting neurodevelopment during fetal life and during the first three postnatal years. Some of its basic mechanisms (for example, neurogenesis, programmed cell death, myelinations, and others), although started before birth, continue to be very high in the first-year post-term [6]. Moreover, it was widely demonstrated that specific time windows, named critical periods, are present and staggered throughout the first years of postnatal life for the most important brain functions (for sensory systems, motor development, language, and higher cognitive functions), and, in these periods, the corresponding neural

circuits display a heightened sensitivity to acquire instructive and adaptive signals from the external environment for its maturation [11].

The effect of sensory experience on brain sensitivity is addressed by numerous researchers in understanding how to maximize the extraordinary potential of brain plasticity in neurorehabilitation for possible restorations in presence of brain dysfunctions. Since this, refinement and maintenance of appropriate neural connections have been made possible in laboratory by paradigms specifically devoted to increasing the quality and intensity of environmental stimulation, such as environmental enrichment (EE). EE is "a combination of complex inanimate and social stimulations", and its main goal is to improve the animal's quality of life by providing them with a combination of multisensory/cognitive stimulation, increased physical activity, and enhanced social interactions and by eliciting natural exploratative behaviors [12].

The possibility of modifying neural circuitry through environmental experiences suggested the idea of taking advantage of the EE in several conditions: the benefits of EE on synaptic plasticity, sensory development, and cognitive processes have been investigated in developing, adult, and aging animals and at a later stage in animals with several neurologic and genetic disorders [13–16]. In many cases, EE enhanced brain weight, neurogenesis, dendritic branching, synapse formation, and neuroanatomical components, with consequent changes also in behavior and learning [17].

These findings were very important for the field of pediatric neurorehabilitation because the EE paradigm is ecological, noninvasive, and well thought-out to enhance the neuroplasticity through experience, and for this reason, several research groups investigated and demonstrated the profound and positive effect of intensive and multisensory stimulation during early stages of life on the human brain [18].

For example, some authors suggested the effect of early multisensory stimulation on visual development of infants at risk of developmental disorders [19–21], and Pineda and collaborators also underlined the presence of a growing body of evidence supporting the use of early sensory interventions in the neonatal intensive care units, which can be safe and potentially important for optimizing infant and parent outcomes [22].

More recently, this line of research is expanding in order to understand if this type of early approach can have effects on social abilities and also, in this case, results appear very promising. In animal models, profound and long-term beneficial effects of early social environmental stimulation were found, encouraging the use of non-pharmacological interventions for the treatment of social defects in neurodevelopmental diseases [23–25].

Consequently, all these findings inspired the development of new protocols for children at risk of ASD, in which sensory-motor and social impairments are the most distinguishable symptoms in early stages: for example, recently Whittingham and colleagues [26] published the ENACT protocol (ENvironmental enrichment for infants; parenting with Acceptance and Commitment Therapy), which is the first randomized controlled trial to test a very early intervention for infants at risk of ASD (infants with one or more biological siblings or a biological parent diagnosed with ASD). It is implemented within the first six months of life and structured by a combination of parent-mediated very early intervention with parental mental health support.

In conclusion, it is widely supported by neurobiological and behavioral findings, the positive value of early intervention for children at risk of ASD and of other neurodevelopmental disorders. For these reasons, several evidence-based models were developed and implemented in the last twenty years.

3. Contemporary approaches for young children at risk of ASD

Taken as a whole, these data highlight the importance of early intervention in the rehabilitation process of children with neurodevelopmental disorders, although several questions remain open regarding some characteristics, such as intensity, focus, setting, and participants.

From a metanalysis of Fuller and Kaiser [27] emerges that the mean study age (of analyzed manuscripts) was associated with treatment effect size on social communication outcomes and that optimal social communication outcomes were observed when the mean age of the participants was 3.8 years, with positive effects diminishing somewhat after that age. However, clinical and experimental findings suggest that to be maximally effective, early intervention must be intensive, active, and tailored for each individual and family-centered [17].

Already Bonnier [9] underlined the greatest efficacy of programs involving both the parents and the children, to improve not only cognitive outcomes but also child-parent interactions. Moreover, an important point to consider is the fact that the families are now well informed, in particular thanks to Internet and social networks, and they know earlier about the risk of neurodevelopmental disabilities; this, on one hand, is an important aspect for a good success of the prevention and early detection programs, on the other hand, it could increase anxiety level of the parents, especially of children at risk of ASD. As a matter of fact, raising children with ASD can have a profound impact on caregivers, who, if guided by professionals, can benefit from strengths-based, future-focused supports early in their parenting experience [28].

According to Zwaigenbaum and collaborators, the central role of parents has been emphasized in the context of intervention of young children with or at risk of ASD: interventions could be designed to incorporate learning opportunities into everyday activities, capitalize on "teachable moments," and facilitate the generalization of skills beyond the familiar home setting [29].

Rehabilitation, therefore, must be individualized to not only the infant and his/her brain dysfunctions but also to the family circumstances, and it should provide support to parents, on account of their fundamental role in child's development. To this end, Novak and Morgan [30] recently suggested the "key drivers of plasticity and learning" in context of early intervention for children at risk of neurodevelopmental disabilities (see **Figure 1**): (1) training-based interventions harnessing experience-dependent plasticity, which means using interventions that specifically train an infant to perform a skill; (2) environmental enrichment that includes toys and exercise equipment to promote voluntary, self-initiated actions and learning and motivating but a repetitive challenge in an ecological context; (3) parent-child interactions, for promoting parent-child bonding, responsive parenting and the wellness of the familiar system.

Based on these requirements, the main approaches currently used in the context of early intervention for children at risk for ASD are described below.

3.1 Behavioral interventions

Behavioral interventions were among the first developed and clinically tested approaches for improving outcomes for ASD children and are based on operant learning [31]. They are characterized by discrete stimulus presentation, prompted exhibition of the desired response, and provision of positive feedback [6]. Although this type of

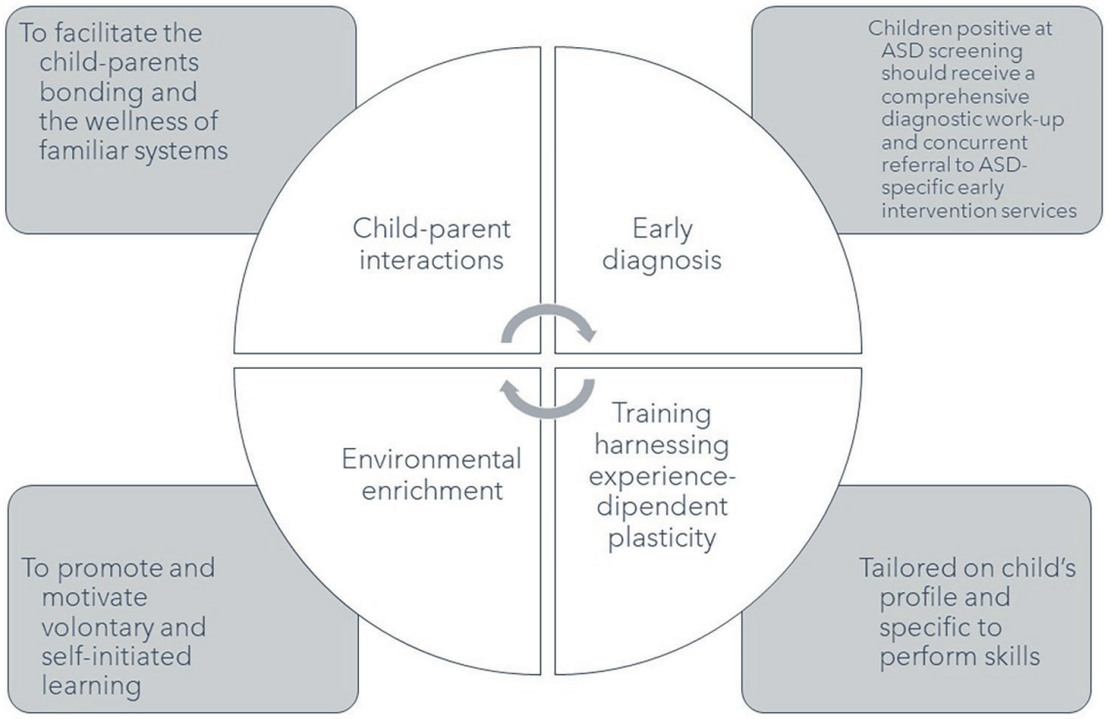

Figure 1.
Graphic representation of main elements for the implementation of early intervention, according to Novack and Morgan [30].

intervention is profoundly changed in comparison with the first models of the years '60 and '70, also now behavioral approaches maintain some fundamental characteristics, in particular, the high intensity of the hours of therapy and the use of reinforcement to increase skills and reduce "autistic behaviors". The most commonly used behavioral program that provides direct intensive service to young children with ASD and their families is the "Early Intensive Behavioral Intervention" (EIBI), implemented under the supervision of personnel trained in applied behavior analysis (ABA) procedures [32]. EIBI uses a specific teaching procedure with a 1:1 adult-to-child ratio and the implementation in either home or school settings for a range of 20 to 40 hours per week, with children from one to four years old. In this model, the analysis of functional behavior is used to develop individualized intervention targets where complex behaviors are broken down into specific steps and reinforced to gradually approximate the desired behavior and ultimately enhance learning [33, 34].

In 2018, a Cochrane Systematic Review focused on the evidence of the effectiveness of EIBI in increasing functional behaviors and skills, decreasing autism severity, and improving intelligence and communication skills for young children with ASD [35]. The evidence supports the use of EIBI for some children with ASD, especially with discrete effects on the adaptive behavior, cognitive functions, and language. No evidence was found about the improvement of autism severity or problem behaviors. However, the authors suggested interpreting the results with caution since the quality of the evidence of these studies is low and the methodological rigor remains a weak point, above all for the small sample size in the studies analyzed and for the use of non-randomized research designs [35]. So further research is necessary to estimate the effect of this rehabilitative approach.

3.2 Developmental interventions

Developmental interventions are based on the idea that emotional development plays a key role in areas such as language, cognition, visuo-spatial processing, and motor development. For this reason, these interventions focus on improving the synchrony, reciprocity, and duration of parent-child or child-child interactions as a pathway for ameliorating deficits in social communication and generating cascading improvements in developmentally related skills. These approaches are primarily delivered in the context of everyday routines such as play, and intervention goals are chosen based on the typical sequences of social communication and language development [31].

In this context, certainly "Developmental, Individual-differences, Relationship based (DIR) Floortime Model" is the most known. DIR was developed by Greenspan and Wieder for children between two and 12 years [36]. It aims in the first instance on affection and, according to this model, the parental engagement is an essential element for child improvement [37]. During the implementation of model, the use of "floor-based play" technique with the child addresses the main purpose of the intervention; floortime sessions are guided by the child, focusing on pretend play and conversation, and the intervention is tailored to the child's specific needs in addition to an individualized and strength-based program for the child [38].

Although some high-quality studies suggest that developmental-based interventions can improve some core challenges associated with ASD, particularly difficulties in social communication [31], both DIR model and the other developmental models were not specifically implemented for young children, and this point could be considered a limitation. For this reason, Solomon and collaborators implemented the "Play and Language for Autistic Youngsters (PLAY) Project Home Consultation program", based on DIR model by Greenspan and Wieder, but specific for young children ages three to five years old with ASD [39]. These authors, by a randomized controlled trial (RCT), demonstrated positive effects of this model on parent's abilities to sensitively respond and effectively engage their child, on shared attention and initiation of ASD children during play, and on improvement of autism symptomatology.

3.3 Naturalistic developmental behavioral interventions

Recently, the increasing of naturalistic developmental behavioral interventions (NDBIs), rooted in both applied behavioral and developmental sciences, has become imponent. NDBIs use natural environments, behavioral strategies, and personal interests to motivate the child and teach developmentally appropriate skills. Moreover, these models utilize several techniques for exploiting all possible opportunities for learning for the child and employ individualized treatment goals; they focus on child-initiated teaching episodes, capitalize on natural reinforcement and child motivation, and can include adult imitation of the child [40]. In NDBIs, reciprocal imitation is considered a useful strategy to promote social engagement in children with ASD, particularly in children with low developmental levels [41].

Examples of early intervention based on this approach are "Pivotal Response Treatment" (PRT) for children between two and seven years [42–44], "Early Start Denver Model" (ESDM) from 12 months to 48 months of life [45, 46], "Joint Attention Symbolic Play, Engagement Regulation" (JASPER) for children between one and eight years [47, 48], and "Reciprocal Imitation Training" (RIT) recently implemented also for toddlers from birth to three years [49].

Some NDBIs are focused interventions designed to address a specific and crucial behavioral area, others are comprehensive interventions that target the entire range of developmental domains, including cognition, social abilities, language, play, and motor systems, considering both abilities in emergency and vulnerabilities of children. Skills are usually not taught discretely or in isolation, but rather in the course of the child's typical daily interactions, experiences, and routines, with multiple materials and by multiple people [50]. Through these early intervention models, it is occurring as a shift of the main goal away from the reduction of core autistic traits and toward the improvement of well-being and optimization of individual potential [40].

Sandbanck and collaborators in a recent review [31] highlighted the presence of several RCTs in support of NDBIs. These studies suggest that NDBIs may be not only particularly useful for supporting development of social communication, language, and play but also for reduction of caregiver stress and for improvement of parental abilities.

3.4 Parent-mediated interventions

Parental involvement is good early treatment practice for ASD because it is one of the factors associated with a better outcome for children, but this type of approach may also support family outcomes, including parent-child interactions and caregiver empowerment [51]. In parent-mediated interventions, parents are taught a combination of techniques to promote the child's social engagement, language, imitation, and play skills. Parents are also trained to become more responsive to the children's communication style and needs, with an effect also in emotional regulation [52].

Many of the early interventions explained above, both NDBI types, such as ESDM and JASPER, and development-based, such as DIR and PLAY models, despite being implemented through direct contact with the child, involve the parent in the session. As a matter of fact, several studies about this type of interventions showed many effects both in children and parent outcomes [39, 53–56].

Moreover, in 2013, a Cochrane systematic review found some evidence for effectiveness of parent-mediated interventions for young children with ASD, most particularly in proximal indicators within parent-child interaction but also in more distal indicators of child language comprehension and reduction of autism severity [51].

In this context, there are also models involving exclusively the work with the parents and in which the aim of the intervention is first to increase parental sensitivity and responsiveness to child communication, to reduce mistimed responses, and to promote new strategies in them, with a secondary increment of the child's communication. These parent-mediated interventions utilize techniques such as modeling and video-feedback; some examples are the "PArent-mediated Communication-focused Treatment in children with autism" (PACT), for parents of ASD children from two to eight years [57], and a model implemented in "British Autism Study of Infant Siblings, based on Video Interaction for Promoting Positive Parenting program" (iBASIS-VIPP), for parents of children with an age range of 7–12 months of life [58]. Studies about these two types of models found a clear benefit for parent-child dyadic social communication, an improvement of attention of the infant to parent, and of adaptive behavior.

4. Future directions

The new pieces of knowledge about brain functions and dysfunctions have profoundly changed the methods of detection, diagnosis, and intervention of neurodevelopmental disorders, such as the ASD. Moreover, the available evidence suggests that skills improve when they are practiced intensively in a playful daily caregiving setting, in which families must have an active role in the promotion of the health of their child [6].

It is also true that research in this field is complex and continually ongoing, also because manifestations of ASD, outcome measures, and contexts may be extremely heterogeneous. Although data about early intervention are promising, especially for daily living and sensory-motor skills of these children, the results must be considered with caution, for this great variability of measures, subjects, and types of intervention [59]. Certainly, it is widely recognized that greater implementation of RCTs in this field of rehabilitation is needed to provide better indications to professionals and parents.

However, as suggested by Vivanti [60], the concept of "evidence-based" is multifaceted, especially in the field of ASD, and *"being able and willing to keep up with the evidence requires an appreciation that the evidence base in the field reflects a provisional state of affairs, rather than an unmodifiable truth"*.

Maybe, parents and professionals should understand that it does not exist a perfect and effective intervention for all children, but the choice can depend on a lot of variables, such as the symptoms' severity, the age of child, the presence of co-occurring disorders, the environmental factors, the learning opportunity and the environmental adversities, and others. However, a relevant intervention target should be to avoid the "normalization of the autistic behavior", and rather take into consideration the well-being of individuals and their families, respecting their neurodiversity, but at the same time, trying to optimize the individual potential and the reach of the desired role within the society [40].

Conflict of interest

The authors declare no conflict of interest.

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References

[1] de Schipper E et al. Ability and disability in autism spectrum disorder: A systematic literature review employing the international classification of functioning, disability and health-children and youth version. Autism Research. 2015;**8**(6):782-794. DOI: 10.1002/aur.1485

[2] Palisano RJ et al. Life course health development of individuals with neurodevelopmental conditions. Developmental Medicine and Child Neurology. 2017;**59**(5):470-476. DOI: 10.1111/dmcn.13402

[3] Palisano RJ et al. Promoting capacities for future adult roles and healthy living using a lifecourse health development approach. Disability and Rehabilitation. 2020;**42**(14):2002-2011. DOI: 10.1080/09638288.2018.1544670

[4] Baykal S, Karakurt MN, Çakır M, Karabekiroğlu K. An examination of the relations between symptom distributions in children diagnosed with autism and caregiver burden, anxiety and depression levels. Community Mental Health Journal. 2019;**55**(2):311-317. DOI: 10.1007/s10597-018-0343-8

[5] Purpura G, Tagliabue L, Petri S, Cerroni F, Mazzarini A, Nacinovich R. Caregivers' burden of school-aged children with neurodevelopmental disorders: Implications for family-centred care. Brain Sciences. 2021;**11**(7):1-12. DOI: 10.3390/brainsci11070875

[6] Hadders-Algra M. Early diagnostics and early intervention in neurodevelopmental disorders—age-dependent challenges and opportunities. Journal of Clinical Medicine. 2021;**10**(4):1-24. DOI: 10.3390/jcm10040861

[7] Cioni G, Sgandurra G. Normal psychomotor development. Handbook of Clinical Neurology. 2013;**111**:3-15. DOI: 10.1016/B978-0-444-52891-9.00001-4. PMID: 23622146

[8] Von Hofsten C. Action in development. Developmental Science. 2007;**10**(1):54-60. DOI: 10.1111/j.1467-7687.2007.00564.x

[9] Bonnier C. Evaluation of early stimulation programs for enhancing brain development. Acta Paediatric International Journal of Paediatry. 2008;**97**(7):853-858. DOI: 10.1111/j.1651-2227.2008.00834.x

[10] Johnston MV. Plasticity in the developing brain: Implications for rehabilitation. Developmental Disabilities Research Reviews. 2009;**15**(2):94-101. DOI: 10.1002/ddrr.64

[11] Hensch TK, Bilimoria PM. Re-opening windows: Manipulating critical periods for brain development. Cerebrum. 2012;**2012**:11. Available: http://www.ncbi.nlm.nih.gov/pubmed/23447797%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC3574806

[12] Baroncelli L, Braschi C, Spolidoro M, Begenisic T, Sale A, Maffei L. Nurturing brain plasticity: Impact of environmental enrichment. Cell Death and Differentiation. 2010;**17**(7):1092-1103. DOI: 10.1038/cdd.2009.193

[13] Cancedda L, Putignano E, Sale A, Viegi A, Berardi N, Maffei L. Acceleration of visual system development by environmental enrichment. The Journal of Neuroscience. 2004;**24**(20):4840-4848. DOI: 10.1523/JNEUROSCI.0845-04.2004

[14] Fischer FR, Peduzzi JD. Functional recovery in rats with chronic spinal cord injuries after exposure to an enriched environment. The Journal of Spinal Cord Medicine. 2007;**30**(2):147-155. DOI: 10.1080/10790268.2007.11753926

[15] Polito L et al. Environmental enrichment lessens cognitive decline in APP23 mice without affecting brain sirtuin expression. Journal of Alzheimer's Disease. 2014;**42**(3):851-864

[16] Begenisic T et al. Environmental enrichment decreases gabaergic inhibition and improves cognitive abilities, synaptic plasticity and visual functions in a mouse model of down syndrome. Frontiers in Cellular Neuroscience. 2011;**5**(December):1-22. DOI: 10.3389/fncel.2011.00029

[17] Cioni G, Inguaggiato E, Sgandurra G. Early intervention in neurodevelopmental disorders: Underlying neural mechanisms. Developmental Medicine and Child Neurology. 2016;**58**:61-66. DOI: 10.1111/dmcn.13050

[18] Purpura G, Cioni G, Tinelli F. Multisensory-based rehabilitation approach: Translational insights from animal models to early intervention. Frontiers in Neuroscience. 2017;**11**:430. DOI: 10.3389/fnins.2017.00430

[19] Guzzetta A et al. Massage accelerates brain development and the maturation of visual function. The Journal of Neuroscience. 2009;**29**(18):6042-6051. DOI: 10.1523/JNEUROSCI.5548-08.2009

[20] Purpura G, Tinelli F, Bargagna S, Bozza M, Bastiani L, Cioni G. Effect of early multisensory massage intervention on visual functions in infants with Down syndrome. Early Human Development. 2014;**90**(12):809-813. DOI: 10.1016/j.earlhumdev.2014.08.016

[21] Fontana C et al. Effects of early intervention on visual function in preterm infants: A Randomized Controlled Trial. Frontiers in Pediatrics. 2020;**8**(June):1-9. DOI: 10.3389/fped.2020.00291

[22] Pineda R, Guth R, Herring A, Reynolds L, Oberle S, Smith J. Enhancing sensory experiences for very preterm infants in the NICU: An integrative review. Journal of Perinatology. 2017;**37**(4):323-332. DOI: 10.1038/jp.2016.179

[23] Oddi D et al. Early social enrichment rescues adult behavioral and brain abnormalities in a Mouse Model of Fragile X Syndrome. Neuropsychopharmacology. 2015;**40**:1113-1122. DOI: 10.1038/npp.2014.291

[24] Garbugino L, Centofante E, D'Amato FR. Early social enrichment improves social motivation and skills in a monogenic mouse model of autism, the Oprm1 -/- Mouse. Neural Plasticity. 2016;**2016**:1-11. DOI: 10.1155/2016/5346161

[25] Chen YS et al. Early environmental enrichment for autism spectrum disorder Fmr1 mice models has positive behavioral and molecular effects. Experimental Neurology. 2022;**352**:114033. DOI: 10.1016/j.expneurol.2022.114033

[26] Whittingham K, McGlade A, Kulasinghe K, Mitchell AE, Heussler H, Boyd RN. ENACT (ENvironmental enrichment for infants; Parenting with Acceptance and Commitment Therapy): A randomised controlled trial of an innovative intervention for infants at risk of autism spectrum disorder. BMJ Open. 2020;**10**(8):1-10. DOI: 10.1136/bmjopen-2019-034315

[27] Fuller EA, Kaiser AP. The effects of early intervention on social

communication outcomes for children with autism spectrum disorder: A meta-analysis. Journal of Autism and Developmental Disorders. 2020;**50**(5):1683-1700. DOI: 10.1007/s10803-019-03927-z

[28] Miller L et al. Impact of 'early intervention' parent workshops on outcomes for caregivers of children with neurodisabilities: A mixed-methods study. Disability and Rehabilitation. 2022;**20**:1-12. DOI: 10.1080/09638288.2022.2143579

[29] Zwaigenbaum L et al. Early intervention for children with autism spectrum disorder under three years of age: Recommendations for practice and research. Pediatric Collective Autism and Spectoral Disorders. 2021;**2021**:269-290. DOI: 10.1542/9781610024716-part06-ch023

[30] Novak I, Morgan C. High-risk follow-up: Early intervention and rehabilitation. Handbook of Clinical Neurology. 2019;**162**:483-510. DOI: 10.1016/B978-0-444-64029-1.00023-0. PMID: 31324326

[31] Sandbank M et al. Project AIM: Autism intervention meta-analysis for studies of young children. Psychological Bulletin. 2020;**146**(1):1-29. DOI: 10.1037/bul0000215

[32] MacDonald R, Parry-Cruwys D, Dupere S, Ahearn W. Assessing progress and outcome of early intensive behavioral intervention for toddlers with autism. Research in Developmental Disabilities. 2014;**35**(12):3632-3644. DOI: 10.1016/j.ridd.2014.08.036

[33] Howard JS, Sparkman CR, Cohen HG, Green G, Stanislaw H. A comparison of intensive behavior analytic and eclectic treatments for young children with autism. Research in Developmental Disabilities. 2005;**26**(4):359-383. DOI: 10.1016/j.ridd.2004.09.005

[34] Frazier TW, Klingemier EW, AndersonCJ, GengouxGW, YoungstromEA, Hardan AY. A longitudinal study of language trajectories and treatment outcomes of early intensive behavioral intervention for autism. Journal of Autism and Developmental Disorders. 2021;**51**(12):4534-4550. DOI: 10.1007/s10803-021-04900-5

[35] Reichow B, Hume K, Barton EE, Boyd BA. Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). Cochrane Database of Systematic Reviews. 2018;**5**:2018. DOI: 10.1002/14651858.CD009260.pub3

[36] Greenspan SI, Wieder S. A functional developmental approach to autism spectrum disorders. Journal of Association Persistant with Handicap. 1999;**24**(3):147-161. DOI: 10.2511/rpsd.24.3.147

[37] Praphatthanakunwong N, Kiatrungrit K, Hongsanguansri S, Nopmaneejumruslers K. Factors associated with parent engagement in DIR/Floortime for treatment of children with autism spectrum disorder. Genetic Psychiatry. 2018;**31**(2):1-9. DOI: 10.1136/gpsych-2018-000009

[38] Boshoff K et al. Child development outcomes of DIR/floortime TM-based programs: A systematic review. Canadian Journal of Occupational Therapy. 2020;**87**(2):153-164. DOI: 10.1177/0008417419899224

[39] Solomon R, Van Egeren LA, Mahoney G, Quon Huber P, Zimmerman MS. PLAY project home consultation intervention program for young children with autism spectrum

disorders: A Randomized Controlled Trial. Journal of Developmental and Behavioral Pediatrics. 2014;**35**(8):475-485. DOI: 10.1097/DBP.0000000000000096

[40] Schuck RK et al. Neurodiversity and autism intervention: Reconciling perspectives through a naturalistic developmental behavioral intervention framework. Journal of Autism and Developmental Disorders. 2022;**52**(10):4625-4645. DOI: 10.1007/s10803-021-05316-x

[41] Contaldo A, Colombi C, Narzisi A, Muratori F. The social effect of 'being imitated' in children with autism spectrum disorder. Frontiers in Psychology. 2016;**7**(MAY):726. DOI: 10.3389/fpsyg.2016.00726

[42] Gengoux GW et al. A pivotal response treatment package for children with autism spectrum disorder: An RCT. Pediatrics. 2019;**144**(3):1-10. DOI: 10.1542/peds.2019-0178

[43] Duifhuis EA, den Boer JC, Doornbos A, Buitelaar JK, Oosterling IJ, Klip H. The effect of pivotal response treatment in children with autism spectrum disorders: A non-randomized study with a blinded outcome measure. Journal of Autism and Developmental Disorders. 2017;**47**(2):231-242. DOI: 10.1007/s10803-016-2916-0

[44] Koegel RL, Bradshaw JL, Ashbaugh K, Koegel LK. Improving question-asking initiations in young children with autism using pivotal response treatment. Journal of Autism and Developmental Disorders. 2014;**44**(4):816-827. DOI: 10.1007/s10803-013-1932-6

[45] Dawson G et al. Randomized, controlled trials of an intervention for toddlers with autism: The Early Start Denver Model. Pediatrics. 2010;**125**(1):e17-e23. DOI: 10.1542/peds.2009-0958

[46] Vivanti G, Dissanayake C. Outcome for children receiving the early start denver model before and after 48 months. Journal of Autism and Developmental Disorders. 2016;**46**(7):2441-2449. DOI: 10.1007/s10803-016-2777-6

[47] Chang YC, Shire SY, Shih W, Gelfand C, Kasari C. Preschool deployment of evidence-based social communication intervention: JASPER in the Classroom. Journal of Autism and Developmental Disorders. 2016;**46**(6):2211-2223. DOI: 10.1007/s10803-016-2752-2

[48] Waddington H, Reynolds JE, Macaskill E, Curtis S, Taylor LJ, Whitehouse AJO. The effects of JASPER intervention for children with autism spectrum disorder: A systematic review. Autism. 2021;**25**(8):2370-2385. DOI: 10.1177/13623613211019162

[49] Ibañez LV, Scott S, Stone WL. The implementation of reciprocal imitation training in a Part C early intervention setting: A stepped-wedge pragmatic trial. Autism Research. 2021;**14**(8):1777-1788. DOI: 10.1002/aur.2522

[50] Schreibman L et al. Naturalistic developmental behavioral interventions: Empirically validated treatments for autism spectrum disorder. Journal of Autism and Developmental Disorders. 2015;**45**(8):2411-2428. DOI: 10.1007/s10803-015-2407-8

[51] Diggle TTJ, Mcconachie H. Parent-mediated early intervention for young children with autism spectrum disorder. Cochrane Database of Systematic Reviews. 2013;**4**:2013. DOI: 10.1002/14651858.CD003496.pub2

[52] Hendrix NM, Pickard KE, Binion GE, Kushner E. A systematic review of emotion regulation in parent-mediated interventions for autism spectrum disorder. Frontiers in Psychiatry. 2022;**13**(1):2118. DOI: 10.3389/fpsyt.2022.846286

[53] Rogers SJ et al. 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. 2019;**49**(2):632-646. DOI: 10.1007/s10803-018-3740-5

[54] Abouzeid N, Rivard M, Mello C, Mestari Z, Boulé M, Guay C. Parent coaching intervention program based on the Early Start Denver Model for children with autism spectrum disorder: Feasibility and acceptability study. Research in Developmental Disabilities. 2020;**105**:103747. DOI: 10.1016/j.ridd.2020.103747

[55] Harrop C, Gulsrud A, Shih W, Hovsepyan L, Kasari C. The impact of caregiver-mediated JASPER on child restricted and repetitive behaviors and caregiver responses. Autism Research. 2017;**10**(5):983-992. DOI: 10.1002/aur.1732

[56] Pajareya K, Nopmaneejumruslers K. A pilot randomized controlled trial of DIR/FloortimeTM parent training intervention for pre-school children with autistic spectrum disorders. Autism. 2011;**15**(5):563-577. DOI: 10.1177/1362361310386502

[57] Green J et al. Parent-mediated communication-focused treatment in children with autism (PACT): A randomised controlled trial. Lancet. 2010;**375**(9732):2152-2160. DOI: 10.1016/S0140-6736(10)60587-9

[58] Green J et al. Parent-mediated intervention versus no intervention for infants at high risk of autism: A parallel, single-blind, randomised trial. The Lancet Psychiatry. 2015;**2**(2):133-140. DOI: 10.1016/S2215-0366(14)00091-1

[59] Daniolou S, Pandis N, Znoj H. The efficacy of early interventions for children with autism spectrum disorders: A systematic review and meta-analysis. Journal of Clinical Medicine. 2022;**11**(17):5100. DOI: 10.3390/jcm11175100

[60] Vivanti G. What does it mean for an autism intervention to be evidence-based? Autism Research. 2022;**15**(10):1787-1793. DOI: 10.1002/aur.2792