A therapeutic approach for ASD: method and outcome of the DERBBI – Developmental, Emotional Regulation and Body-Based Intervention

Magda Di Renzo[1], Elena Vanadia[1], Massimiliano Petrillo[1], Davide Trapolino[1], Lidia Racinaro[1], Monica Rea[1-2] , Federico Bianchi di Castelbianco[1]

Abstract

Autism spectrum disorder (ASD) is a neurodevelopmental disorder displaying individual impairments in social interaction, communication skills, interest and behaviours. In the last decade several studies have been published on the approaches that can be used with ASD children.

This study illustrated the therapeutic approach of the DERBBI method, defined as a relational and body based intervention. The research described the symptoms and emotional development outcomes of ASD children aged 21–66 months, after 2 of the 4 years of planned therapy; the study group included both children who had received a diagnosis of autism and children (under 30 months) who had a risk of developing symptoms.

Approximately 78% of the children with a more severe ASD symptomatology after two years of therapy maintained this diagnosis, instead, among children with a less severe ASD symptomatology, about the 67% after two years of therapy no longer fulfilled the ADOS-2 criteria for autism. Among the children who were at risk of developing the autistic symptomatology, about the 42% no longer showed this risk after 2 years of therapy. The improvements that the children showed in their ability to understand the intentions of others and to contact the emotions of others were also investigated. The findings of this study have underlined the importance of early positive indicators which, among the Autisms, could be defined a specific subpopulation that get better benefits from such a type of intervention.

Key words: *Autism spectrum disorder, therapeutic approach, ADOS-2, Understanding intention, emotional contagion.*

[1] Institute of Ortofonologia (IdO), Via Tagliamento 25, 00198 - Rome, Italy.
[2] Department of Dynamic and Clinic Psychology, Sapienza University of Rome, Italy

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by individual impairments in social interaction, communication skills, interests and behaviors. Recent studies have reported specific motor patterns in children with ASD (Chelini et al., 2018; Khalil, Tindle, Boraud, Moustafa, & Karim, 2018; Shafer, Newell, Lewis, & Bodfish, 2017). Examples have included early asymmetries of the supine posture and walking, early abnormalities on the intersubjective and mimetic-imitative level, and atypical organization and regulation of sensory and motor information (Esposito & Venuti, 2008; Donnellan, Hill, & Leary, 2010; Wales, 2014). In the last two decades there has been a significant interest in the relationship between emotion and cognition and their inseparability during each phase of development (Damasio, 2010; Panksep & Biven, 2012).

Recent data, borrowed from neuroscience, suggests human beings are aware of others' state of mind by understanding their motor purpose through emotional attunement (Stern, 2010; Gallese, 2006; Braten, 2009). In this context, a developmental atypia of the first affective attunement in children with autism spectrum disorder could be related to alterations of that functional mechanism of our brain that allows us to understand the sense of motor behavior of others, using our own states or mental process, that is the embodied simulation (Gallese, 2006). The difficulty of giving an experiential content to others' emotions and in developing imitative processes represent central elements in the autistic organization and consequently should be considered primary targets of therapy (Di Renzo, 2017).

Smith (2009) suggested the presence of an imbalance between cognitive and emotional strategies, consequently, the child with ASD may experience an emotional overload when managing internal states. Therefore, sufficient flexibility in regulation, differentiation, and coping strategies are absent. A study showed that 2-year-old children with autism show significantly lower levels of emotional contagion (understood as automatic reactions to the emotional expressions manifested by another person who experiences the emotion directly), than children of the same age with typical development or with intellectual disabilities (Scambler, Hepburn, Rutherford, Wehner, & Rogers, 2007). Another study analyzed the responses of autistic children in situations where positive and negative reactions were elicited, such that, the experimenter either opened a gift or pretended to get hurt, and the child's response in the first 10 seconds was recorded. The authors noted that low levels of emotional contagion in children with ASD was also related to the degree of impairment of their social-communicative skills (Hepburn, Philofsky, Fidler, & Rogers, 2008). Similarly, at 5 and 8 years of age, children with autism are described as not being able to show appropriate emotions to environmental stimuli. Even in older children (8-13 years), emotional contagion alterations were identified towards specific emotional expressions, such as anger and joy (Beall, Moody, McIntosh, Hepburn, & Reed, 2008). Furthermore, children with autism spectrum disorder may show adequate cognitive understanding of the function of the object, but may show compromised social and emotional skills, with difficulties in joint attention and in the understanding of the mental states of others (Baron-Cohen, 1991; Rogers, & Dawson, 2010; Tomasello, Carpenter, Call, Behne, & Moll, 2005).

These difficulties are often present and can be found in the child's ability to interpret and understand the emotions of others. This difficulty could be due to the complexity of the perceptive, introspective and communicative capacity, but above all, due to the difficulty in tolerating an intense cognitive-emotional state, and difficulties in differentiating the emotion of others from their own (Trevarthen & Delafield-Butt, 2013). In addition, some authors argue that the difficulties of individuals with autism spectrum disorder could be traced to a deficit

in movement and perception development, as well as in body awareness. These sensory-motor reactions become instruments in enabling one to connect with others, and in developing intentional and shared communication in socio-emotional reciprocity (Trevarthen & Delafield-Butt, 2013; Piaget, 1951).

In a recent meta-analysis by West (2018), it was found that motor skills in children diagnosed with ASD differed in a statistically significant way from those of typically developing children; furthermore, among children with ASD, a relationship between motor and communication abilities emerged. Research by Holloway, Long and Biasini (2018) showed that in a sample of 21 children with ASD, the children's social skills were predicted by specific motor impairments in stability, motor accuracy, and object manipulation. Choi, Leech, Tager-Flusberg, and Nelson (2018) compared a sample of 71 high risk children without an ASD diagnosis, 30 high risk children diagnosed with ASD, and 69 children with low risk without an ASD diagnosis. They found that the development of fine motor skills at 6 months of age predicted expressive language at 3 years of age in children at high and low risk of an ASD diagnosis. Another study compared a sample of 20 children with a high functioning ASD diagnosis, and a sample of 21 typically developing children aged between 8 and 14 years. Results showed worst levels of coordination in children in the ASD sample, and showed a relationship between coordination and social skills (Kostrubiec, Huys, Jas, & Kruck, 2018).

Previous longitudinal studies have confirmed a relationship between early sensory seeking with early social engagement and later social difficulties, with assessments administered at 18, 24 and 36 months of age, suggesting the importance of giving particular attention to these aspects in the diagnosis and treatment of children with ASD, both in the short and long-term (Baranek et al., 2017; Baranek et al., 2019; Damiano-Goodwin et al., 2018).

ASD and Developmental Therapeutic Models

Developmental therapeutic models are focused on the importance of first attunements and of the imitative mechanisms, of the processes of sensory and social integration, of the support to the intentionality and to the communication - even preverbal - of the affective development as a foundation on which cognitive abilities are developed. Among these, the Early Start Denver Model (ESDM) is a program of intervention intended for preschool-aged children with autism between 12 and 48 months of age, it encourages initiative, motivation, and participation (Dawson et al., 2010; Rogers & Dawson, 2010). This intervention places emphasis on the improvement of social interaction as the main deficit that characterizes an autism disorder. It considers a hypothetical deficit in the imitative ability due to an underlying praxic disorder or in the ability to program sequences of movement. This deficit would prevent the early establishment of synchrony and coordination at the level of the body, and would initiate progressive difficulties in the area of intersubjectivity. Therefore, according to the Denver Model, the context in which the interactions between the child and the adult take place should be characterized by social involvement, reciprocity, alternation of shifts and shared affection.

Greenspan and Wieder (1997) described another developmental model, the Developmental Individual difference Relationship based (DIR), which emphasizes the encounter with the child in an integrated approach that takes into account their developmental level, the emotional tone and the motivations. Assuming that social relationships guide the development of cognitive abilities, the proposed treatment is *Floortime*, its first aim is to overcome the sensory difficulties in order to re-establish the interpersonal affective contact, as in the absence of social relationships one's self-esteem, ability to take initiative, and creativity do not develop.

The Exchange and Development Therapy (TED, Therapie d'echange et developpment) is essentially based on the exchange between the child and the operators (the environment) to favor socialization and communication skills (Lelord, Barthelemy-Gault, Sauvage, & Ariot, 1978; Barthélémy et al., 1995). This model aims to foster children's functional abilities by encouraging their initiatives in an atmosphere of tranquility, availability, and serenity, terms that are not only a generic approach to transversal treatments but play a specific role on the neurophysiological side. Finally, the term "functional rehabilitation" is determined through the integration and modulation of different neurophysiological processes.

Among the developmental models, the DERBBI- Turtle Project (Developmental, Emotional Regulation and Body-Based Intervention for children with autism spectrum disorders) is the one being proposed. DERBBI represents an interactive developmental model with body mediation that integrates the theoretical aspects described in clinical activity that involves caregivers, and supports social development since the early years of life (Di Renzo et al., 2016a; Di Renzo et al., 2016b). This intervention is aimed at constructing communicative modes, it is mediated by the therapist and the caregiver who help the child to regulate their own reactions when confronted with external or internal stimuli that can be perceived as disturbing or harmful. The intervention also stimulates the child's understanding of the world around them through a bottom-up process that starts from the body and works upwards towards the mind. The therapy aims to stimulate cognitive and communicative abilities, although it does not provide an exclusively structured cognitive treatment before the age of 6, rather, it does so by integrating support for the mental and cognitive development within bodily and relational mediated activities (Di Renzo et al, 2016a).

Therefore, in light of what has been illustrated thus far, the purpose of this study is to define theoretical-scientific and methodological assumptions of the DERBBI model while monitoring the development of the core symptomatology of autism. Additionally, the ability to understand the intentions of others and emotional contagion will be monitored as indicators of future mentalization ability and empathy in preschool-aged children diagnosed with ASD, this was included in the early bodily-mediated intervention program, Turtle Project. Specifically, the research objectives include:

1) Verify the symptomatic course in clinical terms, in reference to the scores on the ADOS-2 measure. Specifically, to verify the reduction of repetitive behaviors scores and the improvement of social affect scores halfway through treatment (after 2 years), controlling for the chronological age and cognitive level of the child;

2) Verify the increase in scores of emotional contagion and the ability to understand the intentions of others, at 2 years from the start of therapeutic treatment.

Materials and Methods

Participants

A group of 32 children was assessed at intake (T0) and re-tested after 1 year (T1) and 2 years (T2), which is the halfway point of the course of treatment. All children were evaluated for ASD symptoms: 18 children aged between 31 and 60 months received the a diagnosis of autism; among these, 9 children (28,1%) assessed with the ADOS-2 Module 1 fell in the Autism category (ASD, Autism) and 9 children (28,1%) fell in the Spectrum category (Autism Spectrum).

14 children aged between 21 and 30 months were assessed with the ADOS-2 Toddler Module; among these, 9 children (28,1%) fell in High Risk category, 4 children (12,5%) fell in the Medium Risk category and 1 child (3,1%) fell in the Mild Risk category.

The mean age of the children in the ASD group (5 females and 13 males) was 42.3 months (SD = 10.3) at T0. The mean age of the children in the RISK group (3 females and 11 males) was 26.6 months (SD = 2.1) at T0.

DERBBI- Turtle Method

For many years, The Institute of Ortofonologia (IdO) has based its diagnostic and therapeutic processes for children with ASD, or at specific risk, on an integrated, multi-professional, developmental-relationship-body mediated approach which is represented by the DERBBI method and Turtle Project (Di Renzo et al, 2016a; Di Renzo, 2017). This approach considers both of the interrelated cognitive and affective components (Alvarez, 2012; Bion, 1967; Freud, 1965; Stern, 2004; Winnicott, 1989). The Turtle Project is aimed at children aged between 2 to 5 years old, diagnosed with autism spectrum disorder. It involves therapeutic interventions that consider the child's individual profile, defines the areas of deficit, and enhances the emotional-relational and cognitive potential (Schore, 2003, 2012; Stern, 2004). The therapeutic project for this developmental stage is centered on bodily dimensions and on the adequate attunement of the mother-child dyad (Anzieu et al., 1987; Di Renzo et al., 2017; Trevarthen, 2001).
The difference between this intervention in relation to other developmental models, both interactive and behavioral (i.e., DIR, TED, ESDM), is the use of the therapist's body as a communication tool. The therapist is not only a facilitator of parents' insightfulness but also acts as a model to favor communication protocols and to enrich an emotional exchange in the dyad. Through his ability to emotionally attune with the needs of the child, the therapist introduces the mother, utilizing play and body mirroring, to new communication and relational methods. The therapist, creating a therapeutic context as natural as possible, participates in the proposed play to activate the child's interest and promotes joint attention. It is through shared play that the child begins to intentionally imitate the gestures of the other, who begins to foresee it, expanding their verbal protoform repertoire and creating the premise for communicative reciprocity and possible mentalization. This therapeutic course has been implemented through individual interventions with the child, which is mediated by the parents (the therapist with the parent/child dyad), and through group interventions (groups of dyads and groups of children).
Phases of the Turtle Project for children from 2 to 5 years of age: duration of 4 years, 10 hours per week, as showed in Table 1.

Instruments

*ADOS-2 – Autism Diagnostic Observation Schedule – Second Edition***.** The ADOS-2 is a semi-structured, standardized assessment of social affect (SA), repetitive and restricted behavior (RRB), play and imaginative use of objects, in relation to a diagnosis of ASD (Lord et al., 2012). It consists of five modules, each of which are appropriate for children and adults of differing developmental and language levels, ranging from nonverbal to verbally fluent. The Toddler Module is utilized for children between 12 and 30 months of age who do not consistently use phrase speech, algorithms yield "ranges of concern" rather than cutoff or classification scores, this allows the administrators to form clinical impressions, and to avoid a formal classification which may not be appropriate at such a young age. The Comparison Score (CS) allows comparisons of a child's overall level of autism spectrum-related symptoms to that of children diagnosed with ASD who are the same age and have similar language skills.

Emotional Contagion Test (TCE). The TCE-Emotional Contagion Test, which was standardized on a group of 120 children with autism, allows for the identification of an empathy precursor, *emotional contagion*, through the administration of pre-verbal stimuli (vocal signals, facial expressions, gestures, proxemic and haptic systems), pre-cognitive stimuli of basic emotions and the encoding of their expressions in child's body, emotions that can not be named because they are not yet conscious (Di Renzo & Stinà 2011; Di Renzo et al., 2016d; Inzani, Cazzaniga,

Martelli, & Salina, 2004). The whole TCE evaluation procedure was videorecorded.

Understanding of Other's Intention (UOI). To assess the ability to understand others' intentions, tasks were administered, which were similar to Meltzoff's Intention condition of Behavioral Enhancement Procedures (Di Renzo et al., 2016c; Meltzoff, 1995). This evaluation is defined as U.O.I., Understanding of Others' Intention.
The test allows researchers to detect the child's ability levels in understanding the intentions of others, scores range from 0 (Absence of capacity) to 4 (Excellent capacity). The whole UOI evaluation procedure is videorecorded.

Leiter-R. The Leiter International Performance Scale–Revised (Leiter-R) is designed for the evaluation of intellectual functions of nonverbal children and adolescents aged between 2 and 20 years old (Roid & Miller, 2002).

Procedure

The participants were recruited in the Institute of Ortofonologia (IdO). The Institute is accredited by the National Health System and follows the procedures for taking care of children and their families, and procedures for monitoring the therapeutic project established by the Public Health System. Starting in 2016, the children were evaluated for a suspected diagnosis of ASD. The diagnosis was performed by a team of qualified clinicians (with extensive experience in the field of autism, with at least 5-10 years of expertise), formed by psychologists /psychotherapists, pediatric neurologists, child neuropsychiatrists, and rehabilitation therapists.
The diagnosis of autism was based on The Diagnostic and Statistical Manual of Mental Disorders, Fifth edition (DSM-5) criteria, in addition to clinical observations, the children were evaluated with the ADOS-2 measure, and with parent interviews through the use of questionnaires and rating scales (American Psychiatric Association, 2013; Lord et al., 2012). Experts evaluating the child and administering ADOS-2 were not the same as those who were involved in the child's therapy. Informed consent was granted from all parents (Declaration of Helsinki). This research met the ethical guidelines and the legal requirements of the country in which it was conducted. The research also complied with the ethical standards of the American Psychiatric Association (APA). After receiving the diagnostic classification, all children were included in the therapeutic project. All the children in the study group at Time 0 had been given the ADOS-2 measure for the evaluation of autistic symptomatology, as well as the TCE, UOI, and Leiter-R measures.
At Time 1, the Leiter-R cognitive evaluation and the measurement of related skills, such as the ability to understand the intentions of the others (UOI), were readministered.
At time 2 the ADOS-2 was readministered for the evaluation of autistic symptomatology. The TCE, UOI, and Leiter-R were also readministered. The measurement of the empathic capacity and of emotional contagion was carried out at T2 because, as per protocol, it is proposed in conjunction with the evaluation with the ADOS-2.

Statistics

Most scores met the assumptions of normality required for parametric statistical analyses, therefore, parametric analyses were used. A multivariate analysis for repeated measures (MANOVA) was conducted to evaluate the changes in the scores that the children obtained during the two years of therapy. The size of the effect was calculated using the partial eta squared; for which $\eta_2 p = 0.02$ is considered a small effect, 0.13 a medium effect, and 0.23 a great effect. To analyze changes in the diagnostic categories before and after the two years of therapy, a Chi square analysis was conducted. The significance level was at $p < 0.05$. All statistical analyzes were performed using the software version 21.0 of SPSS.

Results

Descriptive

Table 2 shows the characteristics of the study sample (N=32) at the time of the first diagnosis (T0). The study group is made of 75 % males (n = 24). The ratio (4:1) reflects the gender ratio currently estimated in the wider population of children with ASD (4.5:1) (Center for Disease Control and Prevention, 2014). With respect to the initial ADOS-2 classification (T0), the study group consisted of 56.2% of children diagnosed with ASD, and 43.8% of children at risk for autism.
With respect to the I.Q. evaluation at T0, 40.6% of children fell into the Average I.Q category, and 53.2% fell into the Intellectual Disability category.
The child's chronological age and I.Q. score were entered as covariates in the subsequent analysis.

Optimal Outcome after 2 years

Among the 9 children who were initially diagnosed with ASD-s, 2 of them no longer fell into the ADOS-2 criteria of an autism disorder after 2 years. Among the 9 children who were initially diagnosed with Moderate Autism (ASD-m), 6 of them no longer fell into the ADOS criteria of an autism disorder after 2 years. Among the 14 children who were initially diagnosed at RISK, 6 of them no longer fell into the ADOS criteria of an autism disorder after 2 years. The Chi-square analysis revealed a significant difference in the overall percentage of children who showed improvements in the diagnostic categories after 2 years ($P < .02$) (see Table 3).

Autistic Symptomatology

In the study group, overall symptom severity was measured at T0 using the ADOS-2 Total score, Social Affect scores, and Restricted and Repetitive Behaviors scores.

The children in the study group exhibited significantly milder symptom severity after 2 years in ADOS-2 Total score and in Social Affect scores (see Table 4).
The ANOVA for repeated measure, with IQ and CA as covariates, did not show a significant effect of the CA variable, while a significant effect of interaction Time X IQ score was found for Total score ($F = 5.12$; $p < .05$) and Social Affect ($F = 5.15$; $p < .05$): scores were reduced after 2 years of therapy, especially in children who had a higher IQ at T0. There were no differences between T0 and T2 in the RRB scores, which remained substantially stable throughout the two years (3.1 vs 3.3).
The changes in RRB scores were analyzed in the two subgroups of children, i.e., those who showed improvements by transitioning from an ADOS-2 diagnostic category (14 children who transitioned from ASD-s, ASD-m, or at Risk to No-Autism) and those who did not show improvements in regard to the ADOS-2 diagnostic category (18 children from ASD-s who remained ASD-s, or children from ASD-m who remained ASD-m). Substantial differences were observed, such that, children who showed improvements significantly reduced the RRB scores (average T0 = 2.1 versus average T2 = 1.3; $F = 4.6$; $p < 05$; $\eta_2 p = .26$), while those who did not improve, showed an increase in scores (average T0 = 3.9 versus average T2 = 5.0; $F = 4.3$; $p < .05$; $\eta_2 p = .21$).

Ability to understand the intentions of others and emotional contagion

The children in the study group were re-tested in their ability to understand the intentions of others (UOI), the assessment was readministered at 1 year and 2 years after therapy (see Table 5). There were statistically significant improvements in the UOI scores, indicating an increase in the percentage of children who reached good levels in their ability to understand the intentions of others after two years of therapy. After only 1 year of therapy, the tendency towards

improvement did not reach statistical significance.
The children in the study group were also re-tested for emotional contagion (TCE) after 2 years (see Table 5). It was found that after 2 years of treatment, the number of children who reached the level of empathy rose from 9.3 to 43.7.

Discussion

The data presented in this study illustrates the results of implementing the DERBBI intervention, specifically, the Turtle Project for preschool-aged children diagnosed with autism spectrum disorder. The evolution of the autistic symptomatology of 32 children was monitored and described following 2 years of therapy, midway through the course of this project. At the time of intake, the children had been diagnosed with autism or, if under 30 months of age, presented with a risk of developing symptoms.
The results indicated that severe levels of symptomatology at the time of intake was less correlated with an optimal outcome following 2 years of therapy. Additionally, being at risk for ASD before the age of 30 months seems to be a fairly reliable indicator of the evolution of symptoms in successive years. In fact, children who presented with a severe diagnosis maintained the same diagnosis in 78% of cases following 2 years of therapy. Conversely, among the children who presented with a moderate diagnosis, approximately 67% no longer met the ADOS-2 criteria for autism after 2 years of therapy. Among the children who were at risk for developing autistic symptoms, approximately 42% no longer met criteria for an autism spectrum diagnosis after 2 years of therapy. The data presented seems to be more encouraging than data from previous studies that have reported lifetime prevalence rates of 80-90% for pediatric ASD cases (Charman, Howlin, Berry, & Prince, 2004; Woolfenden, Sarkozy, Ridley, & Williams, 2012). Nonetheless, results are in accordance with other studies that have reported estimates ranging from 3-25% of children who no longer met criteria for an ASD diagnosis (Helt et al., 2008; Sutera et al., 2007).
Overall, the greatest increase in skills was shown to have occurred on the Social Affect sphere, regardless of the children's age. The improvements in overall symptomatology were more evident in children who at the time of the first assessment, presented with higher, or at minimum measurable, cognitive skills. Similar results have been reported by other authors who have described higher cognitive levels and motor skills at the time of diagnosis, for groups of children who no longer fell into the ASD diagnostic category after therapeutic intervention (Sutera et al., 2007; Turner, & Stone, 2007).
The data presented in this study demonstrate a marked improvement in the manifestation of restricted and repetitive behaviors in children who no longer met the ADOS-2 general criteria for autism after 2 years, when compared to children who transitioned from a severe autism category to a moderate autism category. In contrast, repetitive and stereotypical behaviors increased in intensity in children who did not demonstrate a change in diagnostic category. In support of what had been initially expected, important improvements were observed in the study group, including the children's ability to understand the intentions of the adults they were facing. Similarly, results showed children were better able to manifest coherent emotional responses when faced with a stimulus proposed by the TCE.

Conclusion

In accordance with the recent evidence on the treatment of pediatric ASD, the data presented in this study suggests that in order to have a positive impact on the developmental trajectory of children diagnosed with ASD, who have been placed in a therapeutic course that provides active parental involvement, it is necessary for one to: Identify the child's socio-communicative impairments from their first year of life; Define the child's individual characteristics through careful clinical observation and through standardized,

quantitative and qualitative methods; Provide early intervention (Hamadneh, Alazzam, Kassab, & Barahmeh, 2019; Zwaigenbaum et al., 2015).

Specifically, the DERBBI approach aims to promote the emergence or stabilization of social skills such as joint attention, imitation, reciprocal interaction, and other general functional adaptive skills. It is necessary to include interventions mediated by the child's parents to enable the therapist to work on attunement. The developmental models are characterized by work on the sensory and social integration processes, support for intentionality and communication, and the affective development of children diagnosed with ASD (Zwaigenbaum et al., 2015). In continuation of this model, the therapeutic activities for different age groups provided by the Turtle Project aim to encourage imitation and learning in an emotionally shared context e aims to promote affective attunement as the basis of subsequent social development, and behavioral and cognitive development. The DERBBI model presented in this study favors diadic therapy, or rather, a setting with parental mediation, especially in the child's early years. This is done to allow for an understanding of the atypical functioning and needs of the child, on which to build a new form of relationship that will help the child and mother to connect in an authentic and individualized way, and to motivate them to learn new communication patterns. The therapist utilizing the Turtle developmental model is distinct from those utilizing other diadic therapy approaches due to their active interaction in therapy (Alvarez, 2012). In this way, the therapist stands as a support to the relationship and a facilitator of communication. By actively participating in the exchange and by including the mother-child dyad in the same cognitive context and in a single affective climate, the therapist promotes the expansion of the dyadic state of consciousness (Tronick et al., 1998).

In fact, it is through the use of new forms of syntonization, dysregulation, and reattunement that the pre-verbal psychobiological matrix can contribute to the formation of the first nucleus of the implicit self (Schore, 1994).

In addition to these objectives, what characterizes the DERBBI model is the bodily dimension, which is seen as a mode of communication and learning, and as a tool for achieving a greater awareness of body and space perception, of organization and motor fluidity, and of sensory and perceptual regulation. It also allows the child to be led in an intimate relational hook which will promote a reduction in defensive states, the regulation of activity levels, and an increase in the awareness of others and self. Moreover, the therapy works on the anticipation of actions through the construction of a sensible response to signals, which are predominantly motor (Nadel, 2006; Solomon, Holland, & Middleton, 2012). This is done while simultaneously respecting the child' s inclinations and presentation, as the already exposed emotional construct is preceded by the cognitive construct, and because in childhood, play and the body represent a favored channel of communication and relationships (Di Renzo et al., 2016a).

Consciously attuning to the motor acts of the child with ASD, while recognizing the affective and intentionality content of the interactions, is a technique that not only provides the child with an interactive pattern of actions that is temporally defined, thus, offering perspective, it also compensates for the feelings of anxiety and anguish that are related to the motor dysregulation exhibited by the child (Hardy & Blythe La Gasse, 2013). From this perspective, the motor stereotypy must also be interpreted as a defensive response resulting from overstimulation, which can therefore be regulated and modified. Moreover, the attunement promotes regulation and produces meaning, which allows for the channeling of motor activity in more functional and adaptive ways.

In conclusion, the Turtle Project – according to the DERBBI model – aims to be defined as an "approach model" as opposed to an "universal method or technique", and it is modular and flexible in respect to context and

the individual child. Moreover, the child's developmental course can be modified by preventing symptoms from becoming fixed and solidified, otherwise, symptoms may become pervasive and may dramatically interfere with the quality of life of the entire family system.

Limitations

The main limitation of this study is the absence of a control group, as the children were immediately evaluated in a diagnostic examination and were placed into therapeutic care upon arrival. Thus, researchers were not able to place any participants from the waiting list in a control group. Moreover, although there was a delay of a few months in initiating therapeutic treatment, the evaluations used in this study provided the first follow-up after 1 year of starting treatment. It would be an ethical violation for a group of children to begin therapy 1 year after their diagnosis was confirmed.

Table 1. *DERBBI phases*

PHASE 1	First year of therapy: children of 2 years of age. Duration: 10 hour for week. Therapy team: neuropsychiatrists, psychotherapists, psychologists, psychomotricists, osteopaths
Aim	To promote the emotional attunement between child and caregiver and to stimulate the process of peer imitation. To transforme bodily experiences into emotional ones.
Therapy Mother - Child Dyad	The Mother-Child dyad is fundamental to rediscover the sense and the pleasure of play; to share that favors affective attunement (mirroring). To promote self-regulation perceptive-motor activities, supported by imitation and mirroring, are proposed. The therapy includes a session in small group with mother and child and a session in a small group of 4 children with 2 operators. Each session lasts about 2 hours.
AAT- Animal Assisted Therapy	There is a weekly session with animal. The relationship with the animal can facilitate sensory experiences and emotional regulation.
Parental Counseling	The counseling includes individual or couple sessions every 15 days concerning child's educational project. Monthly group sessions are scheduled with 4/5 parental couples Sessions are scheduled twice per month for fathers only.

Contacts with educational context.	Every month an operator observes the child in the classroom during the educational and socializing activities with the class group. Weekly contacts with the school and 3 meetings a year with the school team.
PHASE 2	Second Year of Therapy: children of 3 years of age. Duration: 10 hour for week. Therapy team: neuropsychiatrists, psychotherapists, psychologists, psychomotricists, speech therapists, music therapists
Aim	To improve the level of emotional regulation; to stimulate the motor initiative and the redefinition of a body schema; to support communication strategies through play.
Therapy	2 weekly individual or group sessions lasting about two hours. The therapy is centered on the body and on sensoriality, also through music therapy sessions to encourage listening, useful for the prosodic aspects of language.
AAT- Animal Assisted Therapy: See Phase 1 Parental Counseling: See Phase 1	
Contacts with educational context.	The project includes three meetings (Working Group for Handicap) in which an operator meets the teachers. In addition, on a monthly basis, an operator performs an observation in the classroom.
PHASE 3	Third Year of Therapy: children of 4 years of age. Duration: 10 hour for week. Therapy team: neuropsychiatrists, psychotherapists, psychologists, psychomotricists, speech therapists
Aim	To improve playing skills, linguistic, cognitive, behavioral and relational skills; attention skilld, motivation and relationship with others. The expressive drawing skills are also reinforced.

Therapy	One session per week of a small group (4 children) with 2 operators and an individual therapy session with child
AAT- Animal Assisted Therapy: See Phase 1 Parental Counseling: See Phase 1 Contacts with educational context: See Phase 2	
PHASE 4	Fourth Year of Therapy: children of 5 years of age. Duration: 10 hour for week. Therapy team: neuropsychiatrists, psychotherapists, psychologists, psychomotricists, speech therapists
Aim	The therapy is centered on the cognitive, linguistic and personal autonomy areas, to stimulate the school learning prerequisites, the attentive skills, also through logical-narrative activities. The expressive drawing activities are proposed to support spatial and temporal organization, but also creativity
Therapy	There are 2 weekly sessions each one lasting about 2 hours: a group session with children and 2 operators, and an individual session with child. It is also proposed the technique of holophony, a technique of sound reproduction that simulates the strategies of human listening by immersing the listener in a three-dimensional auditory reality
AAT- Animal Assisted Therapy: See Phase 1 Parental Counseling: See Phase 1 Contacts with educational context: See Phase 2	

Table 2. *Frequency distributions and percentages of groups based on gender, intellectual disability and ADOS-2 classifications*
Legend. ASD-s = severe autism spectrum disorder; ASD-m = moderate autism spectrum disorder; RISK = Risk Spectrum Disorder

		After 2 years (T2)			
		No Spectrum N (%)	Spectrum N (%)	ASD N (%)	P
Study Group (N=32)	ASD-s (N=9)	2 (6.3)	0	7 (21.9)	.02
	ASD-m (N=9)	6 (18.8)	2 (6.3)	1 (3.1)	
	Risk (N=14)	6 (18.6)	0	8 (25)	
	Tot (N=32)	14 (43.7)	2 (6.3)	16 (50)	

Table 3. *Differences in the number (and percentages) of children in the different ADOS-2 categories, at the beginning and after 2 years of treatment*
Legend. ASD-s = severe autism spectrum disorder; ASD-m = moderate autism spectrum disorder; RISK = Risk Spectrum Disorder

	Sample (N=32)
Gender (% males)	24 (75%)
Age in months T0, mean (sd; range)	35.4 (11.1; 21-66)
Classificazione ADOS e ADOS-2	
% ASD-s	28.1%
% ASD-m	28.1%
% Risk	43.8%
IQ Classifications	
N (%) Average	13 (40.6%)
N (%) Borderline	2 (6.2%)
N (%) Intellectual Disability	17 (53.2%)

Table 4. *Differences between T0 and T2 scores obtained with ADOS and ADOS-2 in the study group (N=32), with IQ and CA covariate*
Legend. T0 = intake; T2 = after two years of treatment

ADOS-2, Mean (sd)				
Total score	16.2 (6.1)	13.8 (8.8)	.05	.15
Social Affect	13.1 (0.8)	10.4 (1.1)	.05	.15
Restricted Repetitive Behaviors	3.1 (.3)	3.3 (.4)	.20	/

Table 5. *Differences with respect to the UOI (understanding of Other Intention) and to the TCE (Emotional Conbtagion Test), observed in the study group at the beginning and after 1 and 2 years of treatment.*

UOI, absent/low N (%)	10 (31.3)	8 (25)		7 (21.9)	
UOI, moderate N (%)	4 (12.5)	4 (12.5)	*.08*	4 (12.5)	*.05*
UOI, good/excellent N (%)	18 (56.3)	20 (62.5)		21 (65.6)	

TCE, absent/low N (%)	15 (46.9)	/	/	8 (25)	*.02*
TCE, emotional contagion N (%)	14 (43.8)			10 (31.3)	
TCE, empathy N (%)	3 (9.3)			14 (43.7)	

Legend. T0 = intake; T1 = after one year of treatment; T2 = after two years of treatment

References

Alvarez, A. (2012). *The thinking heart: three levels of psychoanalytic therapy with disturbed children*. Hove, UK: Routledge.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM–5)*. Washington, DC.

Anzieu , D. , Houzel , D. , Missenard , A. , Enriquez , M. , Anzieu , A. , Guillaumin , J., Doron, J. , Lecourt , E. , & Nathan , T. (1987). *Les enveloppes psychiques* [The psychic envelopes] Paris, France : Dunod .

Baranek, G. T., Woynaroski, T. G., Nowell, S., Turner-Brown, L., DuBay, M., Crais, E. R., & Watson, L. R. (2017). Cascading effects of attention disengagement and sensory seeking on social symptoms in a community sample of infants at-risk for a future diagnosis of autism spectrum disorder. *Developmental Cognitive Neuroscience*, 29, 30–40.

Baranek, G. T., Carlson, M., Sideris, J., Kirby, A. V., Watson, L. R., Williams, K. L., & Bulluck, J. (2019). Longitudinal assessment of stability of sensory features in children with autism spectrum disorder or other developmental disabilities. *Autism Research*, *12*(1), 100-111.

Baron-Cohen, S. (1991). Precursors to a theory of mind: understanding attention in others. In A. Whiten (Ed.), *Natural theories of mind: evolution, development and simulation of everyday mindreading*. Oxford, UK: Basil Blackwell (pp. 233-251).

Barthelemy C, Haumeury L, & Lelord G (1995*). L'autisme de l'enfant. La Thérapie d'Echange et de développment.* Paris: Expansion Scientifique Françaises.

Beall, P. M , Moody, E. J., McIntosh, D. N., Hepburn, S. L., & Reed, C. L. (2008). Rapid facial reactions to emotional facial expressions in typically developing children and children with autism spectrum disorder. *J. Exp. Child Psychol*. 101(3):206–23

Bion, W. R. (1967). *Second thoughts. London.* UK: William Heinemann.

Braten, S. (2009). *The intersubjective mirrorin infant learning and evolution of speech.* Amsterdam/Philadelphia: John Benjamins Publishing Company.

Center for Disease Control and Prevention (CDC). (2014). Prevalence of Autism spectrum disorder among children aged 8 years— Autism and developmental disabilities monitoring network, 11 Sites, United States, 2010. *Morbidity and Mortality Weekly Reports (MMWR), 63(2), 1–24*.

Charman, T., Howlin, P., Berry, B., & Prince, E. (2004). Measuring developmental progress of children with autism spectrum disorder on school entry using parent report. *Autism*, *8*(1), 89-100.

Chelini, G., Zerbi, V., Cimino, L., Grigoli, A., Markicevic, M., Libera, F., & Galbusera, A. (2018). Aberrant somatosensory processing and connectivity in mice lacking Engrailed-2. *Journal of Neuroscience*, 0612-18.

Choi, B., Leech, K. A., Tager-Flusberg, H., & Nelson, C. A. (2018). Development of fine motor skills is associated with expressive language outcomes in infants at high and low risk for autism spectrum disorder. *Journal of neurodevelopmental disorders*, *10*(1), 14.

Damasio, A. (2010). *The Self Comes to Mind*. NewYork, NY:Pantheon.

Damiano-Goodwin, C. R., Woynaroski, T. G., Simon, D. M., Ibañez, L. V., Murias, M., Kirby, A., & Cascio, C. J. (2018). Developmental sequelae and neurophysiologic substrates of sensory seeking in infant siblings of children with autism spectrum disorder. *Developmental cognitive neuroscience*, *29*, 41-53.

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), 17-23.

Di Renzo, M. (2017). The Theoretical Principles of the Body-Centered Therapy to Promote Affective Attunement in Children with Autism Spectrum Disorder. *Journal of Behavioral and Brain Science, 7,* 12. doi:10.4236/jbbs.2017.712039

Di Renzo, M., & Stinà, M. (2011). TCE – *Test del Contagio Emotivo* [Emotional Contagion Test]. Florence, Italy: Hogrefe Eds.

Di Renzo, M., Bianchi di Castelbianco, F., Vanadia, E., Petrillo, M., Racinaro, L., & Rea, M. (2016a). From the emotional integration to the cognitive construction: the developmental approach of Turtle Project in children with autism spectrum disorder. *Autism Open Access , 6*, 160.

Di Renzo, M., Bianchi di Castelbianco, F., Vanadia, E., Petrillo, M., Racinaro, L., & Rea, M. (2016b). T.U.L.I.P. Protocol (TCE, UOI, Leiter-R as Indicators of Predictivity) for the Assessment of the Developmental Potential in Children with Autism Spectrum Disorders. *Autism Open Access, 6,* 188. https://doi.org/10.4172/2165-7890.1000188

Di Renzo, M., Bianchi Di Castelbianco, Plescia, F., Racinaro, L., Petrillo, M., & Rea, M. (2016c). The understanding of others intentions can predict the improvement of symptomatology in children with autism – An exploratory study. *Current Pediatric Research 20,* 2, 183-192

Di Renzo, M., Bianchi Di Castelbianco, F., Petrillo, M., Racinaro, L., Donaera, F., & Rea, M. (2016d). The Emotional Contagion in Children with Autism Spectrum Disorder. *Austin Journal Autism & Related Disability , 2*, 1020.

Di Renzo, M., Bianchi di Castelbianco, F., Vanadia, E., Racinaro, L., & Rea, M. (2017a). The psychomotor profile in children with autistic spectrum disorders: clinical assessments and implications for therapy. *Autism Open Access*, 7, 209.

Donnellan, A. M., Hill, D. A., & Leary, M. R. (2013). Rethinking autism: implications of sensory and movement differences for understanding and support. *Frontiers in integrative neuroscience*, *6*, 124.

Esposito, G., .& Venuti, P. (2008) . Analysis of toddlers' gait after six months of independent walking to identify autism. *Perceptual and Motor Skills*, *106*:259-269.

Freud, A. (1965). *Normality and pathology in childhood assessments of development.* London, UK: Karnac Books.

Gallese,V. (2006). Intentional attunement: a neurophysiological perspective on social cognition and its disruption in autism. *Brain Research, 1079,* 15–24. doi:10.1016/j.brainres.2006. 01.05

Greenspan, S., & Wieder, S. (1997). An integrated developmental approach to interventions for young children with severe difficulties in relating and communicating. *Zero to Three*, *17*, 5-18.

Hamadneh, S., Alazzam, M., Kassab, M., & Barahmeh41, S. (2019). Evaluation of Intervention Programs for Children with Autism. *International Journal of Pediatrics*.

Hardy, M. W., & Blythe La Gasse, A. (2013). Rhythm, movement and autism: using rhythmic rehabilitation research as a model for autism. *Frontiers Integrative Neuroscience, 7*, 19 .doi: 10.3389/fnint.2013.00019

Helt, M., Kelley, E., Kinsbourne, M., Pandey, J., Boorstein, H., Herbert, M., & Fein, D. (2008). Can children with autism recover? If so, how?. *Neuropsychology review*, *18*(4), 339-366.

Hepburn, S., Philofsky, A., Fidler, D. J., & Rogers, S. (2008). Autism symptoms in toddlers with Down syndrome: A descriptive study. *Journal of Applied Research in Intellectual Disabilities*, *21*, 48–57.

Holloway, J. M., Long, T. M., & Biasini, F. (2018). Relationships Between Gross Motor Skills and Social Function in Young Boys With Autism Spectrum Disorder. *Pediatric Physical Therapy*, *30*(3), 184-190.

Inzani, L., Cazzaniga, I., Martelli, D., & Salina, P. R. (2004). Il contagio emotivo: quando le emozioni "passano" tra le persone. *ACP–Rivista di Studi Rogersiani*.

Khalil, R., Tindle, R., Boraud, T., Moustafa, A. A., & Karim, A. A. (2018). Social decision making in autism: On the impact of mirror neurons, motor control, and imitative behaviors. *CNS neuroscience & therapeutics*, *24*(8), 669-676.

Kostrubiec, V., Huys, R., Jas, B., & Kruck, J. (2018). Age-dependent Relationship Between Socio-adaptability and Motor Coordination in High Functioning Children with Autism Spectrum Disorder. *Journal of autism and developmental disorders*, *48*(1), 209-224.

Lelord, G., Barthelemy-Gault, C., Sauvage, D., & Ariot, J.C. (1978). *Les Thérapeutiques d'échange et de développmental (TED) dans les troubles graves de la peronalité chez l'enfant.* Concours Méd.

Lord, C., Rutter, M., Di Lavore, P. C., Risi, S., Gotham, K., & Bishop, S. (2012). *Autism diagnostic observation schedule, second edition*. Torrance, CA: Western Psychological Services.

Meltzoff, A.N. (1995). Understanding the intention of others: Re-enactment of intended acts by 18-months- olds. *Development Psychology, 31*, 838-850.

Nadel, J. (2006). Does imitation matter to children with autism?. In R. J. Williams (Ed.) *Imitation and the social mind* (pp.118–137). NewYork,NY: TheGuilfordPress.

Panksepp, J., & Biven, L. (2012). *The Archaeology of Mind: Neuroevolutionary Origins of Human Emotions*. NewYork, NY: Norton.

Piaget, J. (1951). *Play, dreams and imitation in childhood*. New York: Norton.

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

Roid, G. H., & Miller, L. J. (2002). *Leiter–R: Leiter International Performance Scale–Revised.* Florence, Italy: O.S. Organizzazioni Speciali.

Scambler, D. J., Hepburn, S., Rutherford, M. D., Wehner, E. A., Rogers, S. J. (2007). Emotional responsivity in children with autism, children with other developmental disabilities, and children with typical development. *Journal of Autism Developmental Disorder, 37*, 3, 553-63.

Schore, A. (2003). *Affect regulation and the repair of the self.* NewYork, NY:Norton.

Schore, A. (2012). *The Science of The Art of Psychotherapy.* New York:Norton.

Shafer, R. L., Newell, K. M., Lewis, M. H., & Bodfish, J. W. (2017). A cohesive framework for motor stereotypy in typical and atypical development: The role of sensorimotor integration. *Frontiers in integrative neuroscience*, *11*, 19.

Smith, A. (2009). The Empathy Imbalance Hypothesis of Autism: A Theoretical Approach to Cognitive and Emotional Empathy in Autistic Development. *The Psychological Record, 59*, 489-510

Solomon, W., Holland, C., & Middleton, M. J. (2012). *Autism and understanding: the waldon approach to child development.* Los Angeles-London-NewDelhi-Singapore-Washington: Sage

Stern, D. N. (2004). *The present moment in psychotherapy and everyday life.* New York: Norton.

Stern, D. N. (2010). *Forms of Vitality: Exploring Dynamic Experience in Psychology, the Arts, Psychotherapy and Development.* Oxford: Oxford University Press.

Sutera, S., Pandey, J., Esser, E. L., Rosenthal, M. A., Wilson, L. B., Barton, M., ... & Fein, D. (2007). Predictors of optimal outcome in toddlers diagnosed with autism spectrum disorders. *Journal of autism and developmental disorders*, *37*(1), 98-107.

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and brain sciences*, *28*(5), 675-691.

Trevarthen, C. (2001). Infant intersubjectivity: research, theory, and clinical applications. *Journal of Child Psychology and Psychiatry*, *42*, 3-48. doi:10.1111/1469-7610.00701

Trevarthen, C., & Delafield-Butt, J. T. (2013). Autism as a developmental disorder in intentional movement and affective control. *Frontiers in integrative neuroscience*, *7*, 49, 1-16. doi:10.3389/fnint.2013.00049

Tronick, E. Z., Bruschweiler-Stern, N., Harrison, A. M., Lyons-Ruth, K., Morgan, A. C., Nahum, J. P., ... & Stern, D. N. (1998). Dyadically expanded states of consciousness and the process of therapeutic change. *Infant Mental Health Journal: Official Publication of The World Association for Infant Mental Health*, *19*(3), 290-299.

Turner, L. M., & Stone, W. L. (2007). Variability in outcome for children with an ASD diagnosis at age 2. *Journal of Child Psychology and Psychiatry*, *48*(8), 793-802.

West, K. L. (2018). Infant motor development in autism spectrum disorder: A synthesis and meta-analysis. *Child development*.

Winnicott, D. W. (1989). *Psychoanalytic explorations*. London, UK: Karnac Books.

Woolfenden, S., Sarkozy, V., Ridley, G., & Williams, K. (2012). A systematic review of the diagnostic stability of autism spectrum disorder. *Research in Autism Spectrum Disorders*, *6*(1), 345-354.

Zwaigenbaum, L., Bauman, M. L., Choueiri, R., Kasari, C., Carter, A., Granpeesheh, D., & Pierce, K. (2015). Early intervention for children with autism spectrum disorder under 3 years of age: recommendations for practice and research. *Pediatrics*, 136 (Supplement 1), S60-S81.