

# From the Emotional Integration to the Cognitive Construction: The Developmental Approach of Turtle Project in Children with Autism Spectrum Disorder

Magda Di Renzo\*, Federico Bianchi di Castelbianco, Elena Vanadia, Massimiliano Petrillo, Lidia Racinaro and Monica Rea

Istituto di Ortofonia (IdO), Rome, Italy

## Abstract

**Background:** Children with autism spectrum disorder show a deficit in neurobiological processes. This deficit hinders the development of intentional behavior and appropriate problem-solving, leading the child to implement repetitive and stereotyped behaviors and to have difficulties in reciprocal interactions, empathy and in the development of a theory of mind. The objective of this research is to verify the effectiveness of a relationship-based approach on the positive evolution of autistic symptoms.

**Method:** A sample of 80 children with autism spectrum disorder was monitored during the first four years of therapy, through a clinical diagnostic assessment at the time of intake and then in two follow-up.

**Results:** The results showed that through the Autism Diagnostic Observation Schedule it is possible to assess the socio-relational key elements on which the therapy is based. There was evidence, in fact, of significant improvements after two and four years of therapy, both for children with severe autistic symptoms and for those in autistic spectrum.

**Conclusions:** Socio-relational aspects represent the primary element on which work in therapy with autistic children and can be considered as indicators of a positive evolution and prognosis that will produce improvements even in the cognitive area.

**Keywords:** Autism; Autism spectrum; ADOS; Therapeutic efficacy; Developmental approach

## Introduction

In DSM-5 (APA, 2013), autism is within the Neurodevelopmental disorders, a diagnostic category that includes conditions with onset in the early stages of development, characterized by developmental deficits with impairment in the personal, social and educational areas. The autism spectrum disorder is defined as a deficit in the socio-emotional reciprocity, with reduced sharing of interests, emotions or feelings and deficient use of communicative behaviors, verbal or otherwise that are poorly integrated between them. These deficits in the quality of social interaction include abnormal eye contact and body language to regulate and modulate the relationship with the other, deficits in understanding and use of gestures, in facial expression and in the presence and sharing of symbolic play. The severity of symptoms is based on both the impairment of social communication and patterns of restricted and repetitive behaviors. These behaviors are the result of a defensive, archaic process, the adhesive identification, which eliminates the distinction between the child and the external object and concerns the outward sensoriality, as linked to sensory pathways, rather than the understanding of the functions and states of mind [1]. Another archaic defensive mechanism, the dismantling, implies a splitting process by which the autistic child reduces the object to a multiplicity of monosensory, indistinguishable events. The object is disassembled in small simplified portions according to segments of the sensory experience, rather than split along lines of emotional experience. Such archaic processes prevent the functional and symbolic use of objects, and the attraction for the perceptual monosensory quality prevents thinking skills [1-7].

The feelings and emotions must flow in an organized and integrated way, so if the informations are not organized or arrive "disassembled" to the child, it will be difficult to give meaning to the emotional and

physical experience as well as being able to give an adaptive and intentional response for a communicative purpose or intention [8]. These characteristic aspects of autism suggest the difficulty of the diagnostic assessment, both for the sensory component, which prevents or greatly restricts the use of diagnostic tools, both for the heterogeneity in the socio-cognitive functioning that we can find in autism, basing on the symptomatic severity and intensity of stereotyped behaviors and sensory research. The Psychodynamic Diagnostic Manual points out the deficit in those emotional process that leads to empathy and refers to the affective diathesis, a theoretical concept also underlying the DIR-Floortime approach (Developmental Individual-Difference Relationship-based model), so that in autism spectrum disorders there would be a deficit in the neurobiological processes that allow the creation of appropriate connections between emotions, sensory processing, motor planning and the formation of symbols [9]. These deficiencies hinder the development of an intentional behavior and an appropriate problem-solving leading the child to implement repetitive and stereotyped behavior and to have difficulty in reciprocal interactions, empathy, and in the development of a theory of mind [10,11]. The Institute of Ortofonia, in line with this model, bases its diagnostic and therapeutic process on a developmental approach,

\*Corresponding author: Di Renzo M, Istituto di Ortofonia (IdO), Rome, Italy, Tel: 393355230562; E-mail: [m.direnzo@ortofonia.it](mailto:m.direnzo@ortofonia.it)

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centered on the relationship, which considers as integrated the cognitive and affective components [7,11-25].

We believe that during development the language, intelligence and socio-emotional skills are acquired through relationships and interactions that involve affective exchanges. In the last 40 years the clinical work of the Institute of Ortofonia gave rise to a specific program for autism called the Turtle Project, which provides a diagnostic and therapeutic plan based on the emotional, relational and cognitive potentialities of the child [24-28]. The project includes activities mediated by the body, as it is an important vehicle of emotions, and is centered on relational aspects, to strengthen those processes maybe lacking in the early stages of development [24,25,29-34]. Even the current theories of intersubjectivity and attachment and the researches about insightfulness show how the attunement of caregivers on child's emotional states can promote openness to relationship and communication [25,35-39].

In the context of current research on autism, the Autism Diagnostic Observation Schedule (ADOS) is recognized as a tool of choice in the evaluation and quantification of the severity of symptoms [40]. In this study we adopted the first edition of the ADOS because at the beginning of our research the ADOS-2 was not yet available. The ADOS is recommended in several Best Practice Guidelines (California Department of Developmental Services, 2002; National Research Council, 2001) as an appropriate standardized diagnostic observation tool [41-43].

Several studies have used the ADOS in correlations with other observation tools such as questionnaires and/or interviews for parents and other scales of direct observation of the behaviors attributed to an autism spectrum disorder [44-48]. These researches focused on the utility and validations of the diagnosis of autism according to the instruments used, but have not considered the ADOS to evaluate through the re-tests the longitudinal evolution of symptoms during the years of treatment. In this study, in addition to the assessment of the cognitive skills, it will be taken into consideration all the social and communicative target behaviors according to the areas of the ADOS assessment, in order to evaluate over time not only the changes of the global score but also the evolution of each individual communicative and relational behavior, the evolution of the severity of restricted and repetitive behaviors (mannerisms, unusual sensory interests and stereotyped behaviors and interests) and the ability to use objects (stereotyped/sensorial, functional and symbolic).

The therapeutic project here described and used is based on a clinical, developmental approach that treats as crucial the motivation in learning processes. Considering as inseparable the affective and cognitive components and also, in developmental terms, the priority of the emotional regulation, the therapy aims to activate the emotional relationship with the child to help him in the construction of cognitive schemas.

We have already seen that in autistic children the primary deficit is at an emotional level even before cognitive and that the block in the emotional development lies in a very early stage, in the psycho-physical area [16,17,24,25,29,32,33,49,50]. The results showed some socio-cognitive improvements and the effectiveness of a developmental approach based on the relationships and focused on affective and bodily processes, on defensive archaic process and on sensory integration, that is on the emotional blocks preceding cognitive processes which are functional to the expression of the intellectual potential of autistic children [18,22,23,49,50-53]. These results highlight the importance of

the emotional dimension in the structuring of the autistic symptoms, showing that the information processing in interactive contexts includes intentional and emotional aspects that organize and enhance the activity and cognitive skills, in response to previous perspectives that have shifted the focus mainly on the cognitive determinants [50,54-56].

The main objective of this research is to examine the therapeutic efficacy of the Turtle Project on the evolution of behavioral and relational symptoms of autistic children monitored for a period of four years. The specific objectives are: to determine the differences in the cognitive and symptomatic profile of children with autism and children with spectrum, and verify their evolution over time; investigate the relationship between the cognitive and behavioral aspects before and after treatment; define, within the diagnostic assessment in parallel with the ADOS, the key elements on which to set the therapy, in order to consider them as indicators of a future affective, cognitive symptomatic change both in children with autism and in those with spectrum.

## Materials and Method

### Participants

The sample was composed of 80 children (64 males and 16 females) between 24 and 131 months, with an autism spectrum disorder diagnosis. Most of children came from middleclass families. At intake (T1), 64 children (82.8% males; mean chronological age: 54.45 months; SD=24.9) have been diagnosed with autism (AUT), and 16 (68.8% males; mean chronological age: 60.56 months; SD=26.0) have been diagnosed with autism spectrum disorder (SpD) (Table 1). After two (T2) and four (T3) years of treatment all children were reassessed with the same diagnostic protocol performed at T1. Informed consent was obtained from all parents (Declaration of Helsinki) and the study complied with the national ethical guidelines and APA criteria.

### Procedure

Participants were recruited from the The Institute of Ortofonia. The Institute works in agreement with the National Health System and follows the procedures for taking charge of children and their families according to the treatment plan established by the Regional Health Agency.

	Autism (N=64)	Spectrum Disorder (N=16)
<b>Variable</b>		
Male %	82.8	68.8
Italian %	87.5	93.8
SES		
Low	4.7	/
Medium	75	87.5
High	20.3	12.5
Age in months, mean (SD)	54.45 (24.9)	60.56 (26.0)
IQ scores	56.31 (16.5)	77.69 (19.6)
ADOS score	17.67 (2.9)	9.44 (1.4)
A - Communication	6.25 (1.1)	3.88 (0.8)
B - Social Interaction	11.38 (2.3)	5.56 (1.2)
C - Play	1.77 (0.5)	0.63 (0.6)
D - Repetitive behaviours	4.88 (1.5)	1.94 (1.1)
D1 – Unusual sensory interest in play	1.61 (0.5)	0.56 (0.5)
D2 – Hand, finger, and other mannerisms	1.59 (0.7)	0.69 (0.7)
D4 – Unusually repetitive interests	1.67 (0.5)	0.69 (0.5)

**Table 1:** Descriptive Characteristics: 80 Children with Autism and Spectrum Disorder at Intake.

The children were enrolled in this research between 2009 and 2011. The clinical diagnosis was made by a team of highly qualified clinicians (5 to 10 years of experience in the field of autism) formed by psychologists/psychotherapist, neurologists, psychiatrist, speech therapists and occupational therapists. The diagnosis of autism was based on the DSM-IV criteria (APA, 1994), hence, in addition to clinical observations, the children were administered the Autism Diagnostic Observation Schedule [40]. The experts, who carried out the assessment of the child and administered the ADOS, are not the same as those involved in the child's therapy. This research meets the ethical guidelines and legal requirements of the country in which was conducted. After receiving the diagnosis, all children were included in the Turtle Project (TP), described below.

### Turtle project<sup>1</sup>

The Turtle Project includes a total of 10 hours a week of rehabilitation, of which 3 hours of outpatient activities, 4 hours of home care divided into two weekly sessions of 2 hours each one, 3 hours a week of aquatic and animal-assisted therapy. Besides the 10 hours described, there are individual and group counselling for parents, educational support in schools, specialist visits, diagnostic periodic observations, psychiatrist rehabilitation and neuropsychological assessments also inherent cognitive and social skills. Outpatient treatment includes individual and group sessions, speech therapy, music therapy, psychomotor skills, psychotherapy and a pedagogical work specifically directed to cognitive difficulties.

The common goal of the various approaches to treatment was to emphasize the emotional and relational dimension so to enrich the repertoire of communicative behaviors, allowing the expression of latent intellectual and social abilities. The project involves a strong

<sup>1</sup>The name of Turtle Project comes from wanting to communicate to parents that often the therapeutic process can be long and challenging.

partnership between all therapists, guaranteed by the presence of coordinators that promote an integrated communication between operators, school and family. The following are treatment options that can be modified basing on the age and symptomatic impairment of each child, according to deficit or potential areas found in the child's cognitive and social functioning (Table 2).

### Measures

#### Autism diagnostic observation schedule-ADOS

The Autism Diagnostic Observation Schedule – ADOS [40] is a semi-structured assessment of child's social interaction, communication, play and creativity, and repetitive or restricted behaviors or interests. Activities in each module vary from those appropriate for non-verbal children to those appropriate for verbally fluent children, adolescents, and adults. ADOS is one of the most widely used observation instruments for the assessment of autism and it is recommended in several Best Practice Guidelines as an appropriate standardized diagnostic observation tool (California Department of Developmental Services, 2002; National Research Council, 2001).

The ADOS classifications are based on specific coded behaviors that are included in a scoring algorithm using the DSM-IV diagnostic criteria, resulting in a Communication score, a Reciprocal Social Interaction score, and a Total score (a sum of the Communication and Reciprocal Social Interactions scores). The total score enables the classification of three diagnostic categories: Absence of autism (ADOS score between 0 and 6); Autistic spectrum (ADOS score between 7 and 11); and Autism (ADOS score between 12 and 24). The minimum Communication score for autism is four, and the minimum score for the spectrum is two; the minimum Reciprocal Social Interaction score for autism is seven, and the minimum for the spectrum is four. A child meets criteria for a classification of autism if the scores in the Social

Activities for children of all ages	Description of activities
Home therapy (twice a week: 2+2 hours)	Home therapy includes a range of therapeutic activities which vary according to the age of the child, in order to expand the communication and the ability of the child's relationship with the members of his family. The goal of this therapy is to help the family in reading child's behaviours, even the most enigmatic, and to share the understanding of his emotional states [2,5,7,16,17,26,27,39,56,57].
External activities (Aquatic and Pet therapy: 1½+1½ hours)	The aquatic environment and contact with animals, both provided once a week, are designed to improve child's attunement with the outside world [58-61].
Activities in our Clinical Center for children from 2.5 to 5 years old (3 total hours per week)	
Body mediated therapy (1½ hours): • psychomotor activities • mother-child therapy • psychological support	These treatments offer the possibility of an individual, dyadic or group work depending on the specific characteristics of each child, to provide a context in which the child can make his emotional experiences in a creative and shareable way [26-28]. The main work is on the integration of unisensory perceptions so that the various segments of sensory experiences can gradually evolve into a first emotional experience [8,29,32,33] with mirroring and recognizable meanings [1-4,6,8,39].
Music therapy (1½ hours)	This therapy uses the sound, rhythm and musicality to integrate, coordinate and unify isolated perceptions in one recognizable experience. The goal is to allow the child to bond with his perceptions [62] in order to coordinate experience of a complete, emotionally connoted object (for example, the differentiation between common sound and the recorded maternal voice).
Activities in our Clinical Center for children over 5 years of age (3 total hours per week)	
Speech therapy, in group or individual (1½ hours)	This therapy promotes the communicative, intentional and reciprocal language. Initially the therapy is focused on the development of the pre-requisites of communication, and then it works on the phonological-articulatory and pragmatic aspects of the communication [63,64].
Neurocognitive rehabilitation (1½ hours)	This therapy promotes cognitive processes such as attention, visual memory, abstraction and visual-perceptual skills so to harmonize and integrate in a more functional way the cognitive profile of the child.
Activities that do not require the presence of the child (in addition to the 10 hours per week)	
School support	This includes classroom observation and meetings with teachers, to identify social and academic objectives and to ensure a better understanding of the disorder, to promote the inclusion into the class [65,66]. In Italy, children with disabilities are placed in regular classes, where there is a special education teacher.
Meetings with parents	These include activities such as informative sessions about the disorder of the child, individual or group counselling and psychological therapy. The formative experiences in the group also include activities that promote non-verbal communication and body contact, such as psychodrama or role-playing games [67,68].

**Table 2:** Turtle Project: 10 hours a week of therapy, according to the age of the children.

and Communication domains and the total on the algorithm meet or exceed cut-off scores.

Communication Scale includes five items that contribute to the overall communication score: Frequency of vocalization to others, Stereotyped/idiosyncratic words, Use of other's body to communicate, Pointing, Gestures.

Social Reciprocal Interaction Scale includes seven items that contribute to the overall Socialization score: Eye contact, Facial expressions, Shared enjoyment, Showing, Initiation of joint attention, Response to joint attention, and Quality of social overtures.

Items regarding play and stereotyped behaviors are also coded but are not included in the diagnostic algorithm.

Play behaviors includes 3 items: Symbolic play, Functional play and stereotyped play.

Stereotyped behaviors include 3 items: Unusual sensory interests, Hand and finger mannerisms and Repetitive interests.

Play scores are coded using a 0 to 2 point: 0 indicates symbolic play; 1 indicates functional play and 2 indicates stereotyped play.

All behaviors are coded using a 0 to 3 point coding system: 0 indicating a normal behavior, 1 indicating a mild abnormal behavior, 2 indicating definitive abnormality, and 3 indicating severe abnormality that interferes with the child's functioning.

### Cognitive assessment

The Leiter International Performance Scale-Revised (Leiter-R) [69] is a non-verbal measure of the global intellectual function of children and adolescents aged between 2 and 20 years. Neither the examiner nor the child is required to speak, and the child doesn't need to read or write, either. General intelligence and discrete ability areas were measured with 20 subtests and numerous composites. Scores were provided for each subtest and skill area, plus a full IQ scale score indicating non-verbal global intellectual functioning. The full IQ score had a mean of 100 and a standard deviation of 15. The intellectual disability was indicated by a composite score that is two standard deviations or more below the mean, so a score of 70 was the borderline value.

### Statistical method

ANOVA was used to evaluate the differences between groups. Repeated measures ANOVA was used to analyze the changes in the abilities after two and four years from the beginning of treatment. Effect sizes were calculated using partial eta-squared ( $\eta^2_p$ ). A  $\eta^2_p$  of 0.02 was considered a small effect size, 0.13 a medium effect size and 0.23 a large effect size [70]. The significance level was set at  $p < 0.05$ . Chi-squared analyses were conducted to examine group differences in demographic

variables between the categorical variables. All statistical analyses were performed using SPSS Software Version 19.0.

## Results

### The descriptive of the sample at T1

At T1, both the AUT and SpD groups were comparable for chronological age ( $F(1,79)=0.75$ ;  $p=0.38$ ), for gender (Chi-square=1.58;  $p=0.21$ ), for nationality (Chi-square=2.93;  $p=0.57$ ) and for SES (Chi-square=1.42;  $p=0.49$ ); however, the AUT group showed significantly lower scores than the SpD group in cognitive functioning (IQ;  $F(1, 79)=19.87$ ;  $p < 0.01$ ;  $\eta^2_p=0.20$ ) and higher scores in all the subscales of ADOS (Wilks' lambda: 0.36;  $p < 0.001$ ,  $\eta^2_p=0.20$ ; Communication:  $F(1, 79)=65.67$ ;  $p < 0.01$ ;  $\eta^2_p=0.46$ ; Social Interaction:  $F(1, 79)=95.57$ ;  $p < 0.01$ ;  $\eta^2_p=0.55$ ; Play:  $F(1, 79)=67.53$ ;  $p < 0.01$ ;  $\eta^2_p=0.46$ ; Repetitive behaviors:  $F(1, 79)=51.30$ ;  $p < 0.01$ ;  $\eta^2_p=0.40$ ). There were no significant differences for chronological age on ADOS scores ( $F(1, 79)=1.48$ ;  $p=0.23$ ), nor on IQ scores ( $F(1, 79)=3.70$ ;  $p=0.07$ ).

### Differences between children with autism and autism spectrum after treatment

**Cognitive abilities:** After 2 years of treatment (T2), AUT children and SpD children showed a significant increase in IQ scores and this increase significantly continues even after 4 years (T3) (repeated effect:  $F(2, 78)=32.06$ ,  $p < 0.001$ ,  $\eta^2=0.29$ ; effect groups:  $F(2, 78)=17.80$ ;  $p < 0.001$ ,  $\eta^2_p=0.19$ ; repeated effect x groups:  $F(2, 78)=0.01$ ;  $p=0.98$ ) (Table 3).

**Diagnostic categories:** At T2 the number of AUT children significantly decreased: 19 children of 80 were no longer included in the autism category (Chi square=28.02;  $p < 0.001$ ). At T3 the number of AUT children continued to decrease (Chi square=58.74;  $p < 0.001$ ): 31 of 80 children (38.7%) didn't receive a diagnosis of autism. Of these 31 children, 13 (81.25%) came from the SpD group at the intake and 18 children (28.12%) came from the AUT group at the intake.

Moreover, at T3 17 children fell into the SpD category: of these children, 3 (18.7%) came from the SpD group at the intake and 14 (21.9%) came from the AUT group at the intake. Finally, 32 children fell into the AUT group, and all came from the AUT group at the intake.

With respect to the chronological age variable, there were no significant differences between groups (Wilks' Lambda=0.98,  $p=0.48$ ).

The analysis of variance for repeated measures showed a significant reduction in ADOS scores at T2 and T3 for children in AUT group and for those in SpD group (repeated Effect:  $F(2, 78)=65.15$ ;  $p < 0.001$ ,  $\eta^2=0.45$ ; effect groups:  $F(2, 78)=59.66$ ;  $p < 0.001$ ,  $\eta^2_p=0.43$ ; effect repeated x groups:  $F(2, 78)=0.68$ ;  $p=0.50$ ) (Table 3).

The data analysis revealed the same trend of score reduction of the symptomatology in all functional areas, measured by the ADOS subscales; although the difference between the AUT and SpD groups

	T1		T2		T3	
	AUT	SpD	AUT	SpD	AUT	SpD
<b>IQ scores</b>	56.31 (16.5)	77.69 (19.6)	67.25 (20.5)	89.31 (19.1)	72.59 (23.8)	94.12 (20.1)
<b>ADOS score</b>	17.67 (2.9)	9.44 (1.4)	13.20 (4.7)	6.00 (3.1)	10.9 (5.1)	3.90 (3.8)
<b>A - Communication</b>	6.25 (1.1)	3.88 (0.8)	4.84 (1.7)	2.31 (1.4)	3.92 (1.9)	1.44 (1.3)
<b>B - Social Interaction</b>	11.38 (2.3)	5.56 (1.2)	8.34 (3.2)	3.69 (2.1)	7.02 (3.5)	2.44 (2.5)
<b>C - Play</b>	1.77 (0.5)	0.63 (0.6)	0.92 (0.7)	0.19 (0.4)	0.66 (0.7)	0.13 (0.3)
<b>D - Repetitive Behaviors</b>	4.88 (1.5)	1.94 (1.1)	3.39 (1.9)	0.69 (1.1)	2.95 (2.0)	0.69 (1.5)

**Table 3:** Means (SD) for the IQ and ADOS-Module 1, at Intake and after two and four years of treatment.

remained constant over time, at T3 all children show significant improvements in communication scores, in social reciprocal interaction scores, in play scores, in repetitive and restricted behaviors scores.

**Communication Scale:** Analysis of multivariate variance (MANOVA) revealed a significant differences between groups in communicative behaviors, at T1 (Wilks' lambda: 0.43;  $p < 0.001$ ,  $\eta^2_p = 0.56$ ). As shown in Figure 1A, the AUT group had more deficits than the SpD group in frequency of the vocalizations directed to others ( $F(1, 78) = 32.00$ ;  $p < 0.001$ ,  $\eta^2_p = 0.29$ ), in the use of pointing ( $F(1, 78) = 57.98$ ;  $p < 0.001$ ,  $\eta^2_p = 0.43$ ) and in the use of communicative gesture ( $F(1, 78) = 21.30$ ;  $p < 0.001$ ,  $\eta^2_p = 0.21$ ). There was no difference between groups on stereotyped/idiosyncratic words ( $F(1, 78) = 12.00$ ;  $p = 0.73$ ), because the language is almost entirely absent in these children. There were no differences between group in the use of other's body ( $F(1, 78) = 1.36$ ;  $p = 0.25$ ). There were no significant effect for chronological age (Wilks' Lambda=0.98;  $p = 0.78$ ).

Treatment x group repeated measures analysis (Table 4) confirmed that frequency of vocalizations directed to others, frequency of pointing and of gestures were the communication items that differentiated between the groups over time. These pathological behaviors improve over time in both groups, although they remain present significantly higher frequency in the AUT group if compared to the SpD group. Stereotyped/idiosyncratic words increased in AUT group and disappeared in the SpD group. The use of other's body to communicate was similar between the two groups and decreased significantly over time in both groups.

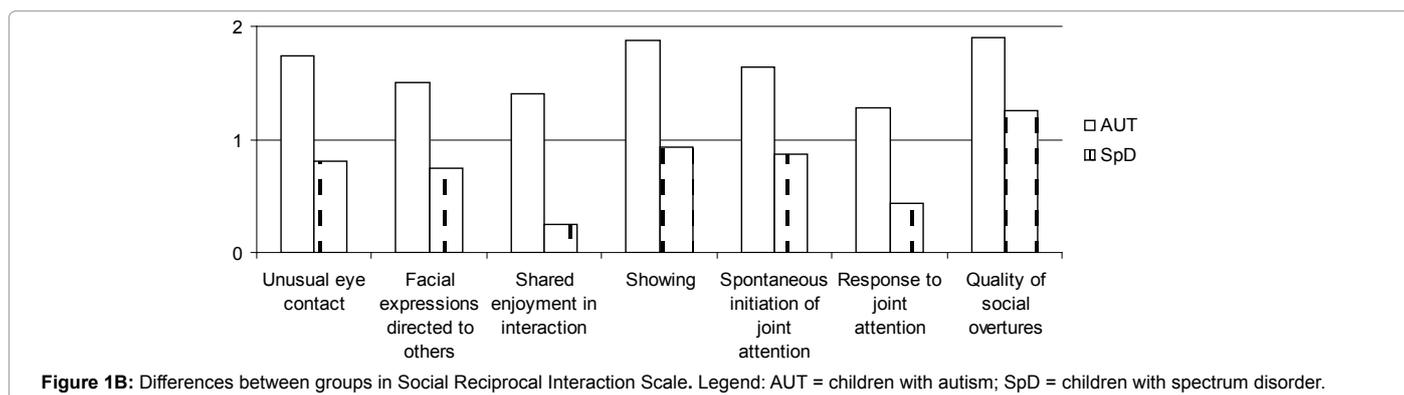
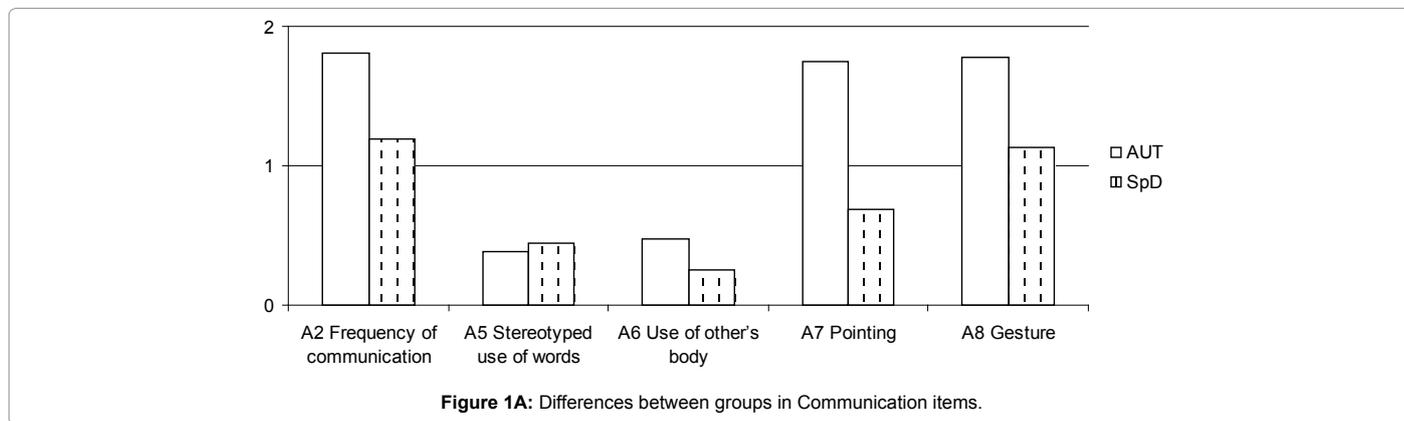
**Social Reciprocal Interaction Scale:** the MANOVA analysis revealed a significant difference between groups in social reciprocal interaction scale, at T1 (Wilks' lambda: 0.33;  $p < 0.0001$ ,  $\eta^2_p = 0.67$ ). As shown in

Figure 1B, the AUT group had significantly more higher scores than the SpD group in all Socialization items: Eye contact ( $F(1, 78) = 50.14$ ;  $p < 0.001$ ,  $\eta^2_p = 0.39$ ), Facial expressions ( $F(1, 78) = 29.56$ ;  $p < 0.001$ ,  $\eta^2_p = 0.27$ ), Shared enjoyment ( $F(1, 78) = 59.49$ ;  $p < 0.001$ ,  $\eta^2_p = 0.43$ ), Showing ( $F(1, 78) = 88.30$ ;  $p < 0.001$ ,  $\eta^2_p = 0.53$ ), Initiation of joint attention ( $F(1, 78) = 26.03$ ;  $p < 0.001$ ,  $\eta^2_p = 0.25$ ), Response to joint attention ( $F(1, 78) = 21.62$ ;  $p < 0.001$ ,  $\eta^2_p = 0.22$ ) and Quality of social overtures ( $F(1, 78) = 50.96$ ;  $p < 0.001$ ,  $\eta^2_p = 0.39$ ).

A series of group x time ANOVA repeated measures (Table 5) confirmed that all socialization items remained different between the groups over time; in particular, the dysfunctional eye contact, the initiation of joint attention, the response to joint attention and the quality of social overtures, significantly decreased over time in both groups, although the scores were higher in the AUT group than in the SpD group.

In addition, AUT children showed significant improvements over time in facial expressions and in showing (T1, T2 and T3); instead, SpD children improved these behaviors only between T1 and T2. Finally, while in the AUT group the improvement on shared enjoyment was evident (T1, T2 and T3), in the SpD group no improvement of shared enjoyment scores was observed over time, because they already started from a score close to 0 (indicating absence of pathological behavior). There were no significant effect for chronological age (Wilks' Lambda=0.98;  $p = 0.53$ ).

**Stereotyped behaviors:** a mixed factorial MANOVA was conducted to verify differences between groups on stereotyped behaviors and to analyze the changes over time. The results showed that the AUT children showed more stereotyped behaviors than the SpD children, at the intake (Wilks' lambda: 0.18;  $p < 0.001$ ,  $\eta^2_p = 0.81$ ) after two years of treatment (Wilks' lambda: 0.70;  $p < 0.001$ ,  $\eta^2_p = 0.29$ ) and after four years of



Communication items	Group	T1	T2	T3	effect, p ( $\eta^2$ )		
					group	time	group x time
A2 – Frequency of vocalization to others	AUT	1.81	1.52	1.19	0.001 (0.30)	0.001 (0.28)	0.93
	SpD	1.19	0.88	0.56			
A5 – Stereotyped/idiosyncratic words	AUT	0.38	0.41	0.55	0.21	0.49	0.01 (0.06)
	SpD	0.44	0.25	0.06			
A6 – Use of other's body to communicate	AUT	0.47	0.34	0.14	0.09	0.01 (0.06)	0.88
	SpD	0.25	0.13	0			
A7 – Pointing	AUT	1.75	1.13	0.73	0.001 (0.28)	0.001 (0.44)	0.07
	SpD	0.69	0.31	0.13			
A8 – Gestures	AUT	1.78	1.14	0.89	0.001 (0.23)	0.001 (0.37)	0.92
	SpD	1.13	0.44	0.25			

Table 4: Mean (SD) differences between groups on Communication Scale, at intake and over time.

Socialization items	Group	T1	T2	T3	effect, p ( $\eta^2_p$ )		
					Group	Time	Group x time
B1 – Eye contact	AUT	1.73 (0.45)	1.13 (0.63)	0.91 (0.66)	0.001 (0.33)	0.001 (0.31)	0.23
	SpD	0.81 (0.54)	0.50 (0.52)	0.19 (0.40)			
B3 – Facial expressions	AUT	1.50 (0.50)	1.20 (0.62)	0.91 (0.71)	0.001 (0.31)	0.001 (0.21)	0.81
	SpD	0.75 (0.45)	0.38 (0.50)	0.19 (0.40)			
B5 – Shared enjoyment	AUT	1.41 (0.55)	0.86 (0.69)	0.61 (0.66)	0.001 (0.34)	0.01 (0.16)	0.01 (0.07)
	SpD	0.25 (0.45)	0.13 (0.34)	0.06 (0.25)			
B9 – Showing	AUT	1.87 (0.33)	1.28 (0.86)	0.98 (0.92)	0.001 (0.31)	0.001 (0.32)	0.95
	SpD	0.94 (0.44)	0.38 (0.62)	0.06 (0.25)			
B10 – Initiation of joint attention	AUT	1.64 (0.54)	1.03 (0.69)	0.80 (0.74)	0.001 (0.23)	0.001 (0.24)	0.56
	SpD	0.87 (0.50)	0.44 (0.51)	0.25 (0.58)			
B11 – Response to joint attention	AUT	1.28 (0.65)	0.63 (0.68)	0.39 (0.60)	0.05 (0.06)	0.001 (0.22)	0.05 (0.04)
	SpD	0.44 (0.63)	0.06 (0.65)	0.06 (0.25)			
B12 – Quality of social overtures	AUT	1.91 (0.29)	1.72 (0.45)	1.58 (0.53)	0.001 (0.49)	0.001 (0.18)	0.31
	SpD	1.25 (0.44)	0.94 (0.44)	0.69 (0.60)			

Table 5: Means (SD) for the social reciprocal interaction scale, at intake and over time.

Stereotyped Behaviours	Group	T1	T2	T3	effect, p ( $\eta^2_p$ )		
					group	time	group x time
D1 – Unusual sensory interests	AUT	1.61 (0.58)	1.05 (0.78)	0.92 (0.78)	0.001 (0.30)	0.001 (0.18)	0.06
	SpD	0.56 (0.51)	0.06 (0.25)	0.31 (0.60)			
D2 – Hand and finger mannerisms	AUT	1.59 (0.68)	1.08 (0.78)	1.06 (0.85)	0.001 (0.26)	0.001 (0.16)	0.93
	SpD	0.69 (0.70)	0.25 (0.58)	0.19 (0.40)			
D4 – Repetitive interests	AUT	1.67 (0.53)	1.27 (0.67)	0.97 (0.69)	0.001 (0.35)	0.001 (0.21)	0.55
	SpD	0.69 (0.48)	0.38 (0.62)	0.19 (0.54)			

Table 6: Means (SD) for the stereotyped behaviours, at intake and over time.

treatment (Wilks' lambda: 0.76;  $p < 0.001$ ,  $\eta^2_p = 0.24$ ) (Table 6). There were no significant effect for chronological age (Wilks' Lambda=0.98,  $p = 0.46$ ).

**Play behaviors:** As shown in Figure 2A, a stereotyped play was present in the 78.1% of AUT children at T1, and in 6.3% of SpD children. After two years of treatment, there was a significant reduction of the number of AUT children with stereotyped play (Chi square=5.01;  $p < 0.05$ ). After four years of treatment, the frequency of stereotyped play in AUT children remained stable.

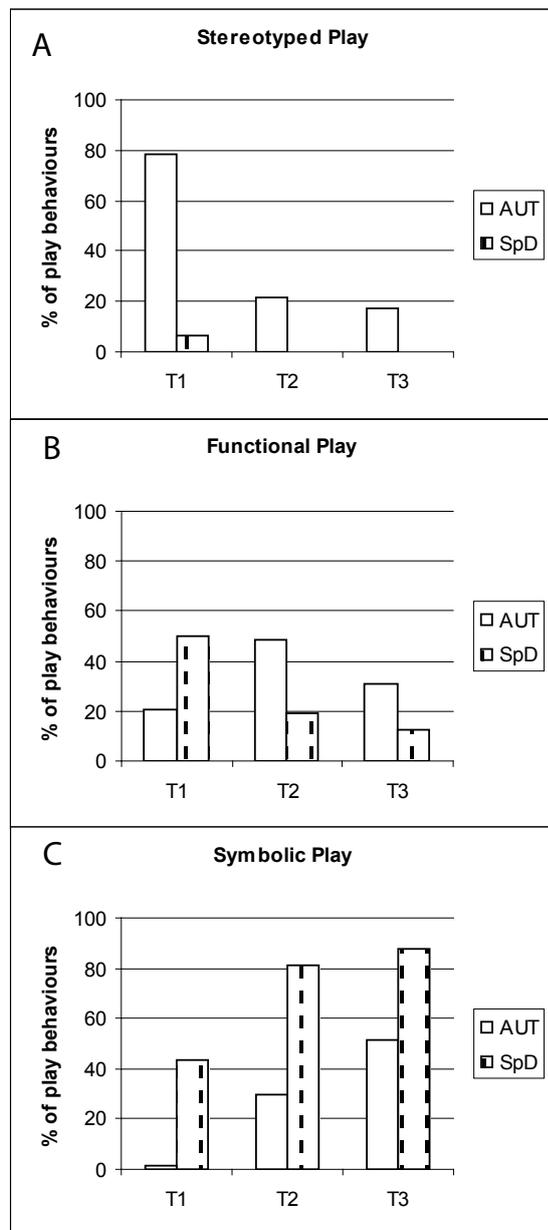
The frequency of functional play in AUT children increased significantly between T1 and T2 (Chi square=5.24;  $p < 0.05$ ), while in the SpD group decreased (Figure 2B) because in the meantime symbolic play was appeared (Figure 2C).

At T1 symbolic play was absent in almost all the AUT children (it

was present only in a child of 36 months, who after two years received a diagnosis of no AUT), at T2 it appeared in a number of children not still significantly relevant (Chi square=2.40;  $p = 0.12$ ), but increased significantly at T3 (Chi square=7.22;  $p < 0.01$ ). In SpD group, the frequency of children with symbolic play increased significantly from T1 to T2 (Chi square=4.70;  $p < 0.05$ ), and then it remained stable at T3 (Chi square=1.10;  $p = 0.29$ ).

## Discussion

The reduction in the number of autism diagnoses based on the ADOS scores, after two and four years of treatment, the significant reduction of symptoms in all the areas assessed (language and communication, reciprocal social interaction, play and restricted and repetitive behaviors) and the progressive improvements in IQ in the entire sample of the study, demonstrate the effectiveness of



**Figure 2:** Percentage of Play Behaviours in AUT and SpD groups, over time. Legend: T1= At Intake; T2= After 2 years of treatment; T3= After 4 years of treatment; AUT = children with autism; SpD = children with spectrum disorder.

a developmental approach based on the relationship, centered on affective aspects, on defensive archaic processes and on sensory integration [16-23,49].

The initial assessment of children in the sample showed the significant differences between the ADOS diagnosis of autism and autism spectrum, based on the score obtained, regardless of the age of the children. Moreover, lower scores in all areas of ADOS are indicative of less structured autistic defences in children diagnosed SpD, allowing a better quality of social and relational skills, as well as the expression of the intellectual potential. The positive evolution of autistic symptoms and the increasing percentage of children who fell into the category of ADOS no-autism are detectable in children diagnosed SpD

already after two years of therapy, highlighting the importance of the distinction between the two categories of ADOS classification. The children diagnosed SpD showed socio-relational and cognitive patterns characterized by difficulties in regulation, flexibility and integration of hypo-expressed skills, while children diagnosed AUT showed the total absence of the same abilities.

At the initial assessment, the AUT group does not differ from the SpD group only in the use of idiosyncratic/stereotyped words and use of the other's body. The use of the body of the other is the expression of a defensive adhesiveness, in which the differentiation and the limits of the ego lose the boundaries in a contiguity where the body of the other is used only for instrumental purposes and not for emotional sharing [1,4,5,8,29,32,33,71]. This specific and precocious use of the body as a form of communication and demand represents the closure to other distal communication strategies, such as the pointing, the use of gestures and vocal productions directed to another, but a therapeutic work on body mediation and sensory integration can lead to open to verbal and nonverbal forms of communication. Compared to the presence of echolalia and idiosyncratic/stereotyped words, the low score observed in both groups cannot be interpreted as proper use of words, since it is an item that can be evaluated only if verbalizations are present, while the entire sample of this research, at the time of intake, was characterized by a general absence of language. The latest version of the ADOS, the ADOS-2 includes this target item in the area of restricted and repetitive behaviors, emphasizing the stereotyped and sensory aspect of this way of using vocalizations and verbalizations, not considering it as a reliable element of evaluation in the language and communication area [72].

The area of reciprocal social interaction is different between the two groups in all target behaviors of the ADOS evaluation in the whole therapy period and in a more significant way than the Language and Communication area. Especially the shared enjoyment during the interaction, intended as the ability to show pleasure during activities with the other, distinguishes the AUT group from the SpD group that already shows this capacity at the time of taking charge.

The restricted and repetitive behaviors progressively and significantly improve, remaining differentiated between the two groups, with a greater frequency and intensity in children with autism. In restricted and repetitive interests inherent actions or play routine may be present the awareness of the relationship with the other, although with the rigidity that characterizes the mode of being in a relationship that is typical of autistic children, as well as mannerisms of the hands and of the whole body does not necessarily preclude relational aspects and may be related to self-regulation and to the discharge of body tension. Unusual interests directed to segments of sensory experience of self and of objects, prevent the connection between sensory processing and emotions, hindering the awareness of a psychological and emotional relationship with the other.

Among the indicators of a positive evolution of autistic symptoms, we identified improvements in the score of unusual sensory interests and the presence of symbolic play, found in all children at the end of four years of therapy who no longer fell within the ADOS criteria for an autism spectrum diagnosis.

The improving of these areas indicates that the therapeutic work that uses body mediation promotes the integration of monosensory perceptions so that the various segments of sensory experiences can gradually evolve into a first emotional experience [29,32,33,73] that activates a process of connection between emotions, sensory processing,

motor planning and the formation of symbols. Another element indicative of positive diagnostic evolution, considered in this research, is the improvement in IQ scores over the four years of therapy, because information processing in interactive contexts integrates emotional and intentional aspects which organize and enhance the activities and cognitive function. The assessment of cognitive skills is, at the Institute Ortofonologia, a fundamental element of the diagnostic process. And the monitoring of the intellectual potential takes place in parallel with the evaluation of those deficit areas that are typical of autistic disorder [66].

We emphasize the fact that the project does not provide a specifically cognitive work before the 5 years of age, age at which are less evident both the defences and processes which hinder the thinking development in autism [1,4,5,71]. No structured cognitive work has been proposed before 5 years, when the processes of imitation lay the foundation for communication and relationship. In these phases of development, therapy should focus on the psycho-physical area [16,24,25,29,32,50], on the emotional blocks that are antecedents to cognitive processes [49,51-53].

This study highlights the long-term effects of a therapy based on a developmental approach on the symptomatic outcomes of children with an autism diagnosis (across autism severity range). The results reported in this study encourage clinicians to identify, from the moment of diagnosis, social-relational aspects as key points on which centre the therapy. To do this, it can be very useful also from a qualitative and clinical point of view to use those diagnostic tools that are recognized as more reliable (in our case the ADOS); in fact, the data show that the work focused on social-relational aspects results fundamental to achieve improvements in the cognitive sphere. Working on these aspects allows the child to mature his self-regulation and interaction abilities; during the four years of therapy in most of the children in the sample progressively better results were achieved. The social and relational areas, assessed with the ADOS, were the key areas on which the therapy was based; the presence or absence of improvements in the emotional and relational aspects so become predictors of a positive evolution in autistic symptoms, and at the same time stimulate the development of cognitive abilities.

## Limitations

When children arrive at the assessment center and receive a diagnosis of autism, they are soon included in the treatment plan. This has not allowed us to combine the studied sample with a control sample of children who were not included in any course of treatment. Moreover, since the data were collected over a period of time during which the ADOS-2 had not yet been published all assessments were carried out with the ADOS first edition.

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