

# The Psychomotor Profile in Children with Autistic Spectrum Disorders: Clinical Assessments and Implications for Therapy

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## Abstract

Autism spectrum disorders (ASDs) are a class of neurodevelopmental disorders defined by qualitative impairments in social functioning and communication, often accompanied by repetitive and stereotyped patterns of behaviour's and interests, with their typical onset during the first three years of life. Recent researches demonstrate that early diagnosis and intervention sensibly improve outcomes. Until now, a limit of the most common therapies has been to get poor results in approaching the relational and emotional difficulties that, finding their origin in the early interactions that the child has with the outside world, must take account of the body as first experiential and communicative channel for the new-born. Although the current assessment protocols provide for development scales and observation of motor skills, do not yet exist studies aimed at identifying characteristic psychomotor profiles and too little attention is paid to bodily dimension in therapeutic terms. The purpose of present paper is to examine the psychomotor profiles of 61 children diagnosed with ASD, analyse their specifics and correlations with symptoms and cognitive development. Results show that children with more severe impairment have greater troubles in modulating their body, in attention, in spatial organization, in symbolic play, in motor behaviour's, starting from imitation, and in communication, even from the most archaic mode, namely the tonic dialogue. Findings, supported by what has already been published on the effectiveness of early developmental-relationship-bodily based approach with ASD children, support the idea that psychomotor area should represent an essential element in childhood rehabilitative therapies, especially in autism, where it is necessary to start from body and experience intended as a solid foundation on which build cognitive and social skills

**Keywords:** Autism spectrum disorder; Body relationship; Psychomotor profiles; ADOS; Leiter-R

## Introduction

Although the psychomotor dimension plays an important role in producing those stereotyped patterns of behavior and atypical movements, such as toe-walking, described in the DSM-5 criteria [1] of ASDs, it has not been widely explored and few studies have focused on the semiology of motor disorders among autistic children. The literature has brought heterogeneous elements in this context, without a real consensus about the efficacy of psychomotor therapy, whereas the attention to the body has often been clouded in favour of an evaluation mostly centred on behavioural and cognitive aspects of ASD. Considering the early onset of the disorder and the centrality of bodily dimension in the emotional and cognitive development of the child, we believe that it is very important to define possible characteristics of the psychomotor profile in autistic children in order to better address the therapeutic intervention which, if mediated by the body, especially in infancy and childhood, has shown excellent results [2]. The increasingly early identification of those behaviours considered at risk for the structuring of an autistic disorder requires a special attention to the body and to the way in which the child tries to adapt to the environment, even with the limitations imposed by his disease. The construction of the body schema is in fact deeply hindered by sensory alterations and lack of attunement with the caregiver, sometimes determined by child's poor proactivity and responsivity, thus causing further interferences in affective and cognitive components of the development. The body rigidity could be, in this sense, the first manifestation of the subsequent thinking and relational processes so thereby constituting an early predictor of the difficulties and potentialities present.

Beyond the predictivity however, we believe essential to understand what kind of organization the child has, using or refusing the body of the other, inhibiting or emphasizing his motor initiative to not confront with the environment, stiffening the bodily schemes to avoid contact

with objects or freezing the adjustment function to prevent a fluid exchange of information with the world.

The psychomotor profile used in the present research on a sample of 61 children is taken from a scale developed by Barthelemy [3] and takes into account different areas, which generally relate to the body with respect to a more or less functional use of objects and with reference to the body of the other. To the areas indicated by Barthelemy [3] we added an item about the adjustment function that seemed to be particularly indicative of the difficulties that the autistic child encounters in his relationship with the world. The function of adjustment, in fact, indicates the ability to adapt movements and body to environmental stimuli and implies that accommodation process that Piaget indicated as the basis for cognitive processing: a child's knowledge as composed of schemas, basic units of knowledge used to organize past experiences and serve as a basis for understanding new ones. Accommodation is what happens when the schema itself changes to accommodate new knowledge [4,5].

The hypothesis that prompted us to include the adjustment function is that it could be an interesting diagnostic index to define the severity of the disorder (assuming that the adjustment function

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cannot be present in children with severe symptomatic manifestations) and an indicator for individualizing the therapeutic project. In this perspective, the rigidity that characterizes the operation of the autistic child might be identified already in the early stages of development through a careful observation of his body. We also took into account the area of separation, understood both as a separation from the caregiver that from the objects in order to observe the attachment style of the child and see if there were differences with respect to symptoms. Of course, the added parameters were scored with the same criteria used for other items so to be correlated with the results of other evaluations.

The observations took place always in the same room and with the same stimuli, with the presence of 4 children, and 2 therapists who compiled the observation form. This was to ensure the fixity of the setting and avoid as much as possible external variations which could influence the observation. The setting was necessarily in group to assess the parameters in relation with the other's body which was not only represented by the therapist but also by children of the same age.

## Methods

### Participants

This study was made on 61 children with autism spectrum disorder (ASD) diagnosis, aged between 3 years and 14.8 years (mean age=7.2, SD=3.03). All children were diagnosed according to the diagnostic criteria of the DSM IV [6] and the ADOS scores [7] and were involved in a therapeutic path from an average of 2 years (range 1-4 years) (Table 1).

The 37.7% of the sample was constituted by pre-schoolers (from 3 to 5.9 years old); the 45.9% was composed of primary school children (from 6.0 to 11 years old) and the 16.4% included children of the secondary school level (from 11.1 to 14.8 years old). Table 1 describes the demographic characteristics of the sample.

In the sample there were 44 males and 17 females, in line with recent publications about autism that indicate a male/female ratio of about 3:1 [8].

At the time of the research, verbal language was poor or absent in these children, then their cognitive level was assessed through the non-verbal Leiter-R scale [9].

### Procedure

Patients and their families were recruited during the period from 2009 to 2010 at the Institute of Ortofonologia (IdO) in Rome. The IdO

works in agreement and accreditation with the National Health System for taking charge of ASD children and their families. The diagnosis of autism of the children involved in the research has been prepared by a group of experts (psychologists, child neuropsychiatrists, speech therapists, psychomotricists) and confirmed by an assessment with ADOS-2, according to DSM-IV criteria [6]. Psychologists and child neuropsychiatrists took care of clinical assessment and psychodiagnosis; two therapists of the assessment team filled the module. During the assessment process (from 1 to 4 weeks after the first interview), parents were informed about the characteristics of the disease in general and of their child in particular. When the child began the course of treatment that is immediately after the diagnostic phase parents were placed in a counselling program, which included, as needed, also group meetings with other parents or therapy sessions together with their child.

The present study excluded children with brain injuries, genetic or metabolic disorders, sensory disabilities and none of the children involved in this research took drugs.

This research meets American Psychological Associations ethical principles and guidelines. The aims and procedures of the study were explained to the parents of all the participating children and they freely expressed their written informed consent in accordance with the Declaration of Helsinki.

### Measures

**Autism diagnostic observation schedule (ADOS):** The Autism Diagnostic Observation Schedule [7] is a standardized semi-structured evaluation procedure of the communication and social interaction areas, including the behavioral and symbolic play assessment as well as the presence of repetitive behaviors and restricted interests, which involves a series of activities that are evocative of conducts related to the autism spectrum disorder diagnosis. The observation and coding of these behaviors are used to assign a score that identifies social and communication deficits of the child pertinent with autism and the autistic spectrum. The ADOS scores, included in a range that goes from 0 to 24, increase depending on the severity of autistic symptomatology, with a cut-off of 7 for the autistic spectrum and 11 for autism.

**Leiter international performance scale-revised (Leiter-R):** The Leiter International Performance Scale-Revised [9] is an individually administered instrument designed to assess the cognitive functioning of children and adolescents ages 2 years, 0 months to 20 years, 11 months of age. The Leiter-R was specifically developed for children and adolescents with communications disorders, cognitive delays, hearing impairments, traumatic brain injury, attention-deficit disorder and certain types of learning disabilities as well as other populations (e.g. autism spectrum disorders) for which traditional intelligence tests may not be appropriate or valid. In fact, it is a completely non-verbal scale and consists of two batteries: the first is the Visualization and Reasoning (VR) Battery which includes ten subtests, measuring nonverbal cognitive visuospatial and reasoning skills then generating Brief IQ (ages 2-20), Full Scale IQ (ages 2-20) and Fluid Reasoning Index (ages 2-20); the second, that is the Attention and Memory (AM) Battery, which also consists of ten subtests that enhance the interpretation of the global nonverbal IQ score by providing valuable diagnostic indicators of speed and non-verbal memory. The two batteries can be administered together or separately. Both batteries include unique "growth" scores, which measure small, important improvement in the cognitive skills even of a child with significant cognitive disabilities. The Leiter-R also includes four social-emotional rating scales (Examiner, Parent, Self and Teacher) that provide behavioral informations, so allowing a multi-

Variable	Autism (N=46)
Male%	72.1
Italians%	91.7
Africans%	1.7
East European%	4.9
Centro America%	1.7
SES	
Low	1.7
Middle	88.5
Alto	9.8
Chronological Age in years	
Mean (SD)	7.2 (3.03)
Range	3.0-14.8
ADOS %	
Module 1	90.2
Module 2	9.8

Table 1: Sample description.

dimensional observation of the examinee. The validity coefficient of the IQ score was calculated for each age group (alpha 0.92 to 0.93). The Leiter-R has good evidence of the validity of the studies on the analysis of content, with data from an extensive analysis and various studies relating to the construct [9]. The IQ scores have a mean of 100 and a standard deviation of 15. The intellectual disability is indicated by a composite score that is two standard deviations or more below the average, so that a score of 70 constitutes the limit value.

**Evaluation resumée du comportement psychomoteur (ERCP):** The Evaluation resumée du comportement psychomoteur [10] is a brief scale that allows objectifying psychomotor problems of autistic child through 17 items (according to a severity score from 1 to 5) grouped into 6 areas:

**Area 1:** Separation from caregivers and from objects: according to chronological age we observe the way in which the child separates from caregivers and objects to define the style of attachment and infer, as a result, the knowledge that the child has reached in terms of relational dimension.

**Area 2:** a) Unusual Postural Attitudes: we observe if the child assumes bizarre postures, for example:

- Facial expressions: grimaces, bizarre facial movements.
- Posture: feet in the air, head back; body twisted or crouched or violently extended; absence of postural anticipation.
- Gait: walking on tiptoes or heels or dragging one foot; turning round; walking sideways.

b) Use of the Body (own and others) we observe if the child uses his body and that of the other in a functional way, if he has differentiated them or if he uses the body of the others as an extension of his own.

c) Tonic Dialogue/Adjustment Function: we observe the child's ability to change his position and body posture to enter into a relationship with each other, reacting to the softness/relaxation/contraction of the body of another person.

**Area 3:** a) Body Orientation towards the environment: we observe how the child directs his body in the space, taking into account the limits set by the environment, and if his exploration is functional.

b) Eye Contact: we observe if the child avoids direct gaze of the others; turns his head away when called; if he stares into space or stares at objects peripherally rather than centrally; and if, when grabbing an object, he does not keep his eyes on it.

c) Shared Attention: we observe the child's ability to pay attention to objects and/or gestures that are proposed by the observer or from other children in the group.

**Area 4:** a) Motor Initiative: the child does not start any game (even if able to do) or interact individually; he looks like passive and slow.

b) Motor Agitation: the symptoms of restlessness occur in both periods of activity and of relax: the child does not control the motor excitement and/or constantly moves.

c) Motor Variability: we observe the ability of the child to modulate his movements on the basis of the situations-stimulus proposed by the observer or by other children of the group (higher or lower force).

d) Motor Aggression: directed towards his own body (hits his head with hands or an objects, heavily falls to the ground, bites, scratches, etc.). Aggression directed toward others (bites, scratches, etc.).

**Area 5:** a) Use of the objects: the child has a strange contact with objects (puts them in his mouth, hits or throws them etc.)

b) Spatial organization: we observe child's ability to perform puzzles or construction.

**Area 6:** a) Symbolic Play: we observe the ability to pretend with respect to persons and objects and therefore the ability to use the environment in a representative and not concrete way.

b) Imitation of meaningful gestures: we observe if the child is able to imitate gestures (even with deferred imitation) and if he shows postural reactions when in the setting are proposed meaningful gestures for him and others.

## Aim

The aims of the present study are: evaluate the profile and/or level of psychomotor development in children with ASD and verify what are the different characteristics in relation to the various degree of autistic symptomatology.

## Results

### Descriptive

At the time of the psychomotor assessment, children had an ADOS score between 3 and 22 (mean=13.5, SD=5.8). Within the sample, 10 children, who had been following the therapy for about two years, they got an ADOS score between 3 and 6, so that they no longer met the ADOS diagnostic criteria for autism (no-AUT=16.4%). Of these 10 children, 7 had reached the first assessment with an ADOS classification of mild ASD and 3 with severe ASD. Inside, 14 children had an ADOS score between 7 and 11 (Mild ASD=22.9%) and 37 children obtained an ADOS score ranging between 12 and 22 (Severe ASD=60.7%). Simultaneously with the psychomotor assessment, we also assessed the cognitive development through the Leiter-R: for 49.2% it was not possible to get an IQ score as the children were not able to pay enough attention to respond to the scale. The remaining 50.8% of children who responded to the test got a non-verbal IQ score between 50 and 117 (mean=77.4, SD=19.9).

### Relation between characteristics of the child and psychomotor behavior

The analysis of the correlation (Spearman's Rho), found that the chronological age is negatively and significantly correlated only with the difficulties of separation; therefore, increasing the age of children, the child's efforts in separating from parents decrease ( $r_s$ : -0.40;  $P < 0.001$ ) and also the reactive attitudes shown toward parents diminish ( $r_s$ : -0.29;  $P < 0.001$ ).

The analysis of the correlation also found that the severity of symptomatology (measured through the ADOS score) is positively and significantly correlated with all psychomotor areas, except for the Area 1 (Separation from caregivers and from objects) and for some behaviours of Area 4 (Psychomotor Agitation and the presence of Aggressive Behaviors); therefore, increasing the scores of symptomatic severity also increase the child's efforts in use of body, unusual postural attitudes, tonic dialogue, orientation towards the environment, motor initiative, spatial and attentive organization, play, motor behaviors and communication (Table 2).

Finally, the analysis showed that cognitive function (IQ score) is negatively and significantly correlated with all psychomotor areas, except for the Psychomotor agitation and the presence of Aggressive

Behaviors; therefore, decreasing the IQ scores, increase the child's efforts in managing his body, spatial and attentive organization, play, motor behaviors and communication (Table 2).

### Psychomotor assessment

**Area 1: Separation from caregivers and object:** Chi-square analysis indicates no difference in the frequency of separation's difficulty between parents and children, both in severe ASD, in mild ASD and in the no\_AUT group (Table 3). It is however important to note that most of the children in all three groups does not present difficulty of separation from parents, nor difficulty in separations from objects.

**Area 2: unusual postures, use of the body (own and other) and tonic dialogue/adjustment functions:** In psychomotor assessment, it is possible identify the presence of Unusual postures. Chi square analysis shows that the percentage of children with Unusual postures is significantly higher in the severe ASD group (89%) compared with mild ASD group (36%) and no\_AUT group (10%) (Chi square=27.68; P<0.001) (Table 4).

Furthermore, the Chi square analysis reveals that the percentage of children with Unusual postures is significantly higher in older children (11 to 14 years:100%) than in preschool age children (3 to 6 years:65%) and in school age children (6 to 11 years: 50%) (Chi square=8.01; P<0.01).

The "chronological age" variable is linked to the symptomatic severity of the child, in fact 9 out of 10 children (90%) of the range 11-14 years were not evaluable by Leiter-R scale, and this ratio is significantly higher (Chi square=8,7; P<0.05) than that found in younger children (48%) and in school age children (36%). To confirm this, it is also important to note that children of the range 11-14 years (ADOS=16.5)

have an ADOS mean score that is significantly higher than that obtained by other age groups (3-6 years: ADOS mean score=14.4; 6-11 years: ADOS mean score=11.6).

Chi square analysis showed that children with severe ASD have significantly more difficulties in the use of their body compared with the mild ASD and no-AUT groups (Chi square=22.9; P<0.001), and in the use of other's body (Chi square=21.4; P<0.01). In particular, we find that in the use of their body, children who have more difficulties are those with severe ASD (76%). Moreover, this percentage is significantly higher than that of mild ASD group (44%). While only 10% of the no-AUT group manifest difficulties in this area (Table 4). Children who have more difficulty in the use of other's body are those with severe ASD (59%), while we observe fewer in the mild ASD group (29%) and in the no-AUT group (10%) (Table 4).

In general, while it is natural to imagine that children with severe autism are those that present the greatest difficulties in the relationship with the body, the interesting fact emerges observing the no-AUT Group, as the difficulties in relating with the body, although not so many, are still present, especially in the relationship with the other (Graphs 1 and 2).

The group with mild ASD instead represents a group of "transition" with respect to the difficulties in dealing with the body. In fact, compared to children with severe ASD, the general percentage of children who have many difficulties decrease, but they are present in 44% of children especially in the use of their own body.

From the analysis, finally, we see that with respect to the tonic dialogue, the group with severe ASD (78%) has greater difficulties

	Area 1		Area 2				Area 3		
	Separation caregiver	Separation Object	Unusual Postural	Use Own Body	Use Other Body	Tonic Dialogue	Body Orientation	Eye Contact	Shared Attention
CA	-0.401**	-0.295*	0.020	-0.025	-0.012	-0.021	-0.049	-0.073	-0.008
ADOS scores	0.198	0.180	0.671**	0.483**	0.404**	0.385**	0.525**	0.605**	0.576**
IQ	-0.026	-0.114	-0.377*	-0.495**	-0.347	-0.434*	-0.526**	-0.515**	-0.549**

	Area 4			Area 5		Area 6		
	Motor Agitation	Motor Initiative	Motor Variability	Motor Aggression	Use of objects	Spatial organization	Symbolic Play	Gesture Imitation
CA	0.187	-0.102	0.137	0.173	-0.003	-0.005	0.088	0.092
ADOS scores	0.030	0.581**	0.454**	0.010	0.614**	0.497**	0.600**	0.561**
IQ	-0.086	-0.361*	-0.590**	-0.120	-0.485**	-0.495**	-0.475**	-0.436*

Table 2: Correlation (Rho di Spearman) between Chronological age, ADOS scores, QI scores and ERCP subscales scores \*P<0.01; \*\*P<0.001.

Legend: CA=Chronological Age; IQ: Intelligence Quotient

	Severe ASD	Mild ASD	No_AUT	Chi square	P
Separation Caregiver	8.1%	0%	0%	3.32	0.50
Separation Object	2.7%	0%	0%	1.97	0.74

Table 3: Behaviors of Area 1: Frequencies percentage.

	Severe ASD	Mild ASD	No_AUT	Chi square	P
Unusual Postural Attitudes	89.2%	35.7%	10.0%	27.7	0.001
Use of own Body	75.7%	42.9%	10.0%	21.3	0.001
Use of other Body	59.5%	28.6%	10.0%	15.8	0.001
Tonic Dialogue	78.4%	57.1%	20.0%	13.6	0.01

Table 4: Behaviors of Area 2: Frequencies percentage.



than the group with mild ASD (57%) and the no-AUT group (20%). In addition, in 50% of no-AUT children some difficulties are still present in this area (Table 4).

**Area 3: Body orientation vs. environment, eye contact and shared attention:** From analysis of the Chi-square emerges that group children with severe ASD (71%) have significantly greater difficulties than children with mild ASD (28%) and no-AUT (10%) in the orientation of the body (Chi square=21.3; P<0.01) (Table 5).

As for eye contact and shared attention, we found that in the no-AUT group there are no major difficulties in eye contact, although in about 40% of children some problems are still present. Nevertheless, problems of shared attention remain even when the autistic symptomatology is no longer detectable (i.e., in the no-AUT group).

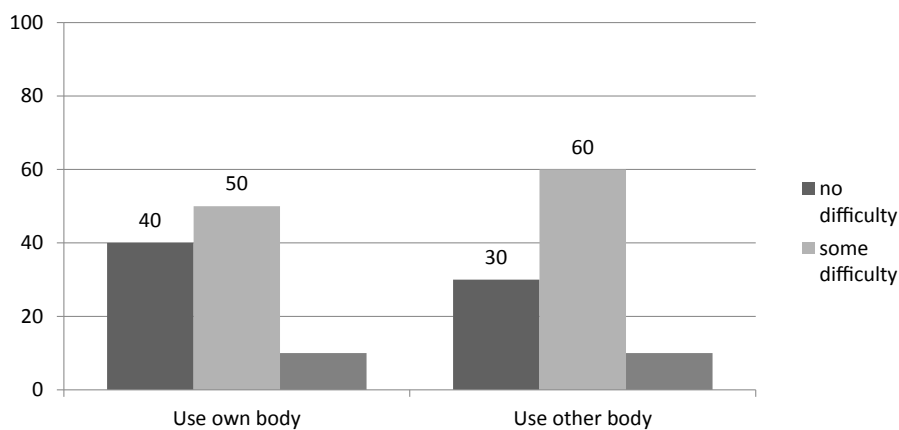
Similarly, 64% of children in the group with mild ASD present just

"some difficulty" in eye contact, while in the shared attention there are still "many difficulties" in more than half of children.

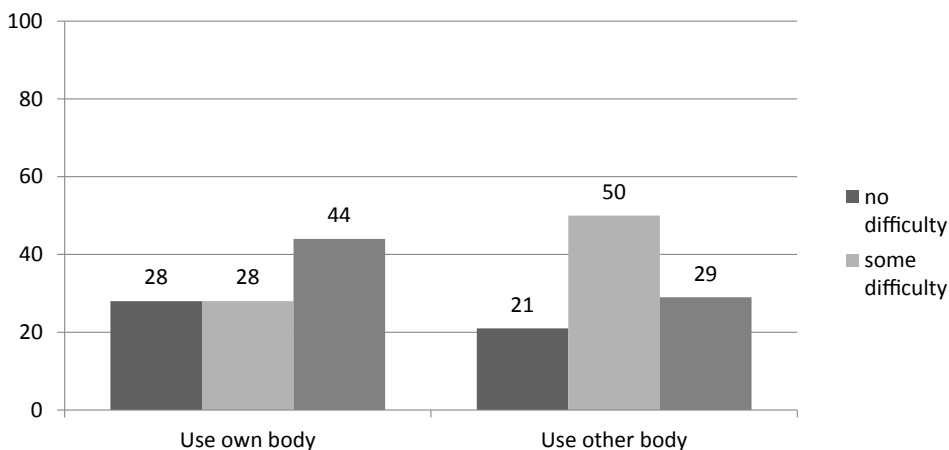
Finally, in the group with severe ASD, about half of children have significant difficulties in eye contact, and almost all of the children present "many difficulties" in shared attention.

**Area 4: Psychomotor agitation, psychomotor initiative, psychomotor aggressiveness, psychomotor variability:** Analysis shows that, with respect to psychomotor agitation, children of the three groups are NOT significantly different. Specifically, 54% of children with severe ASD, 43% of with mild ASD and 60% of no-AUT group do not present difficulties in this area.

As regards the psychomotor initiative, scores of children of the three groups are significantly different. Specifically, 81% of the children with severe ASD have many difficulties, against 35% of children with



Graph 1: Difficulties in use of body in no-AUT group.



Graph 2: Difficulties in use of body in mild ASD group.

	Severe ASD	Mild ASD	No_AUT	Chi square	P
<b>Body Orientation vs. Environment</b>	70.3%	28.6%	10.0%	18.6	0.001
<b>Eye Contact</b>	51.4%	0%	0%	24.2	0.001
<b>Shared Attention</b>	91.9%	57.1%	30.0%	19.2	0.001

Table 5: Behaviors of Area 3: Frequencies percentage.

mild ASD and 10% of the no-AUT children. In no-AUT group however, problems in this area are not yet completely disappeared, given that 60% of the children here still present difficulties.

Finally, as regards the psychomotor variability, children's scores of the three groups are significantly different. Specifically, 76% of children with severe ASD and 57% of children with mild ASD have many difficulties, while none of the no-AUT group presents problems in this area (Table 6).

**Area 5: Use of objects, spatial organization:** Analysis shows that with respect to the Use of Objects, the group with severe ASD (84%) has greater difficulties than the group with mild ASD (28%) and the no-AUT group (10%). In addition, in 60% of no-AUT children some difficulties in this area are still present.

The analysis shows that with respect to the Spatial Organization ability, the group with severe ASD has more difficulties than others. In addition, there is no difference between mild ASD and no-AUT, since in both groups about 40% of children have still many problems in this area (Table 7).

**Area 6: Use of symbolic play and imitation of significant gesture:** Analysis shows that with regard to Symbolic Play still persist many difficulties both in the severe ASD group (97%) than in the mild ASD group (71%), that is significantly greater problems than those met in the no-AUT group (30%). However, in 50% of no-AUT children, some difficulties in this area are still present (Table 8). The analysis shows that with respect to Imitation of Gestures children of the three groups are significantly different. Specifically, severe ASD children are the ones who experience more problems in using gestures; in any case these difficulties are also found in 20% of no-AUT children.

## Discussion

The results of this study confirm how much in ASD children the severity of symptoms and impairment of cognitive functions are related to their difficulties in using their body in relation to the other; therefore, increasing the scores of symptoms severity we find more problems in using body, in spatial and attentive organization in play, in communication and motor behaviors.

Inside the psychomotor profile, we find the presence of unusual posture mainly in ASD children and although they are particularly

found in those over 11 years old, this seems to be a common feature in the most part of assessed children.

Another aspect especially compromised is the one connected with the use of the body in the relationship. In fact, children with severe ASD have many more difficulties in the use of their body and that of the others as well as in the tonic dialogue that is in the ability to modulate the body posture in order to get in touch with the others. It is important to emphasize, however, that even children that after 2-4 years of therapy no longer meet diagnostic criteria for autism, they continue to show difficulties in the relation with the body.

Instead, the ability to maintain eye contact with the other, still heavily compromised in children with more severe symptoms, is almost always present in children of the no-AUT group. Nevertheless, the most evolved aspect of this ability or the ability and intention to share attention with the other, remain in deficit even when the autistic symptomatology is no longer detectable (in the no-AUT group).

The difficulties of regulation and control of body movement, evaluated through the detection of Psychomotor Agitation, are similar in children, regardless of the seriousness of the symptomatology. Again, when you go to analyze a more complex regulatory function, such as the Motor Initiative, we see that in nearly all children with severe ASD, this ability is almost absent, and even in children whose symptoms are not detectable, difficulties in this area are not yet completely disappeared.

We found many problems also in the use that children do of the objects of their environment and in the ability to spatially organize themselves in it, especially in children with severe symptoms, but also in those with mild symptoms.

Finally, when the body is used for symbolic functions, such as the representative game and the imitation of significant gestures of the other, we find many difficulties in the group of children with more severe symptoms, in that with mild ASD and also in that without symptoms.

## Conclusion

The present study allows to reflect on the specificity of the body dimension in the structuring of the autistic disorder, that in our opinion is very important, and opens to some new perspectives, until now neglected, in the therapeutic care and diagnostic evaluation of the child. It also creates the basis for a new area of discussion and research

	Severe ASD	Mild ASD	No_AUT	Chi square	P
Psychomotor Agitation	24.3%	35.7%	10.0%	2.2	0.60
Psychomotor Initiative	81.1%	35.6%	0%	23.9	0.001
Psychomotor Aggressiveness	91.9%	57.1%	30.0%	5.2	0.001
Psychomotor Variability	16.2%	24.4%	0.0%	22.8	0.36

Table 6: Behaviors of Area 4: Frequencies percentage

	Severe ASD	Mild ASD	No_AUT	Chi square	P
Object Use	78.4%	28.6%	10.0%	28.6	0.001
Spatial organization	73.0%	42.9%	40.0%	14.7	0.05

Table 7: Behaviors of Area 5: Frequencies percentage.

	Severe ASD	Mild ASD	No_AUT	Chi square	P
Symbolic play	91.9%	7.1%	0.0%	27.5	0.001
gestures imitation	78.4%	35.7%	20.0%	25.1	0.001

Table 8: Behaviors of Area 5: Frequencies percentage.

about the most appropriate tool for the psychomotor assessment of children with ASD.

The first consideration concerns the presence of some deficiencies in children who, after a course of therapeutic treatment body-centred [11-13], obtained an ADOS score of no-autism. The main difficulty regards the relationship with the other's body, as well as their own, indicating that lack in communication originates in an initial lack of modulation of the body to environmental stimuli and then it is as if mother's attunement would not find in the child a fertile ground. Gallese [14,15] showed how the lack in the process of imitation, which he described as embodied simulation (just to highlight the centrality of the body experience), could be the factor responsible for the lack of communication and empathy, characteristic of autistic children. Most of the authors who studied the theories of development [16-21] emphasized the importance of those imitative processes conveyed by the body in structuring of cognitive and emotional processes. Findings from this research point out the imitative difficulty of children even in cases of no-ASD, then corroborating the literature, especially considering the fact that during the observation not only gesture reproductions are monitored and evaluated but also children postural changes in reference to the gestures of the others. In a qualitative sense, during the evaluation and therapy processes, it is also necessary to take account of minor differences because a child that responds, at least posturally, at the gestures of another person, shows a level of development that is higher than that of a child who does not show any reaction. These qualitative considerations are important not only in planning the therapeutic intervention but also in the parents' perspective because opens to a new view of the child who starts to react, even if only through a postural change, to the stimuli they propose him. If we do not consider these signals, we risk ignoring the way in which the autistic child is approaching the world and therefore we cannot help him to modify his behaviors. This, in psychomotor field, is supported as well as by difficulties with the body also by the difficulties in the tonic dialogue and the adjustment function that express flexibility and adaptation to the environment. Given that gestures are pre-verbal forms of communication and that the understanding of the other's mental states (cognitive and emotional) passes through the sharing of glances and is mediated by posture, it becomes apparent the importance of reading the child's bodily dimension, both in order to better interpret his level of development and to stimulate the areas which are propedeutic to the construction of thought and language.

The term tonic dialogue [22-25] just indicates the deeply communicative gesture exchange between mother and child that afterwards Stern included in the concept of attunement [26]; an exchange that allows the amplification of the motor repertoire that favours the emotional expressiveness and leads to the pre-verbal communication. In fact, the caregiver, modulating the tone of his body in reference to that of the child, offers a possibility of mirroring, stimulates the difference between "me-other than me" that lacks in the autistic child, then allows the adaptation to the environment and provides the basis for a communication that could gradually be part of social repertoires.

Despite the improvements obtained, the children who reached a diagnosis of no-ASD showed advancement in the movement's variability but they continue to not be sufficiently flexible to "adjust" to stimuli from the outside world signalling, thus, a difficulty that seems to be specific of the disorder. It is important, however, to consider the fact that the improvement obtained has resulted in a greater relational opening and therefore more appropriate cognitive performance thanks

to the reduction of the body rigidity obtained with a rehabilitation intervention centred on the body. The psychomotor intervention, in fact, has as its primary aim to modulate the rigidity of the child through a bodily relationship, holding and motivating, in which the therapist's body acts as a model and stimulus for an opening towards the environment. The difficulties that children encountered in the motor initiative motor and which are also present in children who reached the diagnosis of no-ASD, in addition to let us understand the specific nature of the disorder, should make us think about the need for a specific intervention which early could address the difficulties in mirroring. A child who does not have a good proprioception and that fails to enter into relations with the body of the other has thus difficulty in motor activities because the lack of attunement with the other and with the environment determines a block in the process of adaptation.

Another factor to consider when evaluating and therapeutic intervention that becomes of primary importance during the therapeutic intervention is the ability of the autistic child to process, elaborate and integrate sensory stimuli. The perception is a complex phenomenon through which experiences assume meaning and fit into mental representations which constitute the "individual maps of the world", which are fundamental in order to finalize, plan and modulate any act, sequence or motor pattern. Even the interference management, both in sensory and neuropsychologic terms, is often a deficient function in autism and only an intervention that takes account of this aspect, first of all body experiences, which are the first but also the more persistent ones, can aspire the acquisition of new skills that will be generalized in the different contexts of child's life. At a cerebral and in particular prefrontal level, cognition, motivation and emotion are closely interconnected; particularly the dorsolateral prefrontal area would be particularly involved in the abstraction and action planning, the orbitofrontal area would be involved in emotion regulation and decision making, the anterior cingulate area (especially in the dorsal part) would be involved in the control of motivation and interfering stimuli. The limbic system elaborates emotions and vegetative manifestations that accompany them, and is involved in memory processes, so regulating cognitive function and motor behaviors.

If the sense-perceptual experience is atypical, annoying and sometimes painful, the memories that will be stored will also be associated with a negative emotional connotation, thus also further new but similar circumstances will be experienced with difficulty and agitation by the autistic child.

The mirror neurons [15,18,20,27], initially localized at a parietal level, but today also recognized in the precentral gyrus, in the inferior frontal gyrus of the pre-motor dorsal cortex, are a class of neurons that are selectively activated both when an action is made both when it is observed in another person (in particular from conspecifics) [28,29]. Extensive researches have been carried out about their evolution and their relationship with the language, precisely because in humans, mirror neurons are found near to Broca's area. The hypothesis that human language evolved through the information transmitted with gestural performances and finally the mirror system has been able to understand and encode/decode is considered scientifically valid and supports the discussion of the present study, in particular that understanding the intentions of others and learning through imitation rooted in emotional and physical development, so it is from there that in many cases should start the therapeutic intervention in order to activate the mechanisms extinguished or to start-up unreached skills [30].

In our opinion, therefore, these findings encourage further deepening in the psychomotor area to ensure greater complexity in

diagnosis and, above all, to promote therapeutic approaches that can effectively respond to the child's difficulties.

## Limitations

The limit of this research, given the lack of interest so far shown about psychomotor dimension in the diagnostic field, is that in literature there are currently no data that could confirm and/or disconfirm what here emerged but developmental theories are increasingly emphasizing these aspects.

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## Author Contributions

All authors conceived and designed the experiments; Magda Di Renzo, Federico Bianchi di Castelbianco, Elena Vanadia, Massimiliano Petrillo and Lidia Racinaro performed the experiments; Monica Rea analyzed the data.

## Conflict of Interest

No conflict of interest has been declared.

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