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Beyond Montessori: comparative and diachronic reflections on the theme of differences[1]

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Abstract. In the present paper, we aim to investigate the theoretical foundations and consequent actions that moved Maria Montessori to explore, as a pioneer, the theme of individual differences. More specifically, the objective is to analyse the interconnection between the theme of differences which, in Maria Montessori's work, features as context and pretext for informed pedagogical action steered towards inclusion in formal and non-formal educational contexts, revising the classic paradigms of intervention, in the light of the most recent interdisciplinary scientific discoveries.

Keywords. Maria Montessori - differences - deprived childhood - personalized learning - inclusive education.

1. A story of reason and senses

The choice that Maria Montessori made in dedicating herself to the construction and defence of "scientific pedagogy" has its roots in her interest in differences. In an era when thyroid organotherapy, a technique based on the conviction that the infinitesimal dilution of animal extracts – in this case the thyroid gland – could, according to the level of concentration, stimulate, restrain or rebalance diseased organs, the interest – albeit a specious one – in mentally deficient children was renewed in research centres such as the Psychiatric Clinic of University of Rome where the young Maria Montessori was a doctor's assistant. However, in contrast to other doctors, from the start Montessori believed that the «problem with the feeble-minded» was «pedagogical rather than medical»[2]. She stated this publicly at the Pedagogical Congress of Turin in 1898 during her talk on moral education which stirred many consciences both in medical and academic environments, leading the then Minister of Education Guido Baccelli to entrust her with the task of giving primary school teachers in Rome a series of talks on the education of mentally deficient children which later became the "Ortho-phrenic School". The principle, handed down through the centuries, stating that children with disabilities

[1] Gianni Nuti wrote the paragraphs 1,2,3,4, Manuela Filippa 5,6,7,8.
[2] M. Montessori, *La scoperta del bambino*, in Opere, Garzanti, Milano 2009, p. 45.

could not be educated was thus challenged and with the creation of an educational institution for all the children from the mental hospital in Rome, culture action and human advancement took place, extremely important, both socially and historically, even if still based on a segregation model[3]. During two years of intensive work on the front-line, the considerations which arose from practical experiences, on the one hand, superseded both the pietism stemming from dependency culture which denies happiness to the different, limiting itself to ensuring them minimal, inoffensive survival and, on the other, those training strategies which seek the homogenization, at any cost, of behaviours, ideas and ways of weaving relationships to fit the standards of the pre-packaged normality required by the dominant culture.

Montessori adopted two perspectives, considered to be at odds with each other by a certain Western philosophical culture, but in fact complementary. Firstly, Montessori applied rational models of action and research, made up of systematic observation, child behaviour analysis and experimental teaching sessions and methodology, monitored and evaluated according to measurable indicators of change also based on each single child's development process notwithstanding a collective context. Secondly, she embraced Itard's intuition regarding the value of sensorial experience as an opening onto the world for everyone – even if having different abilities – as a pluri-lingual vocabulary of human communication and a multifaceted means of self-knowledge and awareness of others. Even when, in her writings, the scholar spoke of «exercises capable of modifying personality by correcting defects», which nowadays sounds like the expression of an ambition to actualize psychological and existential conditioning, she was in fact referring to games designed to compensate between deficits and multisensory potentials enabling the recovery of what is now called social functioning and consequently overcome conditions of disadvantage, attaining a recognizable position in one's own social environment. Another aspect that Montessori emphasized about Itard's work was the recommendation to trainee teachers to be seductive. A very dangerous concept, if interpreted as an invitation to adopt coercive, controlling ploys and tricks even more immoral when aimed at the fragile. In actual fact, no exhibitionism, but care of aesthetics is recommended in educational communication: gestures and prosody must be prepared with the same dedication with which performers study their acting style, before going on stage. It is not theatricality, but a way of taking care of oneself and others, sharing aesthetical practices regarding the appropriateness and measure of one's pose, the intentional expressiveness used, the variety of styles and forms embodied by one's active corporeality. And all of this must be developed with greater intensity when «tired and fragile souls must be won over to life's remarkable feelings»[4].

2. From single diversity to multiple differences

But the greatest cultural result Montessori achieved was the recognition of difference as a privileged stance from which to uncover the learning processes of all children, not

[3] I. Guerini, *Dall'esclusione all'inclusione. Questioni e possibili itinerari di vita per le persone con impairment intellettivo*, «Italian Journal of Special Education for Inclusion», 8(1), 2020, pp. 36-52

[4] M. Montessori, *op. cit.* 2009, p. 51.

only of people with disabilities, with special educational needs, facing socio-economic difficulties or migrants etc but of the entire human species[5]. Moreover, she understood and affirmed, going against mainstream belief, that the methods tested effectively for the benefit of people with disabilities were useful for everyone, and designing artefacts, objects, accessible educational material – in the highest sense – facilitated the personalization of learning paths for each child attended to, although this also demanded adequate, specific training for teachers, called upon to understand what type of response and interaction can develop between a child and its environment and how new cognitive achievements might be encouraged and not imposed by adopting ever different paths.

The key to understanding the relationship between teacher and pupil is compared to one between an adult and an infant: the lack of interactivity and linear stimulus-response relations such as those which develop amongst adults is disarming and compels us to experiment with alternative strategies to the usual ones, to verify their effectiveness, to grasp particular aptitudes and specific sensibilities: «Only experimental science can lead the way to new, practical education». However, research can be facilitated if independent variables and interference, which Montessori identified in children's families and socio-economic contexts, are limited. Montessori also stressed that educational messages stemming from the children's home environment could not be in contrast with those coming from the Children's House as conditions of poverty, illiteracy and work precariousness were so significant that they could not obtrude on the life of such an innovative school. Nowadays this type of scenario is anachronistic: an overall increase in the level of awareness regarding rights and methods of promoting and defending them on the one hand and on the other the overlapping of different forms of poverty, decisive conditioning on the part of the media together with universal access to information according to the «monopolies of algorithms»[6] makes implementing innovative, experimental learning methods and strategies much more complex relying on «zero is nothing»[7] in terms of interference in education by vital forces from outside school. It is in fact unthinkable, for schools in the third millennium, to exclude systematic cooperation between members of the entire community, which includes not only parents and relations but also friends, informal resources present in the area and the environmental characteristics of the area itself. Only thus can differences according to a broader meaning of the term disability or various other forms of disadvantage and fragility be embodied.

Therefore, the experimental paradigm from which we begin must take into account the multi-dimensional liquid modernity surrounding us, which demands continuous changes to the educational action and relational dynamics promoted. This implies reconsidering the scientific mindset adhered to, because it is fundamental to pledge a preventive alliance with the family and periodically share dynamics, to be aware of the overall context in which children live, aiming at transforming "interference" into opportunities for growth and inclusion, accelerating pupil learning time and raising awareness in all the stakeholders who are part of a human experience that is enriching for everyone involved.

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[5] G. Nuti, *Pedagogia dell'Appartenenza*, EME L'Harmattan, Parigi 2019.
[6] S. Monaci, *Modelli di elaborazione della conoscenza on line: Google e Wikipedia*, in «Quaderni di sociologia», 43, 2007, pp. 151-167.
[7] M. Montessori, *op. cit.* 2009, p. 54.

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When Montessori registered idiot children for public exams, she was highlighting how by embarking on unprecedented and varied paths, it was possible to support the psychic development of children with difficulties, as in Vygotskian theory, as far as making them attain results similar to those of «normal children» which, on the other hand, she pointed out as being «suffocated and depressed»[8].

3. A horizon of freedom

In fact, there is no development without freedom and there is no freedom without full and conscious active participation. Freedom is truly the ultimate aim, the outermost horizon line towards which Maria Montessori's teaching tends. Freedom in life does not only refer to the child, whose independence is threatened when overprotected, subjected to excessive care and to arrangements predetermined by adults, but also to educators and mothers, likewise forced into stereotyped and repressive social roles. Freedom is conceived as a goal to be reached together, through mutual aid which not only implies an evolution in the relationship between educator and learner and between peers but a transformation in schooling as a whole, both physical and cultural, as well as in families and their environment.

The first step towards universal freedom is to question preconceptions that limit teaching behaviour a priori on the basis of simplified reality: abasing a schoolboy's body, «condemned to grow in such an artificial and incorrect way that the bones are deformed» because forced to endure, without moving, the transmission of knowledge by the teacher the "doer", blinds the educator to every learning opportunity that the actual body, with different abilities and characteristics, offers everyone. As does the belief according to which minds must adhere to a single and linear cognitive style, a single chain of steps for learning data and notions by moving gradually and progressively from the simple to the complex (two concepts developed by adults based on a common understanding that projects the adult mind onto the child's) is a narrow-mindedness that we tend to apply because of illusory convenience and hubris.

Looking for a deeper meaning, tending towards a "noble end", releases us from contingencies, from the short-sightedness of those who demand instant responses from instant efforts and, preferably, more substantial responses than the effort itself. It also sets us free from the mediocre reward / punishment dynamic, looking beyond epaulettes and medals, nurturing vocations and not vanity.

The idea which is championed concerns the emancipation from «life repressed by infinite obstacles that oppose its harmonious, organic and spiritual development»[9]. Discipline, if foisted according to training methods, can also become a system of obstacles added to those we are born with, which characterize us by different moulds and measures, unless it is "active", acquired through an increase in awareness by means of experience, during which paths are tried and reactions are tested: it is here that the educator monitors and analyses, patiently observing, without being afraid of chaos, selecting what can become functional to growth processes on the basis of his or her own personal level of development, experimenting with changes in context, modifying anthropic and objec-

[8] M. Montessori, op. cit. 2009, p. 52.
[9] Ivi, p. 26.

tual elements in the surrounding environment to understand if apparently antisocial, hyperactive, intemperate attitudes are linked to a specific milieu and are not endemic and unchangeable. This is all the truer for people with disabilities, with respect to whom the very principle of inclusion compels others to see differing behaviour as an opportunity for change for all the stakeholders who are part of a person with disabilities social environment. This principle must steer the educator to deal cards anew so forcing all the players to set new rules for the game in which all behaviours are reconsidered and the very idea of discipline rethought. In this way, dispositions towards the order of things, towards the beauty of inhabited and built forms, towards harmonious relationships will be able to coexist and interact with the wills and consciences of individuals, happy to contribute with their own styles, to the development and preservation of health – in the broadest sense given by the World Health Organization – in the community.

It is only by allowing children to adapt to the world by freely engaging in actions – stigmatized as mistakes by the surrounding community – and so measuring the real benefits over time and leaving room for self-correction once a solid understanding has been achieved, that foundations can be laid for learning in adult life, independently, distinguishing what favours civil, vital coexistence from what damages it. This implies particular control of time thanks to which one learns to predict the consequences of one's actions: not the immediate ones, personally satisfying even if connected to feelings of possession, prevarication, revenge or reprisal but remote, when it disbands relational exchanges, slows down the acquisition of cognitive needs from collective experiences and therefore of personal, deep and lasting well-being.

Nowadays social acceleration[10] makes it difficult for people to judge their own behaviour according to future outcomes, but the frustration of daily failures when faced with serious or very serious disabilities, for which achievements in terms of learning are extremely low – in both proportion and content – compared to the efforts made by the educator can be alleviated by tending towards an ideal and distant attainment, a utopia that can be reached in the far-off future, perhaps not by the individual but by humanity itself. This restores value to personal relationships, enacted through knowledge as the meeting ground between sensibility, emotional states, actions and inexpressible thoughts. Montessori stated that: «our joy is to touch and conquer souls, this is the one reward that can bring us true compensation»[11]. This position appears to be a modern synthesis between Pestalozzi's emphasis on the affective dimension of education and a scientific approach in which physiological and psychological phenomena become systematic objects of study and transformation. Let's think of references, dear to Montessori, found both in the bible and in Dante which state that it is by nurturing wisdom in loving that continuous, vital processes of personal and community change are fostered.

4. Peace among all humans

Montessori's approach to differences reaches its highest socio-political expression in her thoughts on peace. Harmonious cohabitation between humans is the outcome of

[10] H. Rosa, *Social acceleration: A new theory of modernity*. Columbia University Press, New York 2013.
[11] M. Montessori, op. cit. 2009, p. 35.

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nurturing values that can foster it in advance together with universal education aimed at leaving no-one behind starting from early childhood.

The condition needed to ensure people genuine peace compels us to not forget the weak and the misunderstood, «the most fragile part of humankind»[12].

> Our method (which has been given a personal name to distinguish it from the many other modern attempts at creating new forms of schooling) has given rise to the discovery of moral characteristics, never observed beforehand, in children. That is to say, the new figure of a «misunderstood child» has appeared before us.
> And this is what leads us to active social action to make children better understood, to be committed to defending them striving for the recognition of their rights. Because, the fact that multitudes of weak human creatures exist, living among the able without being understood and therefore without adult society ever consciously hearing their hidden voices calling out their life needs, represents an abyss of unsuspected evils[13].

A lack of understanding carries great weight, especially when diversity is concerned it represents the wall which stops the wish to be acknowledged before being accepted and included, from being realized: a community lives in peace in so far as a common conscience develops regarding the mutual ability to understood each other, to resonate. Forms of oppression can be more subtle than socio-economic deprivations as they concern the absence of equal opportunities, collective blindness to each person's imperceptible needs and rights[14], from birth. It is only this that can save society from what Montessori described as «unsuspected evils»: otherwise the evil of abandonment will prevail.

Pursuing this status also means promoting «constructive social reform»[15] which strives to contrast the «mechanization» of individuals. Several features of this interpretation are importantly modern whereby a prophetic tension in opposition to techne, the idea of productivity, efficiency and functionality regarding personal life and time which runs the risk of isolating and repressing people depriving them of the central position that should be had in every life. Never before has attention to the life of each one of us, citizens of the third millennium, been more prophetic regarding the sweeping change we are facing. Being forced to keep up with a hectic pace of life, in reduced spatiality[16] because of now prevailing "dimensional accelerators", embodied by new communication technologies, results in bewilderment, anxiety and apathy in a great part of world population and moreover this exacerbates differences between the able and the unable, demanding continuous adjustment processes which not everyone is equipped for. This condition must rather be taken as an opportunity to nurture humankind. If new technologies were geared to compensating and heightening personal performance, they would not distort but enhance what is human in man and so differences could find more ways of being expressed, more precise, efficacious channels of communication and consequently the possibility of being acknowledged by others would be greater for everyone. Furthermore, if working time were definitively cut down by a sensible system of automa-

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[12] Ivi, p. 1210.
[13] *Ibidem*.
[14] A. Bobbio, *I diritti sottili del bambino*. Armando Editore, Roma 2007.
[15] M. Montessori *Educazione e Pace*. Edizioni Opera Nazionale Montessori, Roma 2004, p. XII.
[16] H. Rosa, op. cit.

tion which would not cause world impoverishment, time for human relations, the fostering of beauty, scientific research, real contact between bodies and nature would become predominant and the differences between people would be perceived as kindly as a rich compendium in a garden in spring.

However, child education must be the starting point. Every child must be educated without making differences as it is, they who can restore social fabric but they are often victims of the ongoing conflict between adulthood and childhood whereby the victims are the weakest and the only alternative to succumbing is «anguishing adjustment»[17] which moulds psychic mindsets to fit social demands. Emancipation from discrimination begins from educating children early on for freedom, leading to a communal life of peace.

From this forward-thinking perspective, Montessori describes a world devoid of nations, a limitless melting pot of different peoples, where freedom is professed in an environment where roles are played out by means of full «embodiment of individuality», where the environment is the starting point for a personal quest in which to meet others and, from sharing in doing, progressively more intense and complex, individual identities are determined together with motives for a common good. This concept unhinges the doors of prisons made up of predetermined paths, compulsory roads to the homogenization of consciences where a modern concept of society is reflected as a dynamic combination of individual expression which acts and interacts through resonance around centripetal nuclei and, from here, stir the world.

5. Learning by doing: from Montessori to a neuroscientific perspective on the role of the individual sensory experience in the learning processes

In the history of pedagogy, according to the New School and pedagogical Activism, in particular, the idea that learning has its origin in the action, by doing, acquires a central role in the definition of school syllabuses and methods.

One of the most important teachings of Activism, which is centered around the child and personalized teaching, is that children learn much more effectively by doing. As Franco Cambi reminds us, «activism theorized the reintegration of thought and action»[18], giving rise to new experiences based primarily on actions.

Cambi also stresses that doing «must come before knowing, which evolves from the comprehensive/global to the distinct and thus matures on an 'operational' level first as Piaget highlighted; learning places environment at its centre and not codified, systematic knowledge»[19].

The concept that we acquire from these assumptions implies that children's learning is based on active, motivated action and thought which develop by means of an educational environment rather than through adult-oriented, codified, systematic, pre-packaged knowledge. It follows that «formalistic educational institutions» must be rejected as

[17] Ivi, p. 15.
[18] F. Cambi, *Manuale di storia della pedagogia*. Laterza, Roma-Bari 2014, p. 214.
[19] Ivi, p. 328.

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«alien to the spirit of experimental and interdisciplinary theory, only in an anthropological perspective»[20].

It is impossible not to note the similarities with Montessori's theory and discern distant reverberations of contemporary discoveries made by cognitive sciences and neurosciences. We are well-aware that it's a delicate transition which has too often been distorted; we acknowledge the accountability of creating links, highlighting correspondences and comments between education and neuroscience, almost a century later, certain that the fruitfulness of pedagogical considerations can find a new voice in neurosciences and both areas be renewed. Current research in neuroscience has in fact confirmed this pedagogical viewpoint and has also broadened it to include the early stages of development during both infancy and childhood.

The aim of this section is to illustrate Montessori's ideas on the importance of acting as the shaper of learning, to stress the significant links with recent discoveries in cognitive science and neuroscience and outline plausible tailored, personalized learning paths for children with disabilities.

6. Maria Montessori: motor action at the base of cognition

One of the fundamental lessons to be drawn from Maria Montessori's observations is that a child learns through his motor action. Montessori stated that «the likelihood of keeping a child's attention and interest does not depend so much on the 'quality' contained in things as it does on the action possibilities that these things offer»[21]. The innovative idea underlying this simple consideration regarding the characteristics that teaching materials should have, is that it is not the object itself (its quality) that leads the child to learning but the actions that the object encourages, or as stated in contemporary research, the action that it affords.

The concept of affordances is quite recent in cognitive sciences and it is mainly attributed to James J. Gibson[22], even if it is rooted in the earlier functionalist approach[23]. As for definition, «the affordances of an environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not»[24]. With this Gibson offers a new term to describe his theory and to underline, what is important for our topic, that «the different objects of the environment have different affordances for manipulation»[25].

Following this perspective, the objects in the child's environment «afford an astonishing variety of behaviours, especially to animals with hands. Objects can be manufactured and manipulated. Some are portable in that they afford lifting and carrying, while others are not. Some are graspable and others not»[26]. Progressing in our reasoning, mov-

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[20] *Ibidem*.
[21] M. Montessori, *La scoperta del bambino*, Garzanti, Milano 2013, p. 181.
[22] J. J. Gibson, *The ecological approach to visual perception: classic edition*. Psychology Press 2014.
[23] E. J., Gibson, & W. A. Collins, The concept of affordances in development: The renascence of functionalism. In The concept of development: The Minnesota Symposia on Child Psychology, Vol 15 1982, pp. 55-81.
[24] J. J. Gibson, *The ecological approach to visual perception: classic edition*. Psychology Press 2014, p. 119.
[25] Ivi, p. 120.
[26] Ivi, p. 125.

ing forward and backward from cognitive science and neuro- science to their precursors in Montessori's thinking, we can but find astonishing parallels between our initial quote of Montessori's assumption about the quality of objects and the potentiality that they offer for children's actions, and Gibson's quotation: «I now suggest that what we perceive when we look at objects are their affordances, not their qualities»[27]. They both use the term quality to define the physical properties of an object, thus distinguishing them from the actions that these materials afford in children.

Back to Montessori's words again: «to make something interesting, it is not enough that it be interesting in itself but it must lend itself to children's motor activities. There must be, for example, small objects that can be moved about: it is the movement of the hand rather than the object itself which keeps children involved in doing and undoing, in moving and rearranging things time and time again, making prolonged engagement possible»[28].

Hence, motor action is at the core of the learning process: it motivates children and keeps them involved for a prolonged period of time. If we read the above carefully, we see that Montessori stresses «small objects that can be moved», objects that because of their size, can be handled, moved, used. In short, objects which are child-friendly.

Citing Montessori's words, «when objects are made for children, in proportion to their height, and they can use them just as adults would, children's characters seem to change, they become calm and content»[29]. In like manner, the theory of affordances states that «objects afford an action if they are comparable by size»[30].

The Montessorian idea that objects must be child-friendly and that the handler (the child) and the handled (the object) must have comparable sizes is therefore substantiated in studies on affordances: an object must be comparable in size to the subject that handles and perceives it in order to be the agent of an action and consequently of learning. What better validation could there be of Montessori's erstwhile brilliant intuition which saw in an object's size one of the key elements of her prepared environment?

Moving forwards, we find further interesting correspondence in Maria Montessori's words and modern discoveries in cognitive science. The pedagogist stated «and a child's action carried out in response to this invitation gives him/her that lively satisfaction and awakening of energy, which predisposes the child to the most difficult tasks of intellectual development»[31].

Hence, things have voices that "call" children of various ages to action, motor action, motor activity, which follows on from and is in accord with the call, the affordances of objects, forming the basis for their cognitive development.

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[27] Ivi, p. 126.
[28] The original sentence used by Maria Montessori «a misura di bambino» is very effective in describing the need to find objects matching their measures with the children's size.
[29] M. Montessori, *La scoperta del bambino*, Garzanti, Milano 2013, p. 95.
[30] J. J. Gibson, *The ecological approach to visual perception: classic edition*, p. 124.
[31] M. Montessori, La scoperta del bambino, Garzanti, Milano 2013, p. 95.

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7. Action and cognition in children's learning: Maria Montessori's writings from the cognitive science and neuroscience perspective

A large number of studies have cited Montessori's perspective about the primacy of action in learning processes and considerable writings have stressed the significant links to recent discoveries in the field of neurosciences[32]. Herein, we will purely outline its essential features, adding various references to neuroscientific studies on cognitive and affective development in children. If animal models guided and inspired research regarding the role movement plays on the development of cognitive functions, the subsequent human studies were primarily and predominantly centred on adults.

In this section we endeavour to concentrate our perspective on young children, during early development. This could represent an innovative element in comparison to other studies. Therefore, we will focus on the ontogenesis of actions and on their original functions in the learning processes in young children. Consequently, our aim is to understand whether the evidences of the primacy of action in learning processes emerges from recent neuroscientific investigations, by means of motor activity. Does learning by doing, deemed so important by Activism in pedagogy and systematized by extremely detailed observations and practical solutions by Maria Montessori, rest today on scientific evidence?

The answer Fogassi gives us in his chapter on motor system cognitive functions and the importance of the hand is affirmative[33]. First and foremost, it's well known that when a child performs an action when he/she looks again at the same action performed by someone else, memory traces i.e. motor memories are activated. Thus, the action leaves traces in children's brain activity, even very early in infancy.

This simple statement has been confirmed in particular by a study conducted on 10-month-old infants who were taught a new sound-producing gesture which resulted in a sound the infants did not know before[34]. More specifically, infants learnt a new sound-producing gesture that was not as yet a part of their motor repertoire. During the second phase, the infants saw an adult perform a new sound-producing gesture. Bioelectrical brain activity was analysed by electroencephalography and the infants' motor neuron activity was measured while they listened to the two sounds associated to the two sound-producing gestures (the gesture they had performed and the one they had only observed). The study shows a significant reduction in mu rhythms related to the sounds from the sound-producing gestures that the infants performed but not to sounds produced by gestures they had only seen. These results demonstrate that children who have physically experienced an action will observe, or in this case listen to, differently compared to children who did not perform the same action. Furthermore, the motor area of their brains was activated as if they were performing the action themselves whilst they watched gestures, they had already performed themselves. Mu- rhythm suppression in fact indicates gesture inhibition, (the child actually only observes, without performing

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[32] R. Regni, L. Fogassi, *Maria Montessori e le neuroscienze,* Cervello, mente, educazione. Roma: Fefè Editore, 2019

[33] Ivi, p. 239.

[34] Gerson, S. A., Bekkering, H., & Hunnius, S, Short-term motor training, but not observational training, alters neurocognitive mechanisms of action processing in infancy. *Journal of Cognitive Neuroscience*, *27*(6), 2015, pp. 1207-1214.

any action), but in the brain the same motor area are activated, as for performing the gesture again. The authors deduce that motor action can constitute a favourable learning context in the early stages of development.

It is evident from this rigorous study conducted on very young infants that there is a strong bi-directional interconnection between doing and thinking, between action and perception.

This bi-directionality between doing and thinking was also highlighted by Maria Montessori's insight. In a passage taken from The Secret of Childhood we can read that «his psychical life, which must govern his movement, is always pre-existent to the movements associated with it. When the child wants to do something, he knows beforehand what it is; he wants to do something that he knows, that is, that he has seen done»[35].

Hither, Montessori introduced the concept of imitation of actions. A concept very important to cognitive and affective neurosciences, as having the utmost standing in learning processes. Imitating someone else's gestures to expand one's own motor repertoire and to strengthen the connection between action and perception is one of the fundamental mechanisms of motor cognition, that is of physical learning through action. A recent hypothesis put forward by social neuroscience is that motor cognition provides both adults and infants with the opportunity of understanding actions that match their own action repertoire, the gestures and actions that they can perform during specific phases of development.

Interestingly, neural substrates of motor cognition can be evidenced in brain areas, which are both involved in matching action perception and action execution (the mirror neuron system). As a direct consequence, the motor action of children during development, their motor expertise, is closely related to their action understanding[36]. This assumption, deriving from neuroscientific studies, supports basic theories of pedagogical activism, which posits that motor action is at the base of cognition and supports child's development. In fact, from the very first months of life, aspects regarding movement, perception and understanding are interconnected and dependent upon one another, constituting an inseparable, unique element[37].

Maria Montessori did not write of motor action as such in her writings, but rather of the hand as a concentrated symbol of movement and action, and it is this key word that we must look for in her works. Montessori believed that we think with our hands and that there exists an early connection of reciprocity between action and perception. «We could say that when humans think, they think and act with their hands. Traces were left of work carried out by hand shortly after the first appearance of humans on earth»[38]. The hand is first of all an organ that works towards the development of the conscious mind for Montessori. Movement of the hand (and arm) creates a memory trace, an impression. «But when the hand (and arm) are moved around an object, an impression of movement is added to touch»[39].

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[35] M. Montessori, *Il segreto dell'infanzia,* Garzanti, Milano 2017, p. 111.

[36] V. Gallese, M. Rochat, G. Cossu, & C. Sinigaglia, Motor cognition and its role in the phylogeny and ontogeny of action understanding. *Developmental psychology*, *45*(1), 103, 2009.

[37] G. Rizzolatti, V. Gallese, From action to meaning. *Les Neurosciences et la Philosophie de l'Action*, 1997, pp. 217-229.

[38] M. Montessori, *La mente del bambino*, Garzanti, Milano 2017, p. 149.

[39] M. Montessori, *La scoperta del bambino*, Garzanti, Milano 2013, p. 131.

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As we move on in our analysis of Montessori's writings, the author expounds how knowledge, which passes through action (the hand), is recontextualised during development. Children pass from sensitive periods focused on motor skills, when they are 3 or 4 years old, to periods during which functional hand movements develop. Once a child is 6, «it is necessary to backtrack to encounter the infants not yet coordinated hand – pliable in its function – this is a four-year-old child's small, searching hand that touches everything within its reach in an irresistible, unconscious attempt to build coordination permanently»[40]. The hand explores, the hand manipulates in a manner which is only seemingly chaotic but, Montessori states, it is in fact governed by the need for order, classification and knowledge.

To the best of our knowledge, the study of the ontogenetic evolution of learning which originates in acting, exploring the environment with the hand and the body, still needs to be carefully examined in depth by cognitive science and neuroscience.

From a pedagogical perspective, key questions still remain open: we still need to understand how a child's movement during exploration actually develops during different ages and how the role of motor action develops during infancy as a support to the understanding of actions and objects.

8. Pedagogical implications for personalization in teaching practices

«The point from which to start to truly understand our work is not to consider a "method of education", but the opposite: the method is the consequence of having witnessed the development of psychological phenomena which had remained unnoticed and hence unknown for millennia»[41].

Our thoughts on how to plan personalized learning for people with disabilities start from here and not from the method, from here and not from materials.

If Maria Montessori's recommendations are to be followed, if teaching practices are to be personalized, "psychological phenomena" are to be observed first and foremost. In other words, we must observe demonstrations – not only of capabilities but also and above all of interests, inclinations and sensibilities. A child with disabilities, as do typically developing children, expresses inclinations and performs actions motivated and guided by precise sensibilities. These special propensities tell us something about the child, but they can only be expressed in an environment which allows, and considers fundamental, individual choices; choices regarding the type of materials, the most appropriate space in which to act with them, as well as the time this action requires. These choices tell us something about the child, who would otherwise run the risk of being unobserved and hence unknown. If the best possible conditions are not in place for a child to express his potential – capabilities, propensities, likes, motivations – we will not be able to observe him and he will remain unknown to us.

Which environment subsequently favours individualized motor cognition?

Firstly, after analysing affordances we can infer, as Maria Montessori foresaw in The Discovery of the Child, the need to prepare an environment by taking dimensions, sizes

[40] Ivi, p. 227.
[41] Ivi, p. 359.

into account. For children to act on objects and for objects to move children to action, they must be proportionate to the children's hands and placed at a child-friendly height. Objects that are too large in size do not encourage grasping and so will not be grasped. They will not be driving forces for learning or manipulation, likewise, objects placed too high will not encourage children to grasp them, and environments without places to hide will prevent children from finding calm. On the other hand, a bench for two will encourage children to sit facing each other and to share acting on the same object and the presence of two identical objects will stimulate imitation of sounds, gestures, and body movements[42].

Figure 1[43]

9. Conclusions

Maria Montessori explored, as a pioneer, the theme of individual differences, especially in learning processes. She suggested a new way to approach the most delicate part of the humanity, the child and, more specifically, the child with disabilities.

Several recent discoveries in the field of cognitive sciences and neurosciences have confirmed her seminal intuitions on the role of the individual sensory experience during

[42] For further details, see M. Filippa, M.G. Monaci, S. Young, D. Grandjean, G. Nuti, G., & J. Nadel, Shall we play the same? Pedagogical perspectives on infants' and children's imitation of musical gestures. *Frontiers in Psychology*, *11*, 2020.

[43] Figure from G. Nuti, and M. Filippa, In un nido di suoni. Firenze: ed. Polistampa, 2016. Two experimental objects, designed for children between 1 and 3 years old, and built to support the development of exploration and manipulation of sounds and the imitation of sound gestures. For a broader discussion of the topic, refer to two writings published in peer reviewed journals, Filippa, M., Cornara, S., Monaci, M. G., Grandjean, D., Nuti, G., & Nadel, J. (2020). Sound imitation during the preverbal phase: Theory and devices. *Enfance*, (1), 131-148 and the overmentioned M. Filippa, M.G. Monaci, S. Young, D. Grandjean, G. Nuti, G., & J. Nadel, Shall we play the same? Pedagogical perspectives on infants' and children's imitation of musical gestures. *Frontiers in Psychology*, 11, 20

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development, on the importance of the individual action for building knowledge, and on the need of a personalised well-tailored pedagogy based on the observations of each individual child.

She described, and dreamed of, a world where the environment is the starting point for a personal quest and where individual identities are determined together with motives for a common good.

The present paper aimed to suggest potential parallels between Montessori's perspective on individual differences during development and the most recent evidence-based research. However, much remains to be done**,** especially for investigating the role of individual sensitive periods during development, or of environmental enrichment techniques and materials in support of the learning processes, both for children with typical and atypical development.