



# Ambienti e contesti per progettare l'educazione motoria in età prescolare

## Environment and contexts to plan motor education in preschoolers

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### ABSTRACT

For experts and specialists working with children is important to have knowledge about developmental theories to better understand what happens with processes associated with motor behavior and child motor and general development. We can describe development, according to Darwin, Edelman and Gottlieb as: a) continuous process of change in functional capacity; b) related to age (but not dependent); c) involving sequential and irreversible changes, result of interactions within the individuals and between the individual and the environment. Newell (1986) emphasizes the influence of experience (task) in motor development and highlights the dynamical, constantly changing interaction between them. There are factors that can limit, discourage or encourages motor activity called by Newell, constraints. The relationship between the organism and the environment offers affordances, that can be useful to a person, related to his/her capacities. When a child exploring and playing experiences new motor skills and acquire them he discovers new affordances. In the article are reported some studies showing examples of affordances and a research realized in the playground "Primo Sport 0246" that highlight the affordances in a specific tool "Monkey Bars". It is fundamental for educators to consider all the aspects related to a movement, as the organization of spaces, of materials and their characteristics are determinant in promoting affordances and motor development.

Per esperti e specialisti delle attività motorie nell'infanzia è importante la conoscenza delle teorie di fondo per comprendere i processi, il comportamento motorio, lo sviluppo motorio e generale. Possiamo descrivere lo sviluppo facendo riferimento alle teorie di Darwin, Edelman e Gottlieb, come: a) continuo processo di cambiamento di capacità, b) in relazione all'età e non dipendente da essa, c) che promuove cambiamenti irreversibili, come risultato dell'interazione tra individuo e gli altri e tra individuo e ambiente. Newell (1986) enfatizza l'importanza dell'esperienza (compito) nello sviluppo motorio e mette in risalto la costante interazione esistente tra essi. Ci sono fattori che possono limitare o incoraggiare l'attività motoria, chiamati da Newell "vincoli". La relazione tra organismo e ambiente produce affordances, che possono essere utili alla persona in relazione alle proprie capacità. Quando un bambino esplorando e giocando sperimenta nuove competenze motorie e le acquisisce scopre nuove affordances. Nell'articolo sono riportati alcuni studi che mostrano esempi di affordances e una ricerca realizzata nel parco giochi "Primo Sport 0246" che mette in evidenza le affordances in uno specifico gioco "Monkey Bars – Brachiazioni". È fondamentale per gli educatori considerare tutti gli aspetti relativi al movimento, pochè l'organizzazione di spazi e materiali e le loro caratteristiche sono determinanti nella promozione delle affordances e nello sviluppo motorio.

### KEYWORDS

Affordances, sviluppo motorio, età prescolare, educazione motoria, parco giochi.  
Affordances, motor development, preschoolers, motor education, playground.

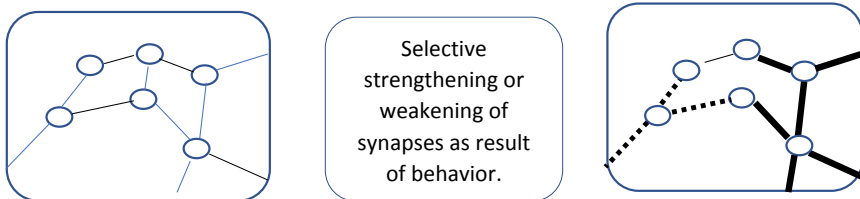
## Introduction – Theretical Perspective on Motor Development

For experts and specialists working with children is important to have knowledge about developmental theories to better understand what happens with processes associated with motor behavior and to better understand child motor and general development (Franchak & Adolph, 2014). Motor development is now attractive due to its association with cognitive, social and emotional domains of development.

What are the roles of genetic endowment, physical maturation and experience in child motor development?

Philosophers in Greek times and later Descartes (1596-1650) believed that certain ideas are innate while Locke (1632-1704) argued that a newborn's mind is a blank slate (tabula rasa). Today it is clear that nature and nurture are inextricably intertwined. From biological point of view the Darwinian evolutionary theory introduced the notion on time as inherent factor and the notion of phylogenetic change. Darwin intended the evolution as a mechanism of accidental selection of variations by environment. The principle of the selection are the variations. Later Mendel introduced the explanation of the growth of the organism considered as the result of instructions contained in the genes.

In 1987 Gerald Edelman in his book *Neural Darwinism – The Theory of Neuronal Group Selection* argued that human body is capable to create complex adaptive systems. His theory of neuronal group selection (Edelman, 1978) was based on three basic points: a) developmental selection: every person has a different synaptic structure due to the functional plasticity of the neuronal groups, self-organized in “modules”; b) Experiential selection: within the neuronal groups the experiences determine a process of synaptic selection. Dependently on the experience the neurons involved can be strengthen or weaken; c) Reentrant signaling: spontaneous groups of neurons are forming re-entrant connections.



**Fig 1. The basis of the Theory of Neuronal Group Selection**

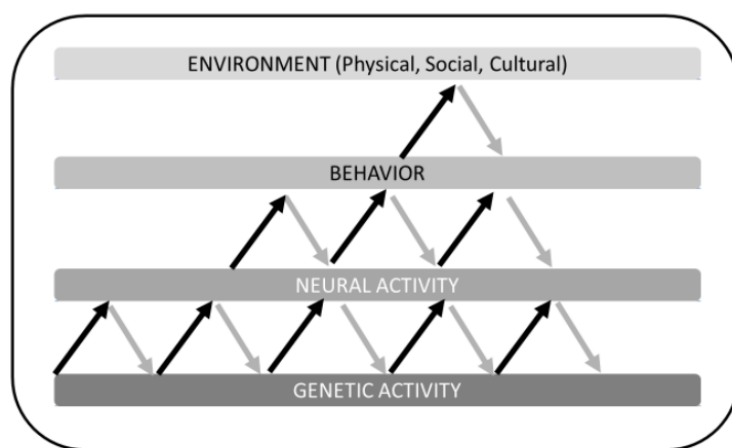
Adapted from Edelman, 1993, p. 116, figure n. 1

Sporns and Edelman (1993) argue that the process of skill learning is specific and this means that if somebody wants to develop a specific task he/she needs to train it in the way to strength the synapses involved in that task. Training facilitates the opportunity to make more probable to execute the same behavior next time.

When the organism interacts with the environment each pair of neurons utilized correlates well and these connections will be strengthened thanks to exercise and repetition. The inefficient connections will be very little correlated and their connections will become weakened and sometimes completely nonfunctional by time. (Adams, 1998). The groups of neural connections persist through selection without influences by genes or the environment. The experience is fundamental in neural connections.

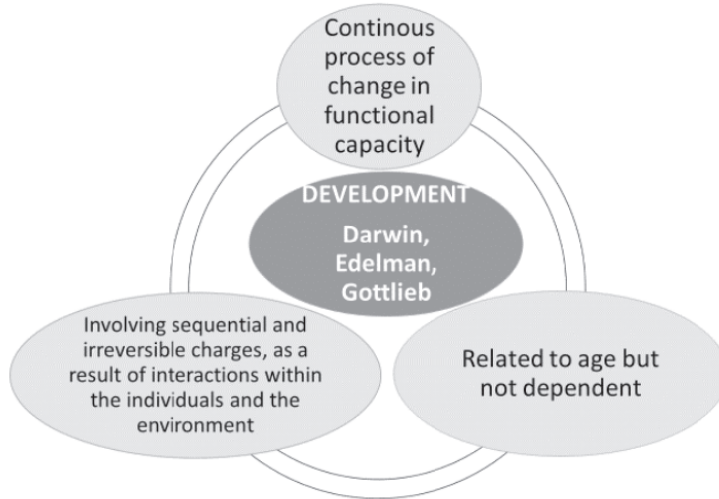
In motor control a movement results from the contribution of multiple population of neurons, each involved in a specific direction of movement (Georgopoulos et al., 1986). A specific movement is the result of the activation of an appropriate combination of neuronal groups. The choice of the appropriate movement, between multiple degrees of freedom of the joints is made in a selection of appropriate movements from a repertoire of variants, resulting from the underlying neuronal group selection (Sporns and Edelman, 1993). Maennistoe et al. (2006) demonstrated that a special targeted skill training in children with motor learning difficulty improved consistently their targeted skills, compared with children trained in general skills. The specificity of the learning is also demonstrated by research of Revie et al. (1993). The synapses not stimulated by experience are subject to pruning. Children are living in an environment where they have some experiences at about the same time, that influences the pruning. The different experiences and the nature of brain activity determine which synapses survive. (Miller, 2011).

Gottlieb argues on the *probabilistic epigenesis*, not just genetic (Gottlieb & Halpern, 2002) of development that *there are bidirectional influences within and between levels of analysis* (2007, p. 1). So, the *phenotypic variation is not strictly limited to random genetic mutation, drift and recombination*, (Gottlieb, 2007. P. 9) but is the result of a lot of epigenetic processes that contribute to individual ontogeny. The environment (experience) selects which genes to activate (18)



**Fig. 2** The figure illustrates the bidirectional influences between environment, behavior, neural activity and genetic activity in Gottlieb perspective (2007)

Summarizing, we can describe development, according to Darwin, Edelman and Gottlieb as: a) as a continuous process of change in functional capacity; b) related to age (but not dependent); c) involving sequential and irreversible changes, as result of interactions within the individuals and between the individual and the environment (Haywood et al., 2009).



**Fig. 3 Development according to Darwing, Edelman and Gottlieb**

### 1.1 Is motor development a general, universal developmental process?

Adolph highlights (2015) that since 1980 there were only few studies (5,2% of 5.617 journal articles) on motor development, compared with cognition, social, language, emotion, personality.

Studies on the mind that played attention on the inner processes (Piaget 1952, Vygotsky, 2013) determined the cognitive revolution. Researchers in cognition often consider the development related to chronological age and the passage of time is considered the factor responsible for developmental changes (Adolph & Berger, 2006; Adolph et al. 2012; Siegler, 2006).

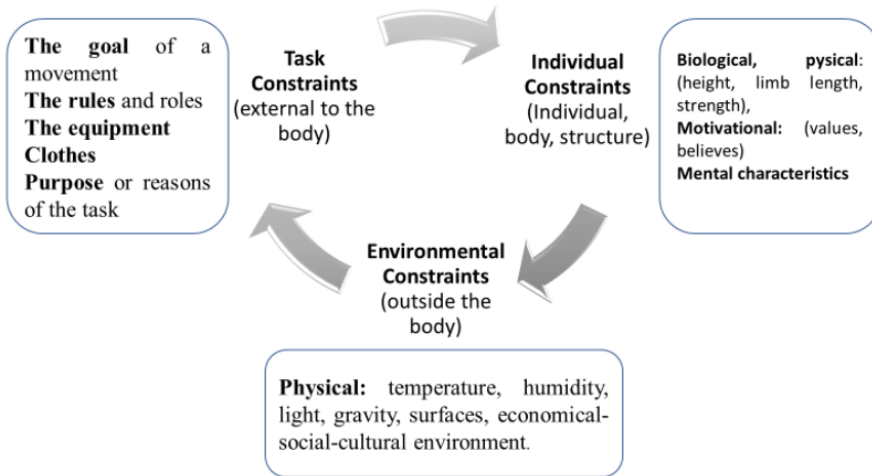
Some researchers now (Adolph, 2015) instead of motor development prefer to use the words perceptual-motor development, perception and action, motor skill acquisition. Adolph (2015) argues that this highlights the relation between adaptive control of motor actions and psychological processes such us perception, planning, decision making, memory, motivations.

The most popular perspective used by researchers in motor development, today, is the *ecological perspective*, that emphasizes the interrelationship between the individual, the environment and the task. For them the emergence of a motor skill is dependent on the interrelation of body, environment and all internal and external constraints. This perspective considers constraints existing within the body, such as cardiovascular, muscular.

### 1.2 The constraints that influence the development

Newell (1986) emphasizes the influence of experience (task) and environment (Haywood et al., 2011) in motor development and highlights the dynamical, constantly changing interaction between them. There are factors that can limit, discourage or encourages motor activity called by Newell, constraints (Haywood et al., 2009).

The researcher suggests that motor development is due to the interactions of the organism with the environment and the task. When one of these factors changes e movement and motor development change.



**Fig. 4 Constraints of motor development of Newell's model.**  
The model shows different factor affecting and individual's movement.

An example of Newell's Model is the development of the overarm throw. Several children master this skill before 12 years old of age, but there are large individual variations in the mastery of the skill. We can observe difficulty with the technique (high arm) or in direction and speed (outcome)(Sigmundsson et al., 2017).

### 1.3 Affordances

Eleonor Gibson posed at the basis of her perspective the *affordances*, a term introduced by James Gibson (1979). The *affordance* is an opportunity for action, what the environment offers or provide for an organism. Some surfaces *afford* walking or crawling, and the social environment offer *affordances* as smiling and angry. The relationship between the organism and the environment offers *affordances*, that can be useful to a person, related to his/her capacities. When a child exploring and playing experiences new motor skills and acquire them he discovers new *affordances*. Everybody has own ability to use potential affordances depending on the experience (Gibson & Pick, 2000).

The relation between bodily capabilities and physical properties of the environment exists objectively in the interface between self and world. The affordances become real regardless of whether they are perceived or used. They reflect both environment and perception-action reciprocity, because they need to be perceived. The perception must guide the action and actions are implicit in the affordances.

For Gibson (1982) "we do not perceive stimuli or retinal images or sensations or even just things; what we perceive are things that we can eat, or sit down on, or talk to" (p. 60). We perceive the functional relation between self and the world.

For example, we don't perceive the size or distance of objects, but whether they are within arms' reach and whether the object will fit into our grasp.

As action capabilities change we become more able to detect appropriate supports and resources to discover new affordances.

Learning new motor skills allows a child to acquire new possibilities for actions, to develop new affordances, to be able to better master his actions in the world and to increase the process of "learning how to learn" (Adolph, 2008).

Infants, toddlers and children live in an environment and in a social context and depend on the caregivers rearing. Cross cultural studies suggest that different caregivers' behavior might influence a different development (Yen-Tzu, et al., 2008; Kolling, 2014).

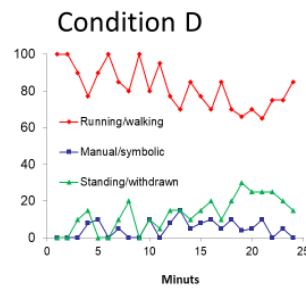
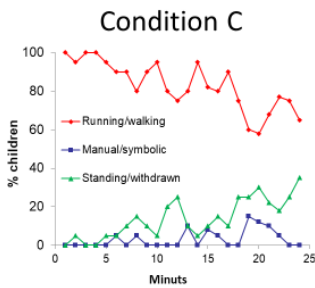
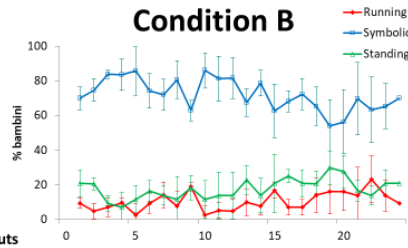
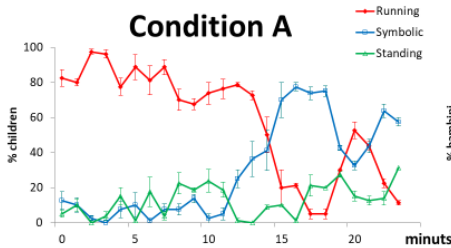
Several studies show that prone sleepers acquire motor milestones earlier than supine sleepers (Jantz, 1997; Yen Tzu et al., 2008). In the various cultural groups people share ideas of adequate parenting practice based on parental beliefs that lead to developmental consequences.

#### *1.4 The role of context and environment in motor development*

It is important to promote opportunities of movement and physical activities in nurseries and kindergarten, to provide motor development. The organization of the environment is an important constraint that can promote motor skills development and affordances. How teachers and educator organize the environment and plan the activity reflects their beliefs. To provide the widest range of efficacious activities for children and to provide their development is important to consider what kindergarten teachers tell about their practices on motor education and what they really do.

A study on the importance of the environment (Tortella, Tessaro, Fumagalli, 2011) was conducted in a kindergarten, with 53 children of 3 years old. Four groups of children were organized and left without instruction (unstructured activity, free play) in a playroom where all furniture were removed for thirty minutes in four different conditions. Condition A: circles of 50 cm of diameter were spread on the floor; condition B: the same circles were piled in one corner of the room; condition c) a pool with soft balls was placed in the center of the room; condition d) the pool was placed in one corner. Each group was video recorded and was measured time spent in the different forms of activities and activity level (by pedometer).

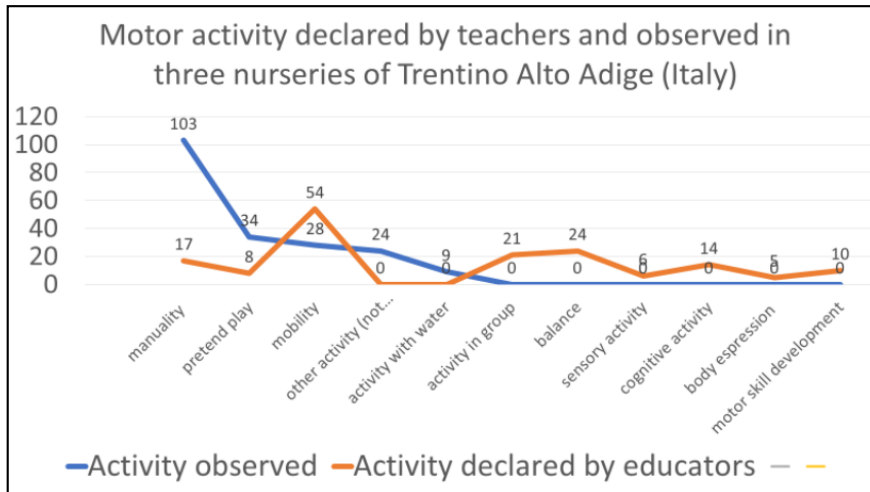
The results highlighted that were children were in condition A spent most of the time running or jumping in the circles (mobility activity); in condition B the most of the time was spent using circles for individual and/or pretend play and running/jumping was limited and random (object control activity). In condition C and D no differences were observed and the children jumped in the pool all the time in both conditions (mobility activity). Data of accelerometer highlighted that children in condition A executed a number of steps significantly higher than the other groups. In all conditions the children imitated each other. Only in condition B children played in little group or with a friend. No differences were observed between boys and girls. The organization of space/environment had significant impact on children motor behavior and the spatial, different distribution of the tools in the space determined the type of their use in terms of motor areas involved (object control skill, mobility).



**Fig. 5 Condition A: children spent most of the time running o jumping in the circles (mobility activity), Condition B: the most of the time was spent using circles for individual and/or pretend play and running/jumping was limited and random (object controll activity), Condition C-D: no differences were observed and the children jumped in the pool all the time in both conditions (mobility activity) Tortella, P., Bortolameazzi, F., Fumagalli, G. (2010)**

In the study (Tortella, Callegari, Tessaro and Fumagalli, 2012) the goal was to investigate on the practice of motor education of children between 18 months and 3 years old in 156 children of 46 municipalities in 6 nurseries of Trentino Alto Adige. Twenty educators of the nurveries was asked to answer to interviews regarding the organisation of daily activity and in the same time they were observed during three days. The results highlighted that what was declared by the

educators was not corresponding with the activity children really did. It emerged that the children spent most of their time in manuality activity (manual dexterity) while educators declared in mobility activity. Children were very sedentary. It emerged that the educator were not aware of the activity they were doing with the children.



**Fig. 6 – Results of motor activity declared by teachers and observation of the activity.**  
(Tortella, P., Callegari, L., Tessaro, F., Fumagalli, G. (2011))

## 2. Motivation

Following the Edelman Theory significant evidence are supporting the notion of the specificity of learning. Stöckel, T.; Hughes, C.M.L , 2015 and Giboin, L.S.; Gruber, M.; Kramer, A (2015) demonstrate low correlation between similar motor task and Drowatzky and Zuccato (1967) highlighted a very low correlations in balance tasks: a person can be good in one balance task but not in another one, as confirmed also by Haga, Pedersen and Sigmundsson (2008).

From the perspective of probabilistic epigenesis it is important to provide children with opportunities to quantitative and qualitative changes in motor development in a variety of context, accompanied by purposeful motor experiences in a variety of context and environments. The educators need to be responsible in the promotion of learning environments for children.

As with new motor skills a child acquires new (affordances) possibilities for actions (Adolph, 2008) it is fundamental to provide children the most number of possibilities to increase motor skills. Increasing motor skills contribute to increase motor competence, that is fundamental to promote physical and mental health, as illustrated in the model of Stodden et al. (2008).



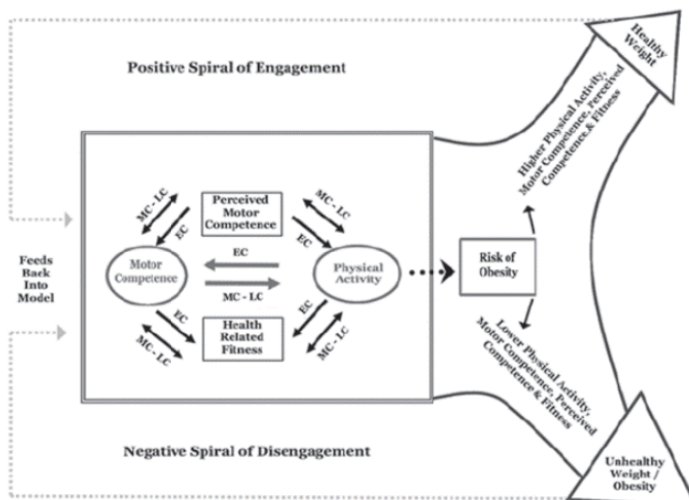


Fig. 7 Stodden model of Developmental mechanisms influencing physical activity trajectories of children (Stodden et al., 2008)

### 3. Question of research

Can a playground provide the affordances to develop motor skills?

### 4. Method

To provide motor skill development and new affordances it was projected the playground “Primo Sport 0246” in Treviso (Tortella et al., 2016). The space (around 2500 mq) was organized in areas (Gallahue, 1982): manuality, balance and mobility.

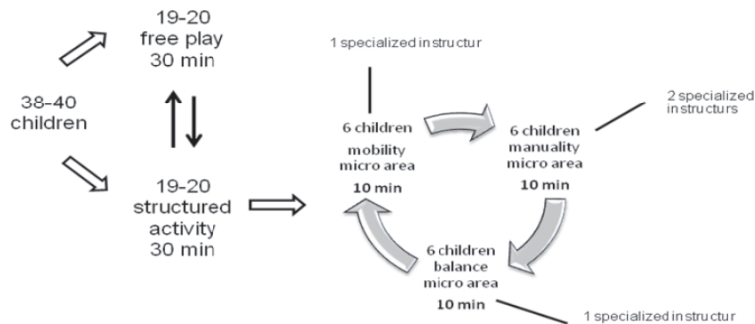


Fig. 8 Playground “Primo Sport 0246” in Treviso (Italy)

The society Verde Sport (Benetton Group) from Treviso, owner of the playground, asked to use normal tools, selected from the catalog of a company. The tools were located in areas of functional use: for example tools for manuality activity are all concentrated in the manuality area and from the simple one to the very difficult one.

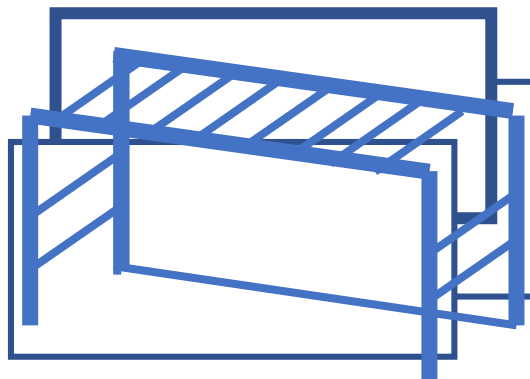
Are the tools positioned in the right place? Are they providing affordances of manuality, mobility and balance in children?

We observed the children for 2 years, from February to June, using videocameras in the various tools and tested the children before and after a training of 10 lessons organized in 30 minute of structured activity + 30 minutes of free play.



**Fig. 9 Model of activity in the areas of the playground “Primo Sport 0246” (Tortella et al., 2016)**

One tool of the manuality area was the “Monkey Bars”. Children had to walk with the hand, hanging on the bars. The tool was 2,30 m high and on the catalog it was recommended for children up to 2 years old.



**Fig. 10 “Monkey bars” – Manuality area**

#### 4.1 Activity in the area of “Manuality”

The children have to walk with the hands hanging on the monkey bars, for 30 seconds, three, four time in 10 minute.

During the activity on Monkey Bars children were asked to walk on the hands as many as possible bars they were able to do.

#### 4.2 Activity during free play

Children have 20 minutes of free time when they can have free play.

TOTAL number of children of 5 years old: 370

2010-11: n. children 38

2012-2014 experimental group n. children 152

2012-2014 free play group n. 74

2012.2014 control group (never came to the playground for training, only for test) n. 106

### 5. Results

The first year of activity (2010-11) the tool was 2,30 m high and the distance from the feet of the children to the floor was around 80-100 cm. We observed that the children did not execute more than 1 bar both in the pre and in the post test and they were not motivated to play on this tool during free play.

After 6 weeks of activity we put under the bars a matrasse 20 cm high, to reduce the distance between the feet of the children and the floor, as we supposed that the jump was too high for the children. The distance to the floor, with the matrasse, was around 15-20 cm. We did not observe any change after this. The children appeared to be not motivated to play on this tool both before and after putting the matrasse.

In the next years (2012-2014) we decided to reduce the height of the tool and cut it. The height is now 1,65 m high. The children can hang with a distance of their feet to the floor of 10-20 cm (mean).

The results were better than the previous year, both in pre and in post test, for experimental, free play and control groups, as is possible to see in the following table

	2010/11	N	2012-2013-2014	N	2012-2013-2014	N	2012-2013-2014	N
	Group	38	Experimental group	152	Free play group	74	Control group	106
Pre-test	0,23		2,14		3,16		2,82	
Post-test	0,89		5,81		5,29		4,70	

Table 1 Results in the test of Monkey bars.

## Conclusion

The first year (2010-11) the activity at the Monkey Bars did not improved after putting a matrasse under the tool, to reduce the distance of the feet of the children to the floor from around 100 cm to around 20 cm.

The years (2012-2013-2014) after reducing the high of the tool at a distance of around 20 cm to the floor we observed significative improvement in the execution of the task at the bars.

The distance from the feet of the children to the floor (20 cm the first year and 20 cm the years 2012-14) promoted different results at the task. We suppose that the distance from the feet to the floor was not determinant the possibility of the children to executed more bars. We suppose that the distance from the eyes of the children to the floor was determinat in improving the manuality skill of the children. These results seem to confirm the theory of affordances (possibility of actions) based on perception-action. The movement is a relation between perception (eyes) and action (feeling of possibility of action).

It is fundamental for educators to consider all the aspects related to a movement, as the organization of spaces, of materials and their characteristics are determinant in promoting physical activity and affordances.

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