The ecological perspective and motor and cognitive development of children: the playground "Primo Sport 0246"

Prospettiva ecologica e sviluppo motorio e cognitivo dei bambini: il parco giochi "Primo Sport 0246"

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ABSTRACT
The ecological perspective considers environment, task and personal characteristics as fundamental and determinant constraints in motor and cognitive development. When one of these conditions changes, the experience result changes. In this study we investigated the role of different methods of teaching/learning motor skills in 5-year-old children (structured activity and free play), in development of cognitive processes and motor competence. 7 children follow a structured program to learn balance motor skills at the "Primo Sport 0246" playground in northern Italy for 10 times, once a week, one hour each time. 25 children played free play in the park, for the same duration and time. After the training the group of children practicing the structured activity increased executive functions and motor competence, while the group that did free play only did not improve. Space organization and materials alone are not enough to increase children's cognitive skills and motor competence and the teacher plays a fundamental role.

La prospettiva ecologica considera ambiente, compito e caratteristiche personali vincoli determinanti nello sviluppo motorio e cognitivo. Quando una di queste condizioni si modifica, il risultato dell'esperienza cambia. In questo studio si vuole investigare il ruolo di diversi metodi di insegnamento/apprendimento di competenze motorie in bambini/e di 5 anni (attività strutturata e gioco libero) nello sviluppo di processi cognitivi e competenze motorie. 17 bambini/e furono esposti a un training strutturato di apprendimento di competenze di equilibrio al parco giochi "Primo Sport 0246" situato a Treviso; il training consisteva in 10 incontri effettuati una volta alla settimana. 25 bambini/e sono hanno invece frequentato il parco per lo stesso periodo e durata ma effettuando solo gioco libero. Dopo il training il gruppo di bambini praticanti l'attività strutturata ha incrementato le funzioni esecutive e le competenze motorie, mentre il gruppo che ha effettuato solo gioco libero non è migliorato né per quanto riguarda le competenze motorie né relativamente alle funzioni esecutive. Se ne conclude che organizzazione dello spazio e materiali da soli non sono sufficienti ad incrementare le competenze dei bambini e che l'insegnante assume un ruolo fondamentale.

KEYWORDS
Playground, Physical Activity, Motor Competence, Preschoolers, Children.
Parco Giochi, Attività Fisica, Competenza Motoria, Bambini In Età Prescolare, Bambini.

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Premises

There is a large consensus in the scientific and educational communities on the beneficial effects of physical activity on health. Scientific associations (WHO, NASPE, AAP, HAH) published recommendations on levels and types of physical activity by children.

The new guidelines on physical activity, sedentary behavior and sleep for children under 5 year of age (WHO, 2019) highlight the importance of physical activity to reduce sedentary behavior. Inactivity is considered as a leading risk factor for global mortality and cause for the increase of overweight and obesity.

During early childhood there is a rapid physical and cognitive development and the child creates the habits. In the new guidelines for 3-4 years old is recommended to practice every day at least 180 minutes in different types of physical activities, at any intensity; at least 60 minutes should be of moderate to vigorous intensity. The recommendation also includes that moments of inactivity should not last more than 1 hour at a time and good quality sleep (10-13 h). For 5 years old children, WHO (2008) recommends at least 60 minutes of moderate to vigorous-intensity physical activity daily. Most of the activity should be aerobic and includes activities performed at least 3 times a week.

As Stodden et al. (2008) suggest, physical activity is related to motor competence, perceived motor competence, health related fitness and risk of obesity. More skilled children practice more physical activity and consequently they develop new motor skills. On the other side, children with low level of motor competence are less motivated to move (Sigmundsson & Hopkins, 2009; Adolph & Hoch, 2018) (see Figure 1).

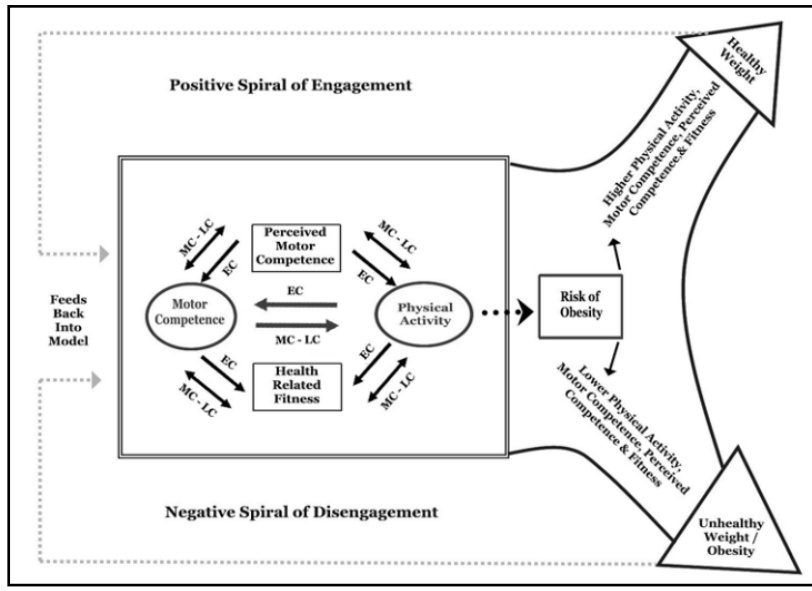

Figure 1 - Stodden model of Developmental mechanisms influencing physical activity trajectories of children (Stodden et al., 2008)

Several studies highlight that physical activity is associated also with cognitive development. Diamond & Ling (2018), Best (2010), Pesce (2012), Tomporowski et

al. (2015) suggest the importance of physical activity with cognitive demands and motor skill learning in development of executive functions.

Diamond & Lee (2018) suggest also that complex physical activity programs with novelty, and variety may be successful in improving executive functions.

The executive functions are reasoning, working memory and self-control, all cognitive processes that are critical for school success, mental and physical health (Diamond, 2012). They are trainable and can be improved by physical activity.

Newell (1989) highlights the fundamental role in motor development and physical activity of the three constraints to action: environment, organism and task. There is a dynamical relation between them and modifying one constraint contributes to modification of the result of the action.

1. The problem

Despite the importance of physical activity in early childhood, the caregivers do not meet the recommendations about quantity of vigorous activity (Vale et al., 2010) of their children, although they believe the children are physically active (Adamo et al., 2016). Kindergarten teachers often declare that they consider physical activity very important for children but that they don't have enough time and adequate spaces to practice it (Tortella & Fumagalli).

Since children usually spend many hours of the day in kindergarten, teacher policies and practices influence physical activity level (Pate et al., 2004). Indeed, Tortella et al. (2011) highlighted that the children of 6 nurseries in northern Italy spent several hours a day in the kindergarten with some of the children (28) present for more than 10 hours (Figure 2). In Newell's model quantity and quality of the activities of children are important for their motor and cognitive development and it is not easy for educator not trained in PE to plan adequate physical activity for children.

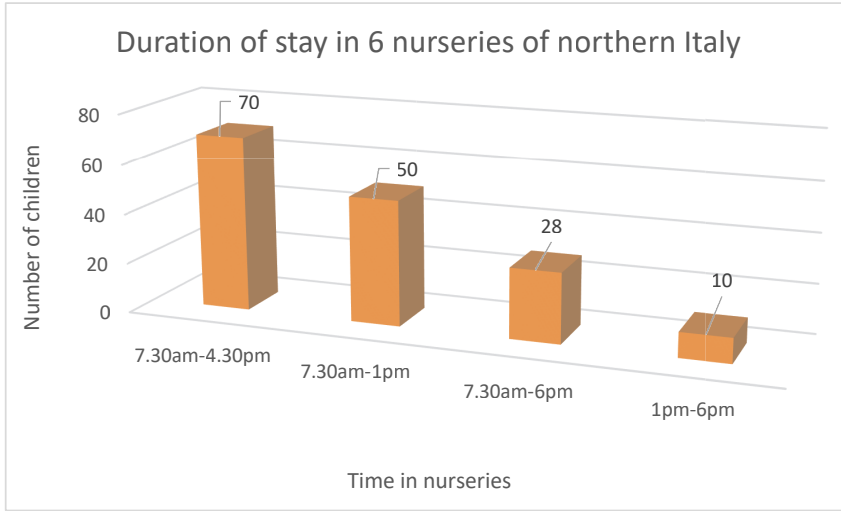

Figure 2 – Daily presence of children in nursery (Tortella et al., 2011)

Accordingly, nursery teachers reported their goals and practice with children related to motor activity but a direct observation highlighted important differences between intention and facts. (Figure 3).

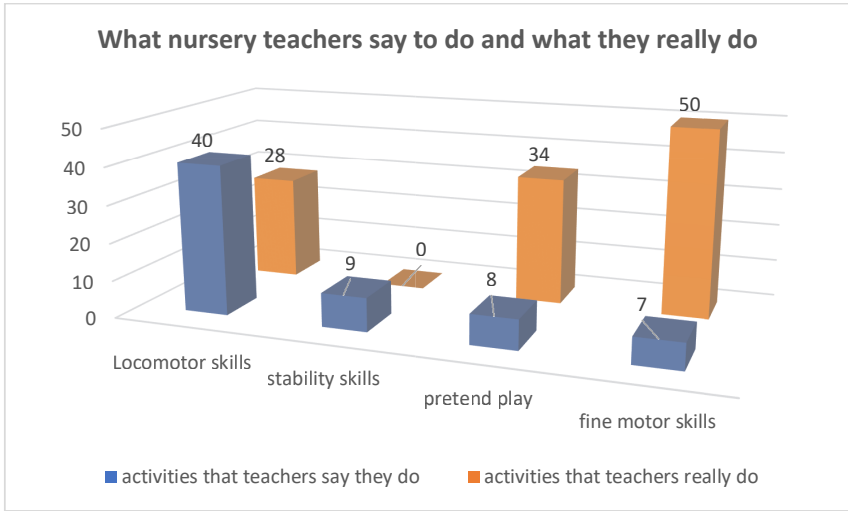

Figure 3 – What nursery teachers refer and what they really do (Tortella et al., 2011)

The teachers stated that they organized many activities involving locomotor skills but failed to recognize that they dedicated time mostly to the training of fine motor skills. They did not do activities aimed at training balance and other fundamental gross motor skills.

A broader analysis of time spent for PA by Italian children was done by administering questionnaires to 433 kindergarten teachers from all over Italy (Tortella & Fumagalli). The questions aimed at obtaining information about quantity and quality of PA in different conditions (Figure 4).

1) **Inside the kindergarten** (gym, other space): 54,52% for 0-1 time; 18,33% for 2 times; 11,76% for 3 times; 4,07% for 4 times; 8,15% for 5 times, 3,17% for >5 times.
2) **Outside the kindergarten** (park, garden): 37,61% for 0-1 hour; 35,59% for 1,5-2 h; 11,49% for 2,5-3 h; 6,08% for 3,5-4 h; 2,7% for 4,5-5 h; 3,6% 5, 5-6 h; 2,9% > 6h.

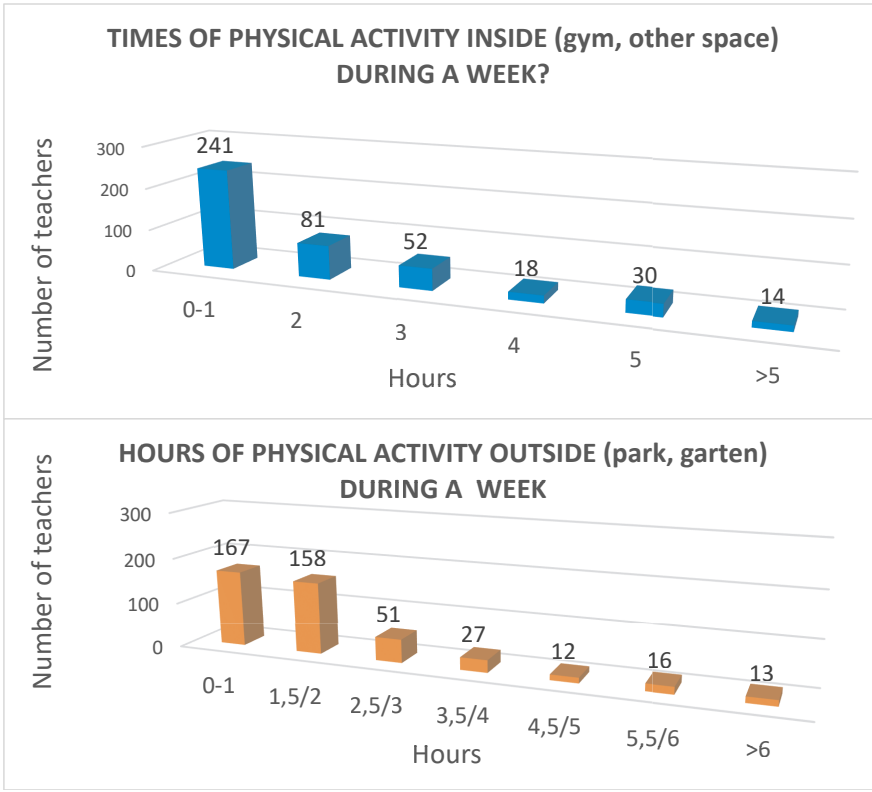

Figure 4 - Physical activity in kindergarten practiced inside and outside (Tortella & Fumagalli, submitted).

The results highlight that Italian children are moving very little and, by far, do not meet the recommendations about daily levels of movement.

2. How can we provide motor and cognitive skills development in children?

Frequency, intensity and duration of an activity are the fundamental conditions to promote development of motor and cognitive skills. There are other factors that influence learning and development, as indicated by the Newell's theory of constraints.

Newell's model indicates that motor development can be limited or helped by:

a) **Individual constraints**: factors inside the body that can be structural (e.g. height, weight, muscle mass) or functional (e.g. motivation).
b) **Environmental constraints**: factors from outside the body (e.g. surfaces, cultural norms, gender roles).
c) **Task constraints**: factors related to a specific task or skill (e.g. goal of a task, equipment, rules).

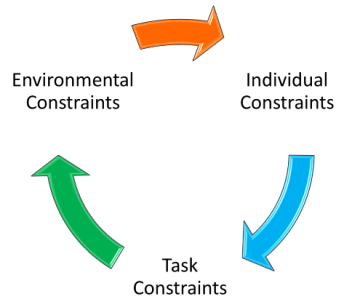

Figure 5 – Constraints of Newell's Model

To promote motor and cognitive development we can focus on some examples according to the Newell model, to understand the influence of the constraints described above.

Recommendations for physical activity and health	Environmental constraints: factors from outside the body (cultural norms).
Authors suggest the importance of physical activity with cognitive demands and motor skill learning in development of executive functions. Diamond & Lee (2018) suggest also that complex physical activity programs with novelty, and variety may be successful in improving executive functions.	Task constraints: factors related to a specific task or skill, goal of a task, methodology).
The caregivers do not meet the recommendations about quantity of vigorous activity. They often report to consider physical activity very important for children but that they don't have time and space to practice it with children	Individual constraints: factors inside the body: functional (motivation, knowledge,). Environmental constraints: factors from outside the body (cultural norms, place).
Teachers reported the goals and the activities they practiced. A researcher stayed some days in the nurseries and observed the activities the teachers really did. She discovered that the real activities where different from those the teachers described	Task constraints: factors related to a specific task or skill (goal of a task, equipment, rules). Individual constraints: factors inside the body: functional (motivation, knowledge,).
Time spent inside and outside the kindergarten	Individual constraints: factors inside the body that can be functional (motivation). Environmental constraints: factors from outside the body (e.g. surfaces, cultural norms, different affordances). Task constraints: factors related to a specific task or skill (e.g. goal of a task, equipment, rules).

Figure 6 - Examples to highlight the influence of the constraints in some situations

Other fundamental aspects in motor development and physical activity

Affordances

Motivation, interest, enjoyment, perception of competence are aspects related to success in physical activity, especially for children (Diamond, 2012; Stodden, 2008). The ecological perspective of affordances can explain and help how to use the complexity of learning to provide motor and cognitive development. "Affordances" is a concept originated from ecological psychology; it points to object's properties that show possibilities of actions. Gibson J. (1977), who coined the word, argues that an affordance, (a possibility of action) depends on user physical capabilities, goals, past experiences. The affordance of a ball is its round shape, physical material, the perceived suggestion of how to use the ball.

The ecological perspective (Newell) in practice – an example

Based on the premises our goal was to develop motor and cognitive skills in children of 5 years old attending a special studied playground "Primo sport 0246".

3. Method

First Step - (**Environmental constraints**) - The first step has been to design, to transform a field into a playground, a place with games for 0 to 6 years old to provide children the environmental opportunities to increase physical activity level and develop motor skills.

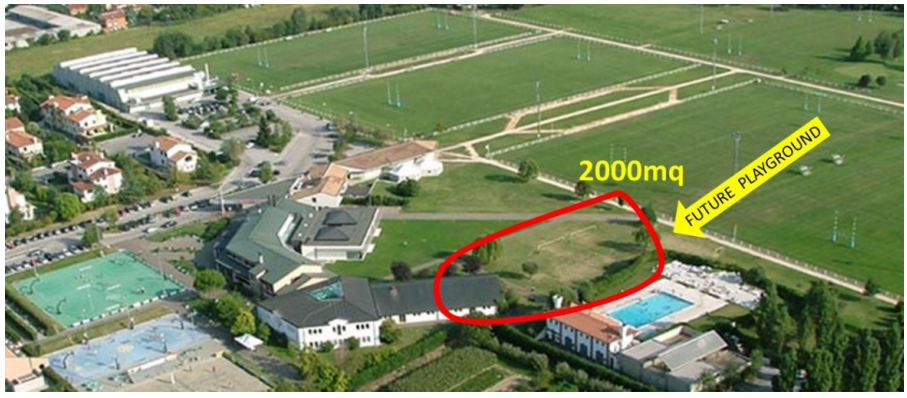

Figure 7 - Ghirada – Treviso, before the playground

To facilitate motor development in children it is necessary to develop locomotor skills, object control/manipulative/skills, stability skills (Stodden et al., 2008; Gallahue et al., 2006); the playground was composed by areas each dedicated to a specific motor goal (Tortella et al., 2016): a) object control/manipulative area; b) stability/balance area; c) locomotor/mobility area.

In each area specific tools were chosen, to promote the motor skills related to the area. These tools in each area are arranged in order of increasing difficulty, to offer the right affordances to children from 0 to 6 years old.

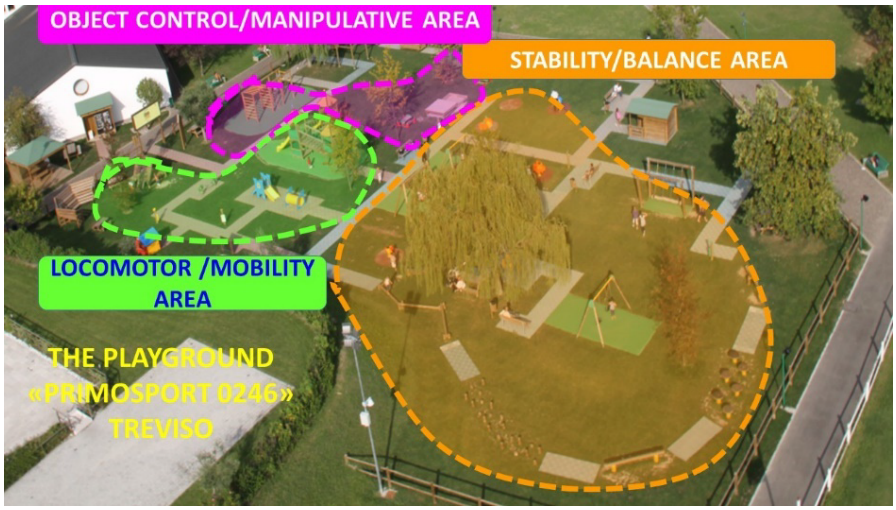

Figure 8 - Playground Primo Sport 0246 – Ghirada, Treviso

First Question: How can children learn to walk on an elastic balance beam and improve their balance motor skills?

1) **Environmental constraints**: does this playground offer the right affordances, to stimulate PA in children and to develop motor skills?
2) **Task constraints**: do the different methods of practicing PA in the playground influence motor skill development?
3) **Individual constraints**: do the different individual characteristics influence physical activity?

To answer these questions, a research was conducted (Tortella & Fumagalli, 2015) to study balance development of children playing in the stability/balance area.

After ethical approval and written consents by the parents, 59 children from 2 kindergartens participated to the study and divided in 2 groups (A and B). The goal of the activity in the balance area, for both groups was to learn to walk on the elastic balance beam, a very difficult task. Both groups (A, B) practiced activity at the elastic bar for 10 min, repeated one day every week for 10 weeks. Capacity of walking on the bar (time to walk and number of errors) was measured at the beginning (pre-test) and the end (post-test) of the study. The two groups of children had the same social and economic background and the same age (5 years old). They had same BMI.

a) Group A was supported by physical scaffolding of the educator in a structured activity;
b) Group B could independently decide the strategy to walk on the balance beam.

Figure 9 - Elastic balance beam

In conditions A and B **environmental constraints** (balance beam), **individual constraints** (motivation, training, strategy, skills, etc.) and **task constraints** (walking on balance beam) were different.

At the beginning of the study (pre-test) both groups were at the same level of competence. After the training of 10 weeks (post-test):

a) Group A: 80% of children was able to walk on the elastic balance beam, doing only few errors.
b) Group (B) 20% of children was able to walk on the balance beam

Environmental and individual constraints, alone, were not enough to help children to increase their motor competence in walking on the elastic balance beam.

The task constraint was different in the two conditions and the physical support by the teacher in a structured activity task was more effective than free activity in reaching the final competence (walk on the elastic bar).

Second Question: How can children improve their executive functions at the playground "Primo Sport 0246"?

1) **Environmental constraints**: does this playground offer the right affordances, to stimulate children to play and to develop executive functions?
2) **Task constraints**: does the different methods applied by educators (scaffolding vs free play) in the playground influence development of executive functions in children?
3) **Individual constraints**: do the different individual characteristics influence physical activity? Two groups of children of 5 years old from 2 kindergarten in

Treviso participated. Both groups came to the playground in the same period, in different days for 1 h a week, for 10 weeks.

a) Group A (17 children) had 30 minutes of structured activity and 30 minutes of free play,
b) Group B (25 children) had 1 hour of free play.

All the children were tested using Day/Night test (Gerstadt, 1994)

4. Results

STRUCTURED ACTIVITY N. 17 children		FREE PLAY N. 25 children	
PRE TEST	POST TEST	PRE TEST	POST TEST
4.67 ± 1.04	1.23** ± 0.34	5.31 ± 1.00	3.56 ± 0.86
n. errors ± st.dev	n. errors ± st.dev	n. errors ± st.dev	n. errors ± st.dev

Figure 10 – Number of errors at Day/Night test. At the POST TEST the group of structured activity executed the test significantly better.

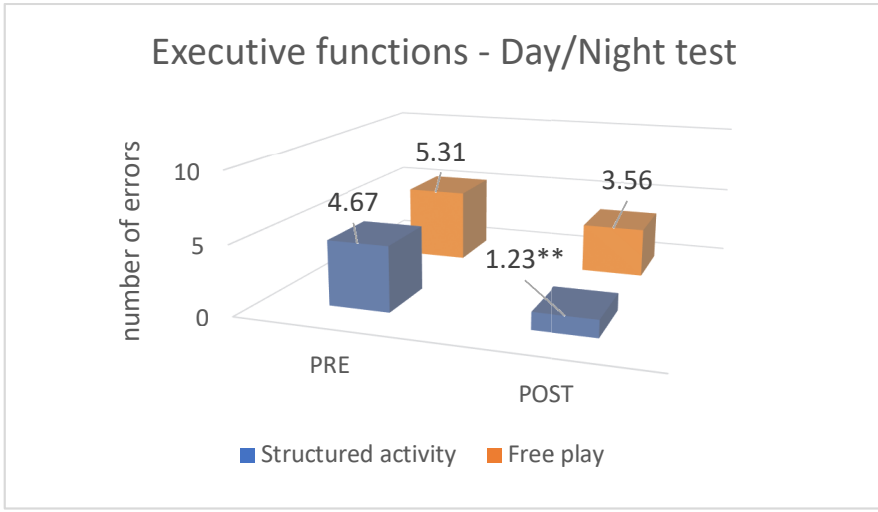

Figure 11 – Results of Day/night test at PRE and POST activity. In blu are the errors of the group of structured activity and in orange the errors of the group of free play

a) Group A– (structured activity + free play) improved significantly executive functions at the post test.
b) Group B (free play) did not improve executive functions at the post test.

Environmental constraints: the organization of the tools and the environment of the playground is not enough, alone, to provide motor and cognitive development.

Task constraints: the different methods in the playground influence development of executive functions. Structured activity + free play is more effective than only free play in motor and cognitive development.

Individual constraints: we did not observe differences.

Conclusion

Only children practicing structured activity + free play improved executive functions at the end of the training period.

Overall conclusion

The role of teachers and methodology is fundamental in motor and cognitive skills of children and in motor development.

It is fundamental to consider the important role of the constraints of development (environment, task, individual) in physical activity and motor development and increase qualitative teachers training in physical and motor education.

Role in the paper

Patrizia Tortella: experiment planning and organization, data acquisition, data analysis, text writing

Guido Fumagalli: experiment planning and organization, text writing

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