How can teachers contribute to develop executive functions through motor activity?

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Abstract

Why are executive functions so important? Can motor activity contribute to develop the executive functions? How can teachers help children in improving their school readiness? The aim of this work is to investigate on these questions and to study 5 years old children after ten weeks of motor activity program in a playground.

Key Words

Motor activity, children, executive functions, proximal zone, playground

Introduction

Why are executive functions so important? Can motor activity contribute to develop the executive functions? Executive functions (EFs) are control functions needed when we have to concentrate, think and avoid to act on impulse. These functions depends on a neural circuit in which the prefrontal cortex plays a fundamental role (Anderson, Jacobs & Anderson, 2008; Bialystok & Craik, 2005; Lunt et al., 2012). The EFs are: inhibition (inhibitory control), working memory, cognitive flexibility, (Miyake et al., 2000) reasoning, problem solving and planning (Christoff, Ream, Geddes & Gabrieli, 2003; Collins & Koechin, 2012; Lunt et al., 2012). They predict school readiness, academic success, career, (Prince et al., 2007) marriage, (Eakin et al., *2004)* mental and physical health (Dunn et al., 2010; Kusche, Cook & Greenberg, 1993). EFs predict success in math and reading throughout all school years (Gathercole et al., 2004).
There is scientific evidence supporting the approaches of aerobic exercise, martial arts and exercising bimanual coordination for

improving EFs in the early school years (Hillman et al., 2008; Chaddock, et al., 2011). There are not yet studies of the benefit of sports for EFs, and is reasonable to think that sport might be very benefit, thanks to challenge EFs (requiring sustained attention, working memory), (Diamond, 2011).

How can teachers help children in improving their school readiness?

Teachers have an important role in improving executive functions. Some fundamental aspects of teaching are: presenting a new challenge when a child is ready for a new one, invite children to take turns instructing or checking one another, helping children when they get upset to stop, to say what the problem is and how they feel and invite them to construct an action plan, implement clearer rules and routines, reward positive behavior, and redirect negative behavior, encouraging the developing of verbally skilled strategies for emotion regulation, repeating practices to produce the benefits, inviting children to wait to play until another child is finished (Diamond, 2011). It is fundamental to know that exercise plus character development are efficacious in improving EFs (Lakes & Hoyt, 2004).
Public school curricula play an important role in preschool children development, particularly in intervening early to improve EFs. Loneliness (Cacioppo & Patrick, 2008), stress (Arnsten, 1998) and lack of physical fitness (Hillman, Erickson & Kramer, 2008) impair prefrontal cortex function and EFs. To improve EFs and school outcomes is necessary to engage children's passionate interests, bringing them joy and pride, giving them a sense of belonging and social acceptance, and opportunities to repeatedly practice EFs at progressively more-advanced levels.

The playground, a space for improving motor skills and EFs.

To improve health and motor activity is important to propose spaces and opportunity of activity. Play in outdoor spaces improves the welfare of children (Ginsburg, K., R. 2007) and particularly stay in green park improve children's attention and concentration skills. Significative experiences depend on frequency, intensity and duration of the motor activity (Klingberg et al., 2005).

Some studies of Tortella et al. (2012) reveal that child perception of difficult in free or structured motor tasks affects on the level of his motivation and self efficacy.
Excessive requests produce frustration and abandonment of the game. The educator can help the child both by modifying the organization of the tools in the environment, changing the spaces and by scaffolding children in proximal zone (Vygotskij, 1978).
Lakes & Hoyt (2004) show that motor activity contributes to cognitive development (executive functions) when motor activity is associated with awareness and meta cognitive processes. the largest increase of executive functions level has been noticed during formal, non formal and informal activities, accompanied by passion and enthusiasm (Hirt, Devers, & McCrea, 2008). Our study is held in a playground near Treviso, a special space called Primo Sport 0246. The concept of the park is for providing motor development in children from 0 to 6 y. old. It is structured in functional areas of motor skills (balance, manuality, mobility) (Tortella, et. Al., 2011).

How can motor activity provide the development of executive functions in children?

Young children show notable gains in their abilities to volitionally control their attention, impulses, thoughts and emotions across early childhood (Blair & Diamond, 2002, 2007, 2008; Hughes & Ensor, 2011).
Motor activities promoting autonomy through EF lens, activities practiced in small groups, activities scaffolded 1:1 coaching, help the development of EFs (Zelazo, 2013).
Better EFs are shown when we are happy, physically fit and feel socially supported (Diamond, 2012).

Metodology

In this paper we write the design of the research, we are conducting.
Five kindergardens of Treviso (north Italy) with 190 children of 4-5 years old are involved:

- A sperimental group of 5 y old children (n. 40) is attending the playground 10 weeks, 2 hours each time; each session is organized in 30 minutes of free play and 30 minutes of structured play;

- B control group of 5 y old children (40) who is not coming in the playground;
- C control group (n. 40, 5 y old children) who is coming in the playground 10 weeks, 2 hours each time; each session is organized in 30 minutes of free play and 30 minutes of structured play;

The educators:

- help children of group A to play in proximal zone (Vygotskij, 1978);
- Tell the children (only group A) to observe the activity of another child and to start his activity when the other child has arrived to a certain point.
- Children are educated to wait.

Children are measured with pre and post motor and cognitive tasks, after 10 weeks: abc movement test (Henderson, Sugden, & Barnett 2007), II edition; Tortella and Fumagalli motor and cognitive tests; day night test (Gerstadt, Hong, Diamond, 1994), Haga tests (2009). Questionnaire are somministrated to parents and teachers. Focus groups are made with parents and teachers.

Conclusions

With this study we propose to compare to groups of children of 5 y old after a period of ten weeks of different methodology of motor activity. We assume to obtain improvement in EFs and in motor skills in group A, thanks to the different educational style of the teacher, in line with the premises.

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