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## **ANALYSIS OF THE CAPACITY OF MOVEMENT DIFFERENTIATION IN ITALIAN PRIMARY SCHOOL CHILDREN**

### **INTRODUCTION**

Physical Education (PE) lessons are compulsory in Italy for school children aged between 3 and 18; the number of hours dedicated to motor and sport sciences is limited to only 2 hours per week in both primary (3-10 years) and secondary (10-18) schools. PE teachers in secondary schools must have completed specific university training (a three-year degree course and a two-year masters course), while in primary schools PE lessons are taught, in the majority of cases, by the class teachers who do not have any specific training in PE. Class teachers do, however, undergo a short basic training programme in PE didactics. The Italian National Curriculum sets many movement coordination objectives that should be met by the end of the third and fifth grade of primary school. These also include technical movements specific to various sports disciplines. It is highly important that these skills are „practised” and assessed during this critical stage of child development (Martin, 1991), as they can condition the acquisition of new motor skills, the child’s capacity for general and specific motor coordination, and even limit the long-term benefits of sport participation. The capacity of movement differentiation is considered to be the fundamental prerequisite for the achievement of maximum motor and sports performance; moreover, it needs to be developed in a specific way, above all in children. According to Blume (1986), the capacity of differentiation is the ability to achieve high precision and coordination between the individual phases of a movement or between the movement of different parts of the body, and it is expressed via the execution of movements in a highly precise and conserved manner. It is based on the exact and conscious perception of the dynamic, chronological and spatial parameters of the movement performed, the combination of which facilitates the execution of accurate movements, enabling the achievement of „movement mastery” (Starosta, 2000). Many elements need to be distinguished in the capacity of movement differentiation and its development should

involve the use of specific exercises selected and ordered by the teacher on the basis of the motor parameters (spatial, temporal and dynamic) and various parts of the body involved in the movement (e.g. the upper limbs, lower torso and movements performed with the hands, fingers, feet and head). The capacity of movement differentiation must also be assessed using motor tests that permit the accurate evaluation of this important capacity. In the literature, standard tests have been ascertained that assess all motor skills, even in adolescents, like those indicated in the protocol by Hirtz, Hotz and Ludwig (2005).

The aim of the present study was to evaluate the capacity of movement differentiation in school children aged 6-10 years.

### **SAMPLE**

The sample comprised N=39 students, aged 6 to 10 years (mean age±S.D.: 7.8±1.1 years), from grade 1, 2, 3, 4 or 5 of an Italian primary school; N=15 males and N=24 females. Students had only 2 hours of PE per week at school.

### **MATERIALS AND METHODS**

An initial evaluation of the students' capacities of dynamic differentiation of the upper and lower limbs took place during the first months of school year (October and November) in order to assess the motor capacities of the students before starting the teaching programme prepared by the primary school teachers. Prior to carrying out the test, the type of assessment involved, student were introduced to the times and the assessment criteria involved by means of verbal and/or visual demonstrations. During the execution of the various tests, extrinsic feedback regarding the knowledge of performance (KP) and knowledge of results (KR) obtained was provided when possible (Driouch, 1993; Mantovani, 2004). For the evaluation of the capacity of dynamic differentiation of the upper limbs, the following tests were performed: i) throwing a ball at a target while standing with one's back to the target; ii) throwing a bag of sand at a target. For the evaluation of the capacity of dynamic differentiation of the lower limbs, the following test was performed: i) Jumping on a target.

### **STATISTICAL ANALYSIS**

For the test of throwing a ball at a target placed behind the subject, the difference between males and females was assessed for each age group (6, 7, 8, 9 and 10 years) using the non-parametric Mann-Whitney test. For the test of hitting the target with bags of sand, the points obtained in each set of 5 trails (5 trails with 80 g bags; and 5 trails with 200 g bags) were added together, as indicated in the evaluation protocol.

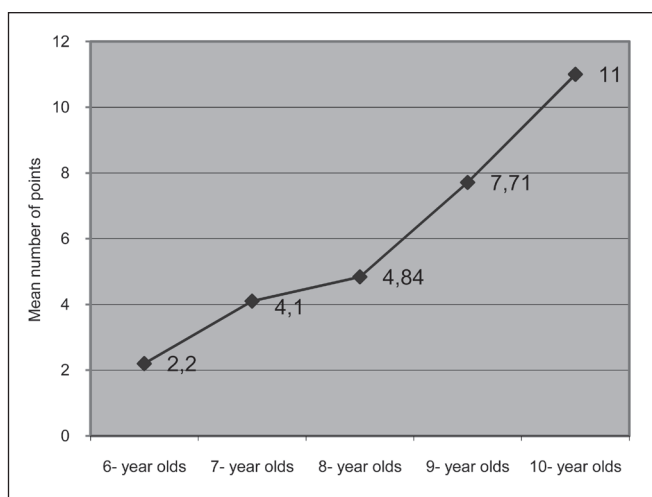
The mean number of points obtained across each set of 5 trials was also calculated. For the jumping on a target test, the following were calculated: i) the distance in centimetres from the tip of the toe to the centre of the circle for two jumps; ii) the mean distance for the two jumps. The results obtained were compared between groups defined by age and gender.

Null hypotheses were rejected and results were considered statistically significant at  $p < 0.05$ .

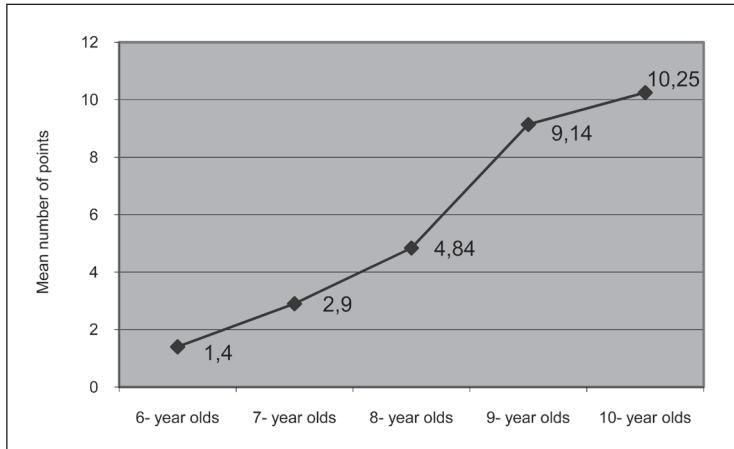
## RESULTS

The results of the test of throwing a ball at a target placed behind the subject did not reveal any statistically significant differences for any of the age groups according to gender: 6-year-olds ( $U = 2.500$ ,  $p = 0.800$ ); 7-year-olds ( $U = 8.000$ ,  $p = 0.667$ ); 8-year-olds ( $U = 10.000$ ,  $p = 1.000$ ); 9-year-olds ( $U = 2.500$ ,  $p = 0.381$ ); 10-year-olds ( $U = 0.000$ ,  $p = 0.333$ ).

For the test of throwing bags of sand at a target (5 trials with 80 g bags; 5 trials with 200 g bags), the mean score obtained, and the consequently the performances, improved as students' age increased (Figure 1 and 2).



**Figure 1.** Test hitting the target with bags of sand 80 g



**Figure 2.** Test hitting the target whit bags of sand 200 g

The mean data obtained from the two trials of the jumping on a target test revealed the following results (Table 1):

**Table 1.** Jumping on a target: mean distances for two jumps per student

Age	Female	Male	Age	Female	Male
6-year-olds	10.5	32.5	8-year-olds	8.5	14.5
	15	69.6		0	18
	57			7	26
7-year-olds	0	6	31.5	24.5	
	33.5	30	12	19.5	
	53.5		0	81.5	
	39.5		9-year-olds	16	4.5
	5.5			0	3.5
	21			13	
6.5		3			
		0			
		10-year-olds	11	16.5	
			0	11.5	

- in the 6-year-olds, the females obtained better results than the age-matched males;
- in the 7-year-olds, the males obtained better results than the aged-matched females despite the fact that one female achieved the maximum score of 0 points by jumping both times onto the centre of the target;
- in the 8-year-olds, the females obtained better results than the age-matched males. Two female students achieved the maximum score of 0 points by accurately jumping onto the centre of the target in both trials;
- in the 9-year-olds, the females obtained better results than the age-matched males. Once again, two female students achieved the maximum score of 0 points by accurately jumping onto the centre of the target in both trials;
- in the 10-year-olds, the females obtained better results than the age-matched males. One female student in this age group achieved the maximum score of 0 points by accurately jumping onto the centre of the target in both trials.

## **DISCUSSION**

The results of this study confirm the hypothesis that the capacity of movement differentiation is age dependent, even though the data present some differences with respect to those of others studies reported in the literature (Pehoiu, 2010). Indeed, even if this capacity is one of the earliest to be expressed, the results obtained for the students closer to adolescence were better than those for students closer to infancy; these results do not agree with those of other studies that demonstrate a negative trend for this capacity in adolescents, due to the stagnant period linked to the growth spurt typical of this stage of maturity (Hirtz, Starosta 2000; Colella, Sannicandro, 2000).

An explanation of the results obtained for this study might lie in the fact that the considerable plasticity of the CNS (central nervous system) during infancy depends on the specific properties of the CNS and of the analyzers (Pehoiu, 2010), and produces both advantages and disadvantages with respect to motor learning: it allows the reception of an abundance of information from the environment and the competence to imitate and adapt but, at the same time, it can also generate various difficulties linked to the limited development of inhibitory processes and motor differentiation. Another explanation could be that the group of the females had the opportunity to have extra-curricular motor/sports experience that is more focussed on the development of motor coordination (e.g. dance lessons), thus helping them produce better results regarding spatial and temporal precision, while the extra-curricular motor/sports experience of the male students might be more oriented toward the acquisition of sports techniques (e.g. football skills). Another explanation could be attributed to the fact that the sample is numerically non-homogeneous (there are more females than males), and this could have influenced the results. A very important finding

emerges from these data regarding feedback. In nearly all the tests, improvements are seen in the students' abilities to perform the tasks, especially in the final trials. All the tests used involved the execution of a different number of trials, and some also involved the provision of feedback regarding the result of each trial. The capacity of movement differentiation is strongly influenced by both intrinsic and extrinsic feedback (Driouch, 1993; Mantovani, 2004) and the results obtained confirm the importance that such feedback assumes for the development of this capacity.

## CONCLUSION

The results obtained through the present investigation indicate that a modest improvement of the capacity of movement differentiation depends on the insufficient exercise caused by a small number of physical education classes – 2 hours per week and by the non-specific competences of teacher (Fairclough, Stratton, 2006). In Italy, the small number of hours dedicated to PE and the lack of teachers specialized in PE in primary school do not produce a positive impact upon the development of motor capacities in children aged 3-10 years, as has previously been pointed out (Jurak et al., 2005). The problem of the limited degree of teacher competences requires appropriate strategies to be put into place to support their teaching activities during the lessons dedicated to PE. Physical exercise in the form of organized school classes is necessary and useful, both from the viewpoint of the pupils' long-term biological and psychosocial development and from the viewpoint of their future daily-life activities (Haga, 2008). Children's first formal physical education experiences occur in primary school.

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## ABSTRACT

Physical Education (PE) lessons are compulsory in Italy for school children aged between 3 and 18; however, in primary schools PE lessons are taught by class teachers who do not have any specific training in PE. The aim of the present study was to evaluate the capacity of movement differentiation in 39 students, (mean age $\pm$ S.D.: 7.8 $\pm$ 1.1 years) in one Italian primary school. The protocols of Hirtz, Hotz and Ludwig (2005) for the evaluation of the capacity of movement differentiation of the upper and lower limbs are utilized. The results suggest a modest development of the capacity of movement differentiation in the sample. In Italy, a small number of lessons dedicated to PE and the lack of teachers specialized for primary school do not produce a positive impact upon the development of motor capacities in children aged 3-10 years, as has previously been pointed out.

**Key words:** *movement differentiation, evaluation, Physical Education, primary school*