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Embodied processes between maths and gross-motor skills

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Abstract

Over the last fifteen years, in several research areas, there has been a lot of studies about "embodied" cognition, ie the emerging view that considers cognitive processes deeply rooted in the interaction of the body with the world (Lakoff & Johnson, 1999). Starting from this theoretical framework and from a previous study that evaluated the possible correlations between gross motor skills and marks at school, the aim of this study was to evaluate the possible correlation between Maths and TGMD (Dale Urich, 1992) results. Through statistical analysis, the results showed some interesting positive correlation between these two variables, confirming the results of previous research and opening up some interesting reflections on the introductory basis theories.

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1.Introduction

Until the last two decades, the most significant approach in cognitive science meant the mind as the software of a computer: it was important to analyze only the operation, without investigating the relations with the hardware, the brain and the body (Borghi & Iachini, 2002). Today, gradually, it has come to the conviction that the mind is influenced by the brain, and especially by the body; at the same time, it has been creating a strong relationship between three fundamental processes that previously were constantly split off from each other, ie the perception, the action and the cognition. In 1998 Susan Hurley regarded the mind as a "mental sandwich", in which perception and action are considered marginal to cognition, defined as the pulp. According to this theory, the mind is considered as a sandwich with two slightly proteic ends: the sensory and the motor, and at the center the meat, or cognitive processes.
Over the past fifteen years there have been several studies and research about "embodied" and "grounded" cognition without neglecting the setting of the traditional cognitive science. In fact, there is no single "embodied" theory, but there are different: some highlight the radical importance of the experience and perceptions, other of the body and action. Depending on the pre-eminence of one or other, there are two main models of Embodied Cognition: in the case the enhancement of perception prevails, the model is "phenomenological", in case prevails motor action, however, the model is "pragmatic". Several scholars, even contemporaries, have given greater rise to perception: such as the "Phenomenology of Perception" by Merleau-Ponty in 1945, the analysis of touch by Husserl in 1952, until the recent record found in the mentions of Gallagher and Zahavi (2009).

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Different, however, is the logic adopted by the pragmatic model, where the supremacy of the action can be reviewed using different keys approach: American pragmatism (Dewey, 1949), for example, intends the concepts not as mere representations of objects, but as a set of instructions useful to the interaction with objects finalized to the action (F. Caruana, A. Borghi, 2013); furthermore, the ecological approach of Gibson is based primarily on the "affordance" concept, ie all the physical qualities of an object that suggest appropriate actions to manipulate it. Each object has its affordances, as well as the surfaces, events and places; the individual does not perceive only a copy of what the outside world refers him, but captures a wealth of information useful for its action (Paloma Gomez F., 2013).
Several models in the world have used embodied cognition as a scientific approach to teaching (in literature, music, art, technology ...). Ellen Esrock (2012), for example, spoke about "embodiment in literature and visual art," telling the story of the particular reading of a novel: the author focused, first, on the description of the hand of a dressmaker who was moving along the waves of a soft fabric, then on the observation of the painting of a woman who was embroidering his handkerchief. In both cases, Esrock said, it is as if it could perceive the physical tension of the fingers or the tactile properties of the fabric, feeling somehow corporeally dipped in the description and in the observation. It's as if it was happening a simulation of what is represented with images or told with words.
At the same time to the recent scientific neuro psychobiological discoveries, a series of legislative changes have been implemented in the educational field showing a strong interest in the importance of the body and movement: an example is the Indicazioni Nazionali per il curricolo della Scuola dell'Infanzia e del Primo Ciclo d'Istruzione (2012). The Infant School aims to develop gradually in the child the ability to read and understand messages from its and others body, respecting it and taking care. It aims also to develop the ability to express themselves and communicate through the body to reach and refine perceptual skills and knowledge of objects, the ability to orient themselves in space, to move and communicate with imagination and creativity. In the Primary School, however, the student is led to the acquisition of different motor patterns, to recognize and assess trajectories and distances, to develop and perform simple sequences of movement, to participate actively in various forms of sports activities respecting the game and behavior rules.
In addition to adopting the "Embodied Cognition" lodging as psycho-pedagogical paradigm to operate didactically, is necessary to use also well-constructed and standardized tools that include basic motor skills. In education the focus is not so much aimed at achieving results in motor performance, but the qualitative evaluation of the harmonic sequence of the development of gross motor skills. Williams (1983) defined the gross motor development as the use progressively more skillful of the entire body in an activity that involves large muscle groups and that requires spatial and temporal coordination of the simultaneous movement of various body segments.

2.Objective

Starting from this theoretical framework and from a previous study that evaluated the possible correlations between gross motor skills and marks at school, the aim of this study was to evaluate the possible correlation between Maths and TGMD (Dale Urich, 1992) results.

3.Method

The context in which this empirical research was carried out is a school in Salerno where physical activity is not performed regularly; it was selected following a positive feedback from a previous training course with the principal and the teaching staff of the school. The sample is composed of about 90 students from five different age groups (from 1st to 5th class) and duly authorized to test administration and access of the profit marks of the second quarter in Maths by the parents of each. With the help of the Physical Education teacher, was given the TGM (Test of Gross Motor Development, Dale Ulrich, 1992) at the end of the activities of the Second Quarter.
The Test of Gross Motor Development is a test with an individual administration, which evaluates the gross motor function of children aged between 3 and 10 years. It measures 12 gross motor skills that are grouped into two subtests, each of which, through some items, assesses different aspect of the gross motor development: locomotion and object control.
With the help of a representative teacher it was possible to access to all Maths marks (in compliance with laws on privacy) to later operate on the possible correlations.
Since the teachers are different, they could adopt different parameterizations of vote, so it was made a correlations to standardize them, according to "standardized rating = (X-average) / DS", where X is the single mark, the average is the average for the class and DS is the standard deviation. The statistical analysis was made, however, using two different

types of correlation index: the Pearson coefficient correlation, which expresses the index of a possible relationship of linearity between two statistical variables, and the Spearman correlation index R for ranks, ie the non-parametric statistical measure of correlation that expresses any monotonic relationship of the variables.

4.Results

Table 1. Pearson's correlation - with standardization

	Subtest 1	Subtest 2	Test average
Maths	0.9805***	0.9827***	0.9931***

Table 2. Pearson's correlation - without standardization

	Subtest 1	Subtest 2	Test average
Maths	0.9805***	0.9663***	0.9894***

Table 3. Spearman's correlation - with standardization

	Subtest 1	Subtest 2	Test average
Maths	0.9906***	0.9711***	0.9905***

Table 4. Spearman's correlation - without standardization

	Subtest 1	Subtest 2	Test average
Maths	0.9994***	0.9628***	0.9923***

Table 5. Pearson's correlation – Subtest 1

	Class 1	Class 2	Class 3	Class 4	Class 5
Maths	0.9846***	0.9837***	0.9811***	0.9713***	0.9828***

Table 6. Pearson's correlation – Subtest 2

	Class 1	Class 2	Class 3	Class 4	Class 5
Maths	0.9599***	0.9491***	1.000***	1.000***	1.000***

Table 7. Pearson's correlation – Test average

	Class 1	Class 2	Class 3	Class 4	Class 5
Maths	0.9866***	1.000***	0.9944***	0.9911***	0.9947***

Table 8. Spearman's correlation – Subtest 1

	Class 1	Class 2	Class 3	Class 4	Class 5
Maths	1.000***	1.000***	1.000***	0.9966***	1.000***

Table 9. Spearman's correlation – Subtest 2

	Class 1	Class 2	Class 3	Class 4	Class 5
Maths	0.9668***	0.9782***	1.000***	1.000***	1.000***

Table 10. Spearman's correlation – Test average

	Class 1	Class 2	Class 3	Class 4	Class 5
Maths	1.000***	1.000***	1.000***	0.9966***	1.000***

5.Discussion/Conclusion

All tables show the results of the Pearson and Spearman correlation coefficient. These were made first between mathematics marks and the two subtests separately and sequentially with the average between the two. Finally, it was also made a correlation for all classes and for the single classes.

From Tables 1 to 4 the correlations were made considering the whole sample and making a standardization of the results of Maths and those of tests (because the marks were given to different classes and by different teachers).

In general, the correlation between mathematics marks and the test is very high. In particular, in the analysis for each class there are some cases in which the correlation is even 1.000 so, there is a perfect correlation.

In a previous research this positive result has been justified by the theory of Decision Making (Iannello et al. 2007), which implies the need for an initial analysis and a subsequent decision-making for the execution of one or more gross motor skills (belonging to subtests 1), as in the case of the disciplines of mathematics (eg problem solving) or music (eg. a new musical instrument approach or a new score).

In view of an introductory theoretical framework where has been affirmed the importance of embodied cognition, which is the emerging view that considers cognitive processes deeply rooted in the interaction of the body with the world, and a statistical analysis between Maths marks and gross motor skills, considered the first group of skills acquired in the developmental age, the conclusions are positive and promising.

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