PHYSICAL ACTIVITY AND SPORT SKILLS AND ITS RELATION TO MIND THEORY ON MOTOR CONTROL

Gaetano Raiola¹, Domenico Tafuri² and Gomez Paloma³

¹ University of Basilicata, Italy
² University of Parthenope Naples, Italy
³ University of Salerno, Italy

Abstract

The didactics traditionally is imparted by the coach/trainer/teacher with tutorials that have the theoretical basis in the Cognitive approach. It means the coach/trainer/teacher illustrates in greater detail by the coach, are of Partial type, Varied, Randomized and Mental Training. It refers to the models of motor control to Open Loop, Closed Loop, and Motor Program Generalized. Teaching Methods of Physical activity is also imparted by another approach called Ecological-Dynamic where the coach does not require the tutorials, but builds a setting learning environment aimed at variety of learning. It refers to the models for the control of the Motor Imagery and Freedom Degrees. The first one could be in first person and in third person; the second one is three consecutive steps: Reduction, Exploration and Capitalization of the degrees of freedom. Aim is to study the issue of motor control theory and its relation to learning process and body knowledge. It carries out specific aspect of learning approach. Main results show two types of correspondence: 1) between cognitive approach and motor control closed loop, open loop and generalized motor program; furthermore, there is a significant correspondence among order, demand, sequence and timing on movement learning: 2) between ecological dynamic approach and motor control Motor Imagery and Freedom Degrees; furthermore, there is a significant correspondence among setting, learning environment and specific strategies of teaching method such as cooperative learning, role playing, circle time, brain storming, peer education, tutorship, focus group. In this way it can see the invasive role of the coach/trainer/teacher in cognitive approach and non-invasive role in ecological dynamic approach.

Key words: cognitive, ecological-dynamic, teaching method

Introduction

In the teaching method of physical activities is traditionally makes use of tutorials that have the theoretical basis in cognitive approach. The physical activities is traditionally imparted by the coach/trainer/teacher with tutorials that have the theoretical basis in the cognitive approach. They, illustrated in greater detail by the coach, are of Partial type, Varied, Randomized and Mental Training. Refer to the models of motor control to Open Loop, Closed Loop, and Motor Program Generalized The partial tutorial consists in making exercise a motor skill complex initially in a simplified form. Movements with a certain degree of difficulty, very complex, can be simplified by dividing the exercises or reducing the speed or requests for precision. For all forms of partial tutorial is the rule that is obtained of learning only as long as the techniques of partial tutorial, that is fragmentation, segmentation and simplification, does not adversely affect the deep structure of the motor program generalized. The tutorial randomized and that varied are other techniques of tutorial that find their justification in theory engine programs generalized. The theory of the programs motors has generalized methodological implications-didactic on direct choice of which provide information in the feedback. This choice depends on the type of error made by the athlete/student. The techniques of mental repetition consist in think about the aspects cognitive and procedural of the action, while the mental representation is to imagine the conduct of an action.

In the teaching of motor activities there is also another approach called Ecological-Dynamic where the coach does not require the tutorials but builds a setting learning environment aimed at variety of learning. It refers to the models for the control of the imagination and mobility of the theory of the degrees of freedom in three consecutive steps for learning impairment: Reduction, Exploration and Capitalization of the degrees of freedom. According to the ecological approach "learn" means being able to find progressively the mobility solution best for a given task in a given context. Emblematic is the expression, coined by Bernstein, "repetition. without repetition": practice does not mean always repeat the same solution to a given task, but repeat over again the process of solving the task itself. If learn movements means optimizing the process of solving tasks engines, resulting didactic implications different from those prescriptive own cognitive approach. In heuristic learning the teacher must assist the student in research autonomous mobility solutions. If the learning tasks too complex, you should not impose constraints to the learner in telling him how prescriptive him how prescriptive simplify the implementation mobility, but you must apply constraints to the environment. Aim is to study the issue of body knowledge by motor control theory and its relation to motor skills. To work by elaboration of specific aspects, it uses an integrated method that joins, in one hand, a historical and documentary approach to describe the evolution steps, particularly on theoretical paradigms on didactics on motor learning.
In other hand, it uses an argumentative deductive approach to talk about on new discoveries on motor control and learning.

**Mind theory on motor control**

It analyses the current state of the affair of how and why the body and movement are central in the motor skills, through methodological and didactic choices in teaching activities at whose foundation there is scientific evidence. "Conceptual knowledge is embodied, that is mapped in our sensory-motor system. This not just provides the structure to the conceptual content, but characterizes the semantic content of concepts according to the way we function in the world with our bodies." (Gallese & Lakoff, 2005). Below is presented a brief summary of the main currents of thinking in the context of motor control and learning, in order to evaluate the resulting of teaching methods, and so to verify if the indications presented in the educational documents can be traced back to such theories. They are synthesized in Cognitive approach and Ecological-Dynamic one. Humans have, in the brain, a series of motor programs, or sequences of commands that, in the central nervous system, coordinate the execution of movements. According to a first formulation, processing of information from sense organs, particularly proprioceptors, allows the system to correct the movement at timing execution. The closed-loop motor control theory (Adams 1968) assumes that the movements are sufficiently slow to allow correction during implementation, based on the data from the feedback. The movement is sufficiently slow when every information on movement, scientific called feedback, could be processed by mind in two hundreds milliseconds and so it is used by the effectors. The longer the execution time, the wider the opportunity to use the motor control circuits based on feedback and comparison between memory trace and perceptual trace. Memory trace is the ideal motor program to take place and effect as well as is in the mind without errors while Perceptual trace is the real motor program that is effected with the errors (Adams 1975).

Comparison is the process which the mind to determine the differences between to ideal motor program and real one to carry out the errors by the feedbacks. In other word, when motion is quicker than of nerve impulses conduction (up two milliseconds), the movement is not susceptible of correction in progress and is programmed completely in the central nervous system due to the inability of the brain to process information and data below the time threshold of two hundred milliseconds according to open loop motor control theory (Schmidt 1985, Keele et al. 1986). Learning movement consists of developing cognitive structures, known as motor program, through information processing. These processes allow the opportunity to compare in real time, by closed-loop motor control, or later, by open-loop motor control theory, obtain results, triggering a process of adjustment and refinement of movement.

Its structure is such that allows the performer to adjust the movement in order to meet the changing needs of the environment. In this way, the generalized motor program (Schmidt, Wrisberg 2004) joins the feedback and comparator between memory trace and perceptual trace, as occurs in closed-loop, and the innate properties of motor centralized program and the exceeding the limit of time threshold of two hundreds of milliseconds to elaborate, the perception, as occurs in open-loop. All of these three motor control theory, open-loop, closed-loop and generalized motor program, are the basis of the cognitive approach. Cognitive approach is used by prescriptive style teaching and has its basis on the preeminent role of the voluntary and determined movement on the environment. The ecological approach, opposite approach of to cognitive one, does not consider necessary to use prescribing mental structures: the action is directly available to those who act in their own environment, the self-organization that do not require the use of a motor program (Edelman, 1987). In this approach, learning is defined as an education of attention (Gibson, 1986). Learning means to optimize the processes of perception and develops the ability to dictate the specific stimuli (Ambretti et al. 2011). In two these approaches presented here, the perception of the context is different and the learning process is defined differently.

In cognitive approach, motor learning means to stabilize an efficient motor program according to special processing information. In ecological-dynamic approach, motor learning is to seek the adaptability of the movement as resulting by the diversity of the environment and the specificity of the individual (Carnus & Marsault 2003). This approach, the other one, considers evolution of behaviour of complex systems, where a complex system is a set, where the body moves, composed of multiple interacting factors made by body segments. In the dynamic perspective learning is to build and stabilize a new state not included in the initial coordination dynamics of the system. The direct consequence of the cognitive theory in educational applications is a prescriptive approach, with a teacher who directs the structure of motor programs, with increasing complexity, and the optimization of their parameters. The aim of the exercises will be to stabilize and improve motor program by reducing the variability in execution through the repetition method and other didactics such as exercise varied, segmented, randomized and idea motion training. Teaching, in ecological approach, is designed to stimulate the emergence of spontaneous solutions, called heuristics to motor problems, taking advantage of variability in executive search process that implements a mobility solution that passes through the continuous variation of motor gestures. Mainly, the basis of this approach is the freedom degrees theory or Bernstein’s problem by Nikolay Alexdrovic Bernstein (1967) that introduces, for the first time, the interaction of single movement in the holistic vision.
His research showed that most movements, like hitting a chisel with a hammer, are composed of smaller movements by three steps to learn the movement. Any one of these smaller movements, if altered, affect the movement as a whole. The three steps are: reductions freedom degrees, exploration freedom degrees and capitalization freedom degrees. The first one consists to immobilize one or plus articulations to execute by repetitions the same action, the second one occurs when in consequence to immobilize one articulation to explore other movements to aim the same outcomes or to give freedom some of articulations that before are immobilized. The last one is when it organizes the whole movement with the feedbacks by reduction freedom and exploration degrees to perform the movement by repetitions which are differently among them because one movement is different to others.

For this reason, Bernstein called this phenomenon "repetition without repetitions" (Bernstein, 1991). Later, this motor control system has been considered as motor imagery (Lotze & Halsband, 2006). The knowledge of structural and functional organization of the motor system has evolved and deepened in recent years, gradually abandoning the idea of a brain where the processing of sensory information was entrusted to different and dedicated cortical areas, according to a model in which sensory and motor information are very interdependent (Lateh, 2004). A central role in this reversal of perspectives is due to the discovery of mirror neurons, early in monkeys and later in humans. Open loop and closed loop are two of the most important theory of motor control and learning, nowadays it must includes a new theory that can better explain the motor learning (Di Tore, Raiola, 2012).

It is motor imagery theory. Before to talk about it, it has to introduce some new neurological discoveries: Mirror neurons system. "Mirror neurons are for neuroscience what the DNA was for biology" (Vilayanur Ramachandran, in Iacoboni, 2008). Studies in human brain have shown the existence of mirror neurons system similar to that discovered in monkeys while the "Group of Parma of Giacomo Rizzolatti" (1996) has noted that they responded both when the monkey performed directly the movement of reaching the food, either when was another individual to perform the action by recording the activity of certain neurons of motor area called F5 in grasping tasks in the brain of a monkey, a group of researchers (Rizzolatti et al., 2001). "Whenever we see someone performing an action, in addition to activation of the visual areas, there is a concurrent activation of motor cortical circuits that are normally active during the execution of these actions. In other words, the observation of an action involves the simulation of the same. The fact that the motor system is active not only during the run, but also during observation of actions, suggests that exists a relationship between control and action representation "(Gallese et al., 1996).

The discovery of a same group of neurons involved in both perception and action dismisses the idea of specialized brain areas and implies interdependence between perception, cognition and motor system and motor learning produces parallel dynamic functional changes during the execution and imagination of sequential foot movement (Lafleur & Jackson, 2002). The first phase of motor learning is characterized by imperfect movements, a high dependence on feedback and a large cognitive and attention load (Atkeson, 1989). The evolution and stabilization of learned movements is reflected in neuroanatomical level, on a change in brain areas recruited and activated neuronal circuits (Halsband & Lange, 2006). While the immediate repetition of an observed action is supported almost exclusively by the mirror neuron system, learning by imitation requires the intervention of the prefrontal lobe, particularly in the area 46 of Brodmann, and some areas of the cortex anterior mesial. The area 46, generally associated with functions related to working memory, in this case plays a role in combining elementary motor acts in more complex motor patterns. During the learning process, in fact, mirror neurons are responsible for the allocation of the observed action into individual pieces, which are then reassembled into a sequence so that appropriate action is reproduced as close as possible to that observed (Zwicker et al., 2011). The motor imagery is a cognitive process of mental simulation of an action in the absence of physical movement. MI was deeply investigated also by Marc Jeannerod. One of the most scientist about the neurological process. He had lived between 1935 and 2011, its scientific life was entirely dedicated at neurology and neurophysiology, as well as other Scientists about cognitive neuroscience and experimental psychology are interested. Specially, the mechanisms underpinning motor control, motor cognition are investigated by Decety in 1996, Driskell and Copper in 1994, Gallese and Rizzolatti between 1996-2012, Lafleur in 2002, Sanders in 2004. It also defined as a state of general activation during which a person feels himself to perform an action. The motor imagery should be distinguished from mental practice, the first refers to the cognitive process while, the second refers to the process of mental training that takes advantage of the first process. There are two types of motor imagery: in first-person and in third-person. In first person mode, the subject imagines himself to perform an action but not in the sense of seeing himself as an external or reflected image, in the sense to see what he would see, if he performed a movement and at the same time feel emotions, excitation, stress and changes of arousal. In third person mode, the person sees himself or another person as an external image, as with the use of a camera. The most effective for learning is that first-person. Numerous studies have shown that the performance is optimized through the cognitive process of motor imagery. During the motor imagery the cerebral areas of the pre-motor cortex, the same which a muscular contraction would put in action, are activated.
The pre-motor cortex is responsible for complex sequences of movements and selects them in response to a stimulus. The pre-motor cortex is located in front of the primary motor cortex and laterally on the surface of the frontal lobe. The execution and imagination activate the same regions of the cerebellum, basal ganglia and motor cortex. All this is possible thanks to mirror neurons which are the biological basis on which is based the motor imagery. Mirror neurons are a class of neurons which are activated when we make a move and when we observe it, as if the observer did the movement. Mirror neurons were discovered in the 90’s by a group of researchers in a macaque, group coordinator is Giacomo Rizzolatti. In 1995, the same group of researchers demonstrated the existence of a neuronal group, similar to that of macaques, also in man. Mirror neurons have been found in the pre-motor cortex and the parietal lobe, area to which deputed only motor function and not the cognitive function. The activation of mirror neurons allows to map on the same nervous substrate actions performed and observed or imagined. In this way you create an internal image released from execution. Mirror neurons are a particular class of visual-motor neurons which allows to learn and optimize a motor gesture without executing it.

Mirror neurons represent the space of internal sharing that allows us to imitate, learn and understand the intentions of motor events. The ability to create an inter-subjective space which is then shared with the world is connected to the role played by embodied simulation, neuro-scientifically based on mirror neurons.

**Conclusion**

Teaching method of Physical education in school has to be considered according to the ministerial documents (Raiola 2011ab, Raiola 2012ab). In this way, the knowledge is quickly developing and the changed are too fast to include in revision. It is useful to involve scholars in applied study in educational field of school and of sports club to have the same scientific idea. Too often, the world of school and the sports one are too away each other to collaborate. Cognitive approach is an usual way to understand the movement, that is the historical way to study and investigate the issue in behaviorist/cognitive interpretative key.

Ecological Dynamic approach is an extraordinary way to understand the movement, that is the innovation way to study and investigate the issue in gestalt/phenomenology interpretative key.

**References**


TJELESNA AKTIVNOST I SPORTSKA VJEŠTINA I RELACIJE S TEORIJOM MIŠLJENJA NA MOTORIČKU KONTROLU

Sažetak

U didaktici tradicionalno je sadržan odnos coach / trener / učitelj s tutorialom koji ima teorijski temelj na kognitivnom pristupu. To znači da coach / trener / učitelj ilustrira detalje kao trenera, ako su parcijalnog tipa, raznovrsni, nasumični pa i s primijesama mentalnog treninga. To se odnosi na modele motoričke kontrole na otvorenoj petlji, zatvorenoj petlji, i generalizirani motorički program. Nastavne metode tjelesne aktivnosti također se daju po drugom pristupu koji se zove ekološko-dinamički gdje coach ne zahtijeva tutorial, ali gradi okruženje postavke učenja usmjerene na različita učenja. To se odnosi na modele za kontrolu motoričkih slika i stupnjeva slobode u prostoru. Prvi bi mogao biti u prvom licu, pa u trećem licu; drugi je tri uzastopna koraka: smanjenje, istraživanje i kapitalizacija stupnjeva slobode. Cilj rada je pitanje teorije motoričke kontrole i njegov odnos prema procesu učenja i znanju tijela. Ta kontrola obavlja specifični aspekt pristupa učenju. Glavni rezultati pokazuju dvije vrste korespondencije: 1) između kognitivnog pristupa i motoričke kontrole zatvorene petlje, otvorene petlje; nadalje, postoji značajna korespondencija između naloga, zahtjeva, redoslijeda i tajminga kod učenja pokreta: 2) između ekološko-dinamičkog pristupa i motoričke kontrole - Motor Imagery i stupnjevi slobode; nadalje, postoji značaj, na korespondencija između postavljanja, okruženja za učenje i specifičnih strategija nastavnih metoda kao što su suradničko učenje, igranje uloga, krug vremena, brain-storming, vršnjačke edukacije, tutorstva, fokus grupe. Na taj način se može vidjeti invazivna uloga coacha / trenera / učitelja u kognitivnom pristupu i neinvazivna uloga u ekološko-dinamičnom pristupu.

Ključne riječi: kognitivno, ekološko-dinamično, ognitive, ecological-dynamic, nastavne metode

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Correspondence to:
Gaetano Raiola, Ph.D.
University of Basilicata
85100 Potenza, via N. Sauro 85, Italy
Phone: +39 0971 201011
E-mail: raiolagaetano@libero.it