VERSO UNA FISIOLOGIA DELLA QUALITÀ DEL MOVIMENTO

ANCORA SUL SIGNIFICATO COORDINATIVO DEL PARADOSSO DI LOMBARD

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INIZIO DELLA QUARTA PARTE DELLA 16^A^
CONTINUA

Da quanto è stato illustrato nelle puntate precedenti di questo studio emerge che il problema, per la prima volta affrontato con intenti sperimentali da K. Wachholder, dell'intervento dei muscoli poliarticolari nel movimento manifestato dall'organismo umano ed animale, si dimostra molto ostico per il ragionamento dell'uomo, rimandando ancora una volta le velleità scientifiche degli studiosi della coordinazione motoria alla desolante conclusione di N.A. Bernstejn, richiamata nella continua precedente e sintetizzata nella parafrasi: MOTUS PARENDO VINCITUR+.

Prima di trarre le inevitabili conseguenze, per la nozione di allenamento per il conseguimento dei risultati nelle competizioni sportive, dalla ormai evidente irrisolvibilità, per la razionalità umana, del problema della coordinazione motoria, si vuole insistere ancora una volta sulla necessità di ripudiare il concetto di ALLENAMENTO TECNICO, oggi largamente accettato tanto nella prassi, quanto nella teorizzazione dell'allenamento sportivo, insegnata in tutte le sedi impegnate a formare gli operatori che professionalmente programmeranno e condurranno l'allenamento finalizzato al conseguimento dei risultati nello sport competitivo.

In particolare, è inderogabilmente doveroso che il prestigio dell'Università italiana, quale istituzione depositaria della Cultura, cessi di svolgere una disonorevole funzione di propaganda ideologica, impartendo l'insegnamento dell'allenamento sportivo, nelle nuove Facoltà di Scienze Motorie, come l'insegnamento della coordinazione motoria, l'insegnamento dell'allenamento tecnico.

Per questo motivo, prima di passare, nella prossima continua di questo Corso, all'illustrazione delle conseguenze che l'irriducibilità algoritmica della coordinazione motoria umana produce sulla nozione di allenamento per il conseguimento dei risultati nelle competizioni sportive, viene richiamata l'attenzione di tutti coloro che si interessano dell'inquadramento razionale della motricità umana (per intenderci, di tutti coloro che non intendono soffermare il loro interesse sul fenomeno da una prospettiva esclusivamente estetica od etica), sulla riflessione dello studioso che con più tenacia, approfondimento, completezza e competenza ha affrontato la problematica posta dalla coordinazione motoria umana al ragionamento dell'uomo, Mark L. Latash.

Dal suo esaustivo lavoro: NEUROPHYSIOLOGICAL BASIS OF MOVEMENT ci è consentito estrarre la parte che viene qui di seguito riprodotta, perché ribadisce la contraddittorietà tra le nozioni di coordinazione e controllo del movimento volontario e, dunque, tra biomeccanica ed allenamento tecnico.

DYNAMIC PATTERN GENERATION (1)

One can hypothesize that the execution of any functionally important motor task is associated preprogramming of certain moto patterns, depending on the task and on possibile perturbations that can occur durino the task execution. These preprogrammed patterns provide for the very quick initiation of compensatory responses to the perturbatione. Because these motor reactions are prepared by the central nervous system prior to an actual perturbation, they always lead to rather crude approximate corrections that can be further corrected with a voluntary action. Locomotion is one of the most commonly used movements in everyday animal and human activity. As such, the mechanism of locomotor movements is well protected with a set of preprogrammed corrections that can be triggered by appropriate proprioceptive stimuli.

The alternative approach locomotion (as well as to the generatione of other movements) ha been pioneered by Scott Kelso and Gregor Schoner and termed the dynamic systems approach or dynamic pattern generation.

According to this approach, the system for movement production - including the central neural structures, the effectors and their connections with the central structures, and environmental forces- can be modeled with a nonlinear differential equation. The term nonlinear means that the response of a system, as described by these equations, to an input signal may change disproportionally to changes in the input signal. Such equations cannot typically be solved analytically. When applied to motor problems, they can describe rather complex behaviors including, in particular, oscillations and changes in relative coordination. Note that oscillations are typical features of locomotor movements, while changes in relative limb coordination describe changes in gaits.

The dynamic systems approach has shown impressive success in its description of certain features of motor coordination, including interlimb and interjoint coordination. There are two major views on the approach. Some accept it as the only correct approach to voluntary movement production in humans - the one that ties together events of the inanimate world and biological phenomena. Others see it another example of mathematical modeling, that is, an example of efforts to address biological problems with tools that have been developed for other areas of science. It is no surprise that a complex equation can model complex behavior better than a simple equation. A major question is whether its parameters can be assigned physiological meaning. To date, parameters of equations used within the dynamic systems approach have not been assigned a measurable physical or physiological meaning; that is, their values are selected rather arbitrarily in order to make sure that the model produces desired coordination patterns.

Let us figure 1, which is analogus to a figure originally published by champions of the dynamic systems approach, Claudia Carello and Michael Turvey, to illustrate the major difference between the motor programming (or CPG) approach and the dynamic systems approach. The upper drawing (A) illustrates control of locomotor of an owl from the motor programming (or CPG) view.

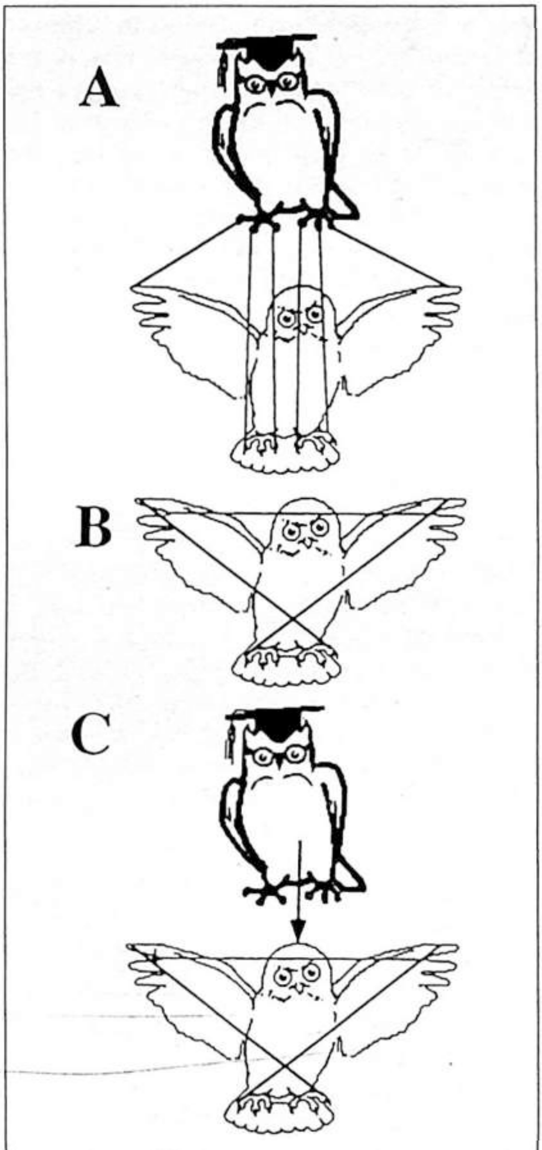

Figure 1 - An illustration of the motor programming approach (upper drawing, A), the dynamic pattern generation approach (middle drawing, B), and a combination of the two (bottom drawing, C). Note that the upper drawing does not involve coordination and the middle drawing lacks control.

The "owl homunculus" controls all the details of owl movement patterns, as with a marionette.

The middle drawing (B) illustrates the same owl without any supreme homunculus but with numerous links connecting its elements (connections with external variables are also implied; note the open eyes of the owl!), in line with the dynamic systems view. It is supposed that these links give rise to the equations mentioned, potentially leading to complex behavioral patterns.

Note that the upper drawing lacks the element of coordination or, more precisely, that all the details of coordination are delegated to the ultimate controller; in other words, they are assumed to be preplanned by the supreme omnipotent homunculus. This is not very attractive for a number of reasons, particulary because, as we know, similar coordination patterns can be observed in spinal animals that apparently lack any homunculus. Moreover, assigning all the details of coordination to a smart "black box" does not solve the problem but rather emphasizes our inability to deal with it.

The middle drawing illustrates a much more appealing approach to coordination, which can emerge without any supreme problem solver; but it lacks the element of control. This owl will never be able to change its behavior based on its own will, only in response to signals from the environment. Remember that earlier (2) we discussed the differences between the physiology of initiative and the physiology of reflextype movements and came to the conclusion that behavior cannot be based exclusively on reactions to external stimuli. Thus, this drawing is also unsatisfactory.

The bottom drawing (C) shows a "hybrid owl" that retains all the coordinative links among its elements but also has an independent descending signal, generated by its upper neural structures, that can be used for movement initiation or modification even if the environment does not dictate it. This descending signal represents one of the important parameters in the equations that describe the coordination. Bernstein's principle of initiative states that this input cannot be reduced to reactions to external stimuli. In this respect, its nature remains mysterious. This may not sound very "scientific", but unfortunately, I am unaware of viable alternatives to the scheme shown in figure 1 C. Coordination and control can and must coexist in order to allow both active central generation of meaningful movements and adjustment of coordination to control and environmental demands

NOTE

\+ N.A. Bernstejn - Problema vzaimootnosenij koordinacii i lokalizacii. Arch. Biol. Nauk. Moskva, 1935, 4.

(1) Testo ripreso, con consenso, dal lavoro: Mark L. Latash - NEUROPHYSIOLOGICAL BASIS OF MOVEMENT. - Human Kinetics, P.O. Box 5076, Champaign, IL. 61825-5076. 1998.

(2) Cfr. Continua precedente di questo Corso (Ndr).

QUESTIONARIO

PROBLEM 1

Give examples of other tasks that are associated with a system of preprogrammed corrections.

PROBLEM 2

In classical experiments by Kelso, when the subjects tapped a rhythm with two index fingers, an increase in tapping frequency could lead to an automatic switch from an out-of-phase regime into an in-phase regime. Try to interpret these observations based on the three approaches illustrated by the three parts of figure 1.

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