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Study of the Performative Changes due to the Modification of the Motor Programs through the Sincrony Methodology

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Abstract

Understanding how human beings generate movement is a fundamental objective due to the implications that it itself has in the various fields of application, especially those concerning the teaching methodology in stages of growth. Starting from the study of the Sincrony Theory (and its methodological applications into sports field, the authors have built an experimental paradigm to verify the different impact of Motor Programs based on the cause of movement compared to Motor Programs based on the effect. The basic idea is that movement perceived on a visual level matches to the effect of muscle contractions not visible in the manifest act but which are the cause. The authors studied a paradigm to evaluate whether through simple linguistic indications aimed at making a motor pattern used for causes, changes in performance would have been recorded. The authors therefore chose to evaluate running performance in growing youth who were not trained in this sporting discipline. The authors modified only the language with which the subjects were asked to run and evaluating the possible performance differences through the Cooper test.

The authors tested three groups of subjects, all groups initially carried out the test without receiving indications related to running technique. Subsequently to"group one" the experimenters explained about the running technique based on the activation of Motor Cause patterns, based on synchrony methodology. No methodological specifications were received from the "second group". The "third group" was given technical explanations based on the correctness of the technique. The results showed a 6% increase in the first sample with a statistically significant difference compared to the control, sample three did not show performance improvements and the performance results were variable compared to those of groups one and two.

According to the authors, the reasons for these results lie in the fact that when the athletes manage to have a motor program based on the real causes of the movement, the system is optimized, with less use of the antagonist muscles recruited in that given action. Normally, however, this does not happen since the Motor Programs are on average based on effects: "thinking" about a movement (by effects) causes, according to the authors, a slowdown due to both a greater elaboration process and a greater involvement of the antagonists in the action. In the third group, the authors wanted to ascertain the contribution of learning by inverse model,i.e. by correcting the motor output through inverse feedback linked to the effect that should be obtained if the motor project were based on the causes without however giving an explanation to the athlete of the themselves.

In this case not incrise performative is according to the authors based on the fact that the inverse corrections cause a sort of attentional overload until there is automation of the new motor patterns. The authors expect that in the latter case, if the subjects repeated the test several times, training to manage the corrections on the motor output, a performative improvement would be restablished. In the light of the foregoing, it may be extremely interesting to deepen the argument for which the type of explanation can influence the optimization of the motor gesture.

Keywords: Motor programs based on cause • Cooper test • Performance • Motor programs based on the effect

Introduction

Understanding the ways in which human beings generate the common movements of daily life or those specific to sports is an important scientific goal due to the relevant implications it could have in the medical, rehabilitation and sports training fields [1]. We know that the Nervous System helps to generate the processes necessary to generate such movements. Many motor control models in fact assume that there are a series of central activations that occur at the level of the nervous system and that will culminate in the activation of the muscles involved in a given voluntary movement [2-8].

These models usually assume there are two broad sequential phases, one planning and one executing the movement [9-14]. This division, however reductive, helps to explain the mechanisms of motor control of movement and information processing as a function of the same [15-21]. Human locomotion and running can provide useful insights to understand the strategies used for motor control [22-27]. Furthermore, some studies related to the kinematics of locomotion and human running have suggested that some neural circuits may in some way also specify the kinematics of lower limb movement in movements cyclical [28-31].

In this case, muscle activation should be somehow interposed or related to an integrative system of kinematic planning that respects the kinetic requirements of the locomotion movement under consideration [32,33]. In fact, some theories hypothesize, based on the theories of Wilson of 1961 and Grilner of 1981, that in the motor control of locomotion, there are neural circuits that generate "rhythms". (Central Pattern Generation, CPG), shifting attention from motor behaviors of the type reactive to those of the "active" type. This notion later evolved into the concept of the Motor Program [34,35]. This term (PM) indicates an abstract mental representation that is invariant with respect to the geometric and dynamic aspects of real movement.

This definition, according to the Sincrony model for the study of performative movement, is based on the elaboration for the creation of the Motor Program of the visible effects of the movement and not on the real causes that cause it. In the act of locomotion and running, therefore, our Motor Program would be based on the analysis of the visible action (effects) not on the activation principles (causes) [36-40]. Ivanenko and colleagues in their 2004 work focus on how the origin of gait should be considered the propulsion (cause) rather than the heel strike event or stride width (effects).

We agree with these observations by believing that support and stride are direct consequences of the propulsive act and that it itself depends on a complex neural structure that has its basis in the process of planning the movement and in the use of Motor Programs based mainly on observation of motor effects [41]. In this study, therefore, we want to evaluate through

the Cooper Test the possible performative change in running resulting from the use of a motor program based on causes (Sincrony Model) rather than on the effects and therefore evaluate the possible applications incompetitive sport [3]. We also want to be stable if the resulting propulsive act is optimizing with respect to a correction with an inverse model of the effects (REF).

Materials and Methods

We have chosen to use a test for the evaluation of running as a representative cyclic motor act: the Cooper test. This test has been used extensively in the study of sports activity, therefore it nourishes a strong level of data stability, it was conceived in 1968 by NASA doctor Kenneth H. Cooper [42]. In its original form, the test involves running for twelve minutes trying to cover the maximum distance possible. In order to measure endurance, the subject-athlete should run trying to maintain a constant pace [43,44].

Each subject-athlete took the Cooper Test in different sessions and with different orders, all the participants had never been subjected to this Test before. The administration distance between the first Cooper test (T1) and the second (T2) was approximately three days. No subject-athlete, whom we will exclusively call subjects, has been trained or trained to improve performance in T2 during this time interval. Furthermore, no one was informed about this second administration so as not to foment any subject any motivation for learning during the T1 execution. Test T1 was administered after a three-day rest period of the sample from any form of physical training. All the subjects carried out the Tests, T1 and T2, on a marked track, with demarcation every twenty meters and a stable, flat surface made of composite material. All subjects participated with suitable footwear and clothing.All subjects were tested at the same time of day and with the same atmospheric conditions in the absence of rain or winds.

Subjects

All tested subjects are females of Caucasian origin aged 13 years to 17 years. We tested a completely female sample to reduce undetermined gender variables [45].

All subjects were chosen from a sample of a competitive sportswoman, excluding however anyone who came from previous experiences in sports in which running was presented as a basis or purpose. This, in our opinion, is useful to ensure: on the one hand the presence of efficient Motor Programs and familiarity with the use of the body, on the other the absence of precise Motor Programs representative of a previous specific motor learning in running. Furthermore, the sports training base of the subjects ensured the ability of the experimenters to understand and apply the requests made to them. All subjects underwent T1 and T2 tests in the absence of a menstrual cycle. No test subjects were excluded from the sample. The tested subjects were divided into three groups for a total sample of 129 Cooper Tests repeated for two different sequences, the girls had an average age of 14.9 years.

Group one is made up of 55 subjects with an average age of 14.8 years. The second group is made up of 39 subjects with an average age of 14.7 years considered the control group. The third group made up of 35 subjects with an average age of 15 years also considered control compared to the main research. All the subjects were tested in the developmental range between 13 and 17 years because it is in these years that we can have: a consolidated internalized body pattern and the presence of a restructuring of the acquired motor patterns. This aspect in our opinion makes hypothetical changes in performance easier to observe. However, a study in adults and /or in males remains desirable.

Group 1 Test T1

Group 1 carried out the Cooper T1 Test and received the following information from the experimenter: "you will have to travel as far as possible in 12 minutes, every 400 meters you will be provided with information on the time remaining for the completion of the test. Try to keep a constant pace, at the whistle stop where you are. Try to give your best because the evaluation will help us to establish your real state of fitness, strive to go as far as possible".

The subjects were not all tested on the same day but divided into randomized groups. At least one of the two "responsible" investigators (SR) plus an assistant experimenter were always present for the test to ensure the qualitative accuracy of the test. At least one of the two SR experimenters was present for all the trials in an attempt to minimize the experimental error variables by re-proposing the same experimental conditions in the various subgroups. The time was calculated with a professional sports chronometer and the length calculated with a signature every 20 meters by measuring following the RTI 240.3 rules of the FIDAL.

Group 1 Test T2

Group 1 carried out the Cooper T2 Test no later than four days after the T1 Test, on average, the T2 Test was carried out with an average distance of 2.5 days from T1. No subject was informed of the second Test nor was trained to do so. In T2, group 1 received the following indications from the experimenter: "... you will have to e, be careful you will have to concentrate on imagining that you are PULLING BACK the floor, every 400 meters you will be provided with the information of the time remaining to complete the test. Try to keep a constant pace, at the whistle stop where you are. Try to give your best because the evaluation will help us to establish your real state of fitness, strive to go as far as possible"

The explanation of the real causes of the movement was then given to them, the example was verbalized: "imagine that your lower limbs are oars and the road is water, you have to imagine rowing backwards, as an effect you will go on, don't worry, keep rowing. "The experimenters made sure the subjects were clear about the task before starting T2.

Test T2 was carried out on the same path as T1, maintaining the same experimental setting. All subjects maintained the same suitable shoes in both tests.

Group 2 Test T1

Group 2 carried out the Cooper T1 Test and received the following information from the experimenter:".you will have to travel as far as possible in 12 minutes, every 400 meters you will be provided with information on the remaining time to complete the test. Try to keep a constant pace, at the whistle stop where you are. Try to give your best because the evaluation will help us to establish your real state of fitness, strive to go as far as possible". Exactly like group 1 and the identical conditions of experimental setting, experimenters and randomization of the sample were maintained.

Group 2 Test T2

Group 2 carried out the Cooper T2 test no later than four days after the T1 test, on average, the T2 test was carried out with an average distance of 2.5 days from T1. No subject was informed of the second Test nor was trained to do so. The Cooper test was repeated to this group exactly as in phase T1 without changing any request. So let's consider this our control group.

Group 3 Test T1

Group 3 carried out the Cooper T1 Test and received the following information from the experimenter: "you will have to travel as far as possible in 12 minutes, every 400 meters you will be provided with information on the time remaining for the completion of the test. Try to keep a constant pace, at the whistle stop where you are. Try to give your best because the evaluation will help us to establish your real state of fitness, strive to go as far as possible". Exactly like group 1 and group 2 and the identical conditions of experimental setting, experimenters and randomization of the sample were maintained.

Group 3 Test T2

Group 3 carried out the Cooper T2 test no later than four days after the T1 test, on average, the T2 test was carried out with an average distance of 2.5 days from T1. In T2, group 3 received the following indications from the experimenter: "you will have to, be very careful you will have to concentrate on trying to keep the running technique with wide strides and an almost complete breech support, every 400 meters you will be provided with the

information of the remaining time for the completion of the test. Try to keep a constant pace, at the whistle stop where you are. Try to give your best because the evaluation will help us to establish your real state of fitness, strive to go as far as possible"

The explanation on the effects of movement was then given to them and the example was verbalized: "when you run your lower limbs perform more apie strides and the way in which the foot first rests with the postero-central part and then reaches the antero-central"Also in this group the experimenters made sure that the subjects were clear about the task before starting T2. Test T2 was carried out on the same path as T1, maintaining the same experimental setting. All subjects maintained the same suitable shoes in bothtests.

Results

The three samples tested are women between the ages of 13 and 17. There are no significant age differences between them. The data were analyzed through correspondence analysis in order to assess whether the results could be to some extent dependent on structural variables such as the age of the subjects themselves. A logistic regression was then performed in order to compare the results read in the test samples with the control sample.

From the analysis of the correspondences it emerges that:

- Performance in general (Cooper test score) has a certain correlation with the age of the tested subjects (corr.= 0.639).
- The increase in performance does not appear to have a correlation with the age of the subjects, (corr. -0.092).
- A positive correlation (0.576) is observed between the change in performance observed by Cooper test and the work that was required of the athletes.

The logistic regression analysis highlighted the goodness and significance of the results read, showing a T-Value = 9.03 with significance "<.0001

Discussion and Conclusion

The authors observe in this research how following a single indication, based on the motor programming of the causes, provided immediately before the T2 test without any type of training prior to the required task, immediate effects of an average performative increase of 6% are obtained. ,significant and in any case positive in all subjects with a single exception where performance stability was manifested. According to the authors, this is extremely relevant for practical purposes since the motor program for causes was received by almost all of the sample and with "simplicity" (immediate increase in performance).

According to the authors, therefore, a significant improvement in performance can be achieved by working exclusively on motor programming by causes, so the work on the volume and intensity of the classical methodology could be improved through integration with neurophysiological sciences. According to the authors, the improvement in athletes where performance is already high, it could be assumed that the objectives will be achieved in a shorter time, the overall possible improvement should be explored with new ad hoc studies created perhaps even in a male sample. The growth phase (13 years -17 years) that is representative of the period of modulation and adaptation of the motor programs must certainly be kept in mind. According to the authors, it could be interesting and useful to repeat the study on a sample of adults in whom the modulatory flexibility of the motor patterns is lower. The further increase in performance resulting from this type of work would remain to be tested.

The experimenters also observed a qualitative improvement in the execution technique as a result of the programming incipit, it is also suggested in the eventual test on an adult sample an evaluation of the qualitative aspect. The data collected in the third group do not show such significance as to allow the authors a consistent description of the phenomenon. However, authors feel comfortable to share their readings on the matter. In the sample there was no significant or homogeneous improvement, this could be possible because the corrections on the technique, although limited to two specifics: increase in stride and roll of the foot in support, were generally an excessive workload to be assimilated and then reproduced in such a short time. Authors imagine that through an adequate training, positive results would certainly have been achieved in that champion as well. It would be interesting to continue to train the champions and to verify after three or more months the possible differences between those who apply the Motor Program based on causes compared to those who train the correction of the resulting technique. It would also be desirable to work on professional athletes in non-racing disciplines to assess whether they already have motor patterns in them for causes and not for effects, being themselves at the Top level in their sport. There are great prospects for growth and the influence of this differentiation on the Motor Programs for future studies. In fact, the authors think of a possible methodological application for teaching based on programs for causes.

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