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Effects of a sensory strategy in an isometric muscular endurance task

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ABSTRACT

Objetive. The use of music and video in exercise domain might act in parallel over other physiological signals and its central interpretation may change the rate of perceived exertion and subsequently the final performance.
The purpose of this study was to examine the effects of sensorial modulation in an isometric muscular endurance task.
Method. Ten volunteers have performed three tests, in which they had to keep the dominant arm abduction until exhaustion whilst the following variables: total time, rate of perceived exertion (RPE),median frequency (MF) and root mean square (RMS) were monitored. Each subject has performed a control (CO), deprivation (DP) and stimuli (SC) condition. Analysis of variance (ANOVA) one-way was applied followed by post-hoc Scheffé test. The smallest worthwhile change was used to provide a qualitative analysis of performance.
Results. No significant differences were found in muscular activity between conditions and performance ($p > 0.05$). The slope of RPE was significant higher to DP compared to SC (4.3 + 0.77 a.u. *vs* 3.53 + 0.46 a.u., $p < 0.05$; respectively). Furthermore, a higher probability of improvement for time to exhaustion was found to SC compared to DP (97 %) and CO (92 %), conversely the opposite outcome was demonstrated to DP compared to CO (59 %).
Conclusion. It was concluded that a sensory strategy was capable to modulate RPE and performance.

Palabras clave:
Modulación sensorial.
Música.
Actividad motora.

RESUMEN

Efecto de una estrategia sensorial en una actividad isométrica máxima del músculo

Objetivo. El uso de la música y el video en la realización de los ejercicios pueden actuar en paralelo con otras señales fisiológicas y su interpretación central podría cambiar el esfuerzo percibido y posteriormente la actuación.
El propósito de este estudio fue verificar el efecto de la modulación sensorial en una actividad isométrica máxima del músculo.
Método. Diez voluntarios realizaron tres pruebas en las que tenían que mantener la abducción del brazo hasta la extenuación mientras se obtenían las siguientes variables: el tiempo total, tasa de esfuerzo percibido (TEP) y los indicadores de actividad muscular (frecuencia media (FM) y raíz cuadrada de la media (RCM)). Cada individuo realizó un control (CO), privación (PR) y condición de estímulos (CE).
Resultados. No se encontraron diferencias significativas en la actividad muscular entre las condiciones y el rendimiento ($p > 0,05$). La pendiente de TEP fue significativamente mayor a la PR en comparación con CE (4,3 + 0,77 a.u. vs 3,53 + 0,46 a.u., $p < 0,05$, respectivamente). Además, se encontró una mayor probabilidad en el tiempo de agotamiento en CE en comparación con PR (97 %) y CO (92 %), y menos probabilidad de que el rendimiento sea encontrado en PR en comparación con CO (59 %).
Conclusión. Se concluyó que una estrategia sensorial fue capaz de modular TPE y rendimiento.

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INTRODUCTION

The applications of sensory strategies as music and video have been highlighted by many studies on physical exercise domains[1-10]. Additionally, those have provided meaningful results to psychophysiological and performance variables[11-14].The explanation of this phenomenon is called parallel process, a kind of mechanism inside the brain capable to identify the importance level behind each afferent signal, selecting which of them really deserve the full or partial interpretation[15,16]. To explore this hypothesis, a whole framework of psychophysiological assessment has got to be done, evaluating performance achieved, psychological and physiological state of subjects is very important to obtain a general aspect and take correct decisions.

To illustrate this point of view, low-intensity physical exercises as walking in a comfortable pacing might cause soft perceptions about heart or respiratory rate, on the other hand, when the activity increase such intensity (e.g. running at 8 km/h) the muscular afferent signals receive importance and the rate of perceived exertion tends to surge[17,18]. When the task presents a high-intensity, a great number of afferent feedback from muscles and other physiological components are sent to the brain and their interpretations might produce the final perceived exertion, which is sometimes responsible for influencing final performance[15,16].

This interpretation occurs through an attentional focus, which selects what is more important at that time or what should receive more signals, allowing at initial moments of such task with low-intensity be sought-after by audios or visual signals, acting as a tool to extend the final point to exhaustion[12,19]. In activities involving the whole body, subjects may control what they do and what will be done to complete the exercise with the highest success[20-22], therefore, activities involving open-loop circuit with established workload may show greater alterations from sensory organs[2,21].

There is a great amount of studies involving sensory strategies, which can contribute with exercise and sport domains[23-29], in majority; they include an increasing audios feedback, and finally reporting better results to performance or psychological state[30]. However, deprivation of sensory feedback might bring fatigue sensations in advance. Thereby, the purpose of this study was to investigate the effects of music and video in an isometric muscular endurance task.

METHOD

Subjects

For this study, 10 health men were selected (21,0 ± 1,5 years, 69,8 ± 5,2 kg, 175,0 ± 4,0 cm), who were students of sport sciences from the Faculdade de Motricidade Humana - Universidade Técnica de Lisboa - Portugal (FMH-UTL), recruited from sports science classes. After a brief explanation about the study, the subjects that accepted to participate in the research had signed a term of consent informing the objectives and possible risks of the research. This study was approved by the local Ethics Committee.

Experimental approach to the problem

First of all, the subjects were informed they could not practice any kind of physical exercises at the day before the test as well as in the test day.

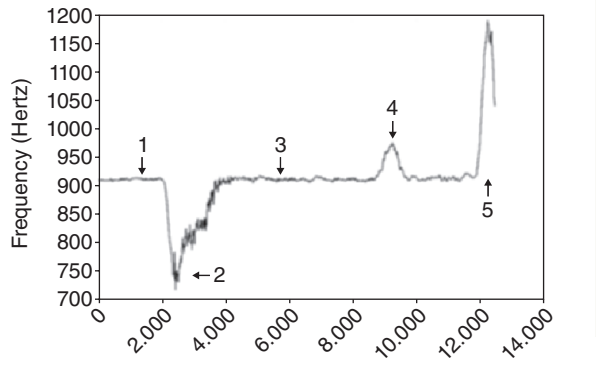

Fig. 1. The curve interpretation through electrogoniometer. The arrow 1 shows the arm position at 0 º related to the trunk; the arrow 2 shows the arm variation to 90º (abduction) The arrow 3 shows a stable position at 90 º related to the trunk; the arrow 4 shows a little fall of abduction (50 Hz was considered the exhaustion moment); the arrow 5 shows the complete fall of arm to the initial point. Time: ms.

Secondly, they have passed by three experimental conditions; deprivation (DP), stimuli (SC) and control (CO) that were performed at three different moments and in a random order, as a way to nullify the effect of learning during the sessions.

The task consisted of keeping the arm at the abduction position (angle near 90° of the body) until exhaustion. The forearm had to keep a full extension and the arm should be positioned in a 0° rotation (thumb forward). An electrogoniometer (BioPlux®) was used to measure the angle between the arm and the body, allowing a maximum of 10° variation. Any extra fall over than 80° or any corporal compensation to the left side was considered fatigue and any of these situations the task was stopped; an example is presented at figure 1. All the arm position variations was analyzed by an electrogoniometer positioned in the posterior wrist region, which was associated with a telemetry system for collection of biological signals BioPLUX® research 2010 (PLUX, Lisbon, Portugal). The electrogoniometer signal processing was performed by a MATLAB® routine software V.R2010a (The Mathworks Inc., Natick Massachusetts, USA) defined for this purpose. The point that corresponded with 50Hz represented fatigue (10°).

The RPE was measured using the Borg 15 point's scale[31] during isometric shoulder abduction, being applied in the beginning of the task and every 30 seconds until the end. All the subjects were trained previously to use the Borg scale with the aim that they could choose and differentiate all of perceived exertion levels (even without vision and hearing situation).

Performance tests

The subjects were exposed to three experimental conditions: deprivation (DP), Stimuli (SC) and control (CO), with an interval of at least forty eight hours between sessions. Time keeping was done with a digital stopwatch accurate (1/1000 seconds) and started when the arm reached an abduction level of 90 degrees.

In the SC condition, the subjects were instructed to choose a music (motivational features; self-selected method) which was used to give them auditory and visual stimulus. Through headphones the volume was adjusted according to subjects' preference keeping always near decibels (± 75 decibels). The recommendation was that the chosen song could motivate them during a vigorous physical exercise. A television was used in front of the subjects to show the video clip from the chosen