THE USE OF PHYSIOLOGICAL PARAMETERS IN MEASURING THE VEGETATIVES CONSEQUENCES OF MENTAL IMAGERY

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INTRODUCTION

Mental practice can be defined as the symbolic rehearsal of a physical activity without any observable muscular movement (Weinberg,1982). The effects of mental repetition of an activity entail not only the improvement of motor performances, but create vegetatives consequences, which are connected to the degree of imagined effort (Decety, Jeannerod, Germain et Pastene, 1991; Decety, Jeannerod, Durozard & Baverel, 1993). These beneficial effects of imagery have been explained by considering that the central structures of programming allow the anticipation of the metabolic requirement according to the established goals. Goals are objectives or states generally considered as the immediate precursors of behaviors. According to control theory (Carver and Scheier,1981, 1982; Powers,1973), an individual's goals or purposes are reference criteria against which sensed feedbacik is compared. A negative feedback loop reduces the discrepancy between the goals and the perceptual input, thereby directing behavior toward the goals specified by the reference criteria. A crucial argument in control theory is that goals are arranged in a hierarchy of means and ends, in which low-level, concrete goals (movement programming) serve to achieve high-level, more abstract goals (exhibiting competence). The authors who do not agree on the explanatory theory of vegetative changes observed during the mental imagery phase, also have differing opinions concerning the existence of measurable muscular activity.Traditional instruments of measure such as heart rate and electromyography, were as well as force measurement.The force allowed us to know the mechanical force produced, which should be zero during imagery phase not to have a conclusion in favor of a mechanical action.

METHODS

If we consider, after having analysed the work of Jagacinski et Nicholls (1984,1987) that the central structure involved in the programming of a real activity, as in an imagined activity, defines the contents of this activity according to a goal, we can then assume that the mental operations occuring before the beginning of an action affect the level of effort and the energetic or metabolic resources used.We ask 24 male subjects whose average age was 22,3 years and who had obtained good results from the Sheehan imagery questionnaire (1967) to imagine a precise isometric contraction : bending the elbow. Subject was connected to equipment that recorded the electromyographic signal, heart beat and muscular force level. The quality of the signal (EMG and CF) for each electrode setting was obtained and checked on the screen of the computer recording the physiological parameters. Through the use of

instructions, one group of 8 subjects had to complete the task (called the goal of implication in a task), 8 other subjects had to do better than the others, surpass them (goal of implication in the ego) while the 8 remaining subjects were given no instructions to achieve the goal. All the subjects went through two experimental sessions two weeks apart and including positive\negative feed-backs. In the real execution phase as well as in the imagery phase, the measurements of heart rate (electrode type Red Dot 2248, Gel Solid Diameter 4,4 cm), the electromyography of the biceps brachi (with Myodata for recording and processing electromyographic surface signals on a PC-AT Computer) and force used (by force sensor installed via the B-channel of the oscilloscope) are the primary indicators concerning the vegetative changes.

RESULTS

They show by ANOVA analyse 3 (no goal, task involvement goal, ego involvement) x 2 (positive vs negatif feed-back) subjects who received negative fedback reported greater effort in ego involvement than in task involvement ($p<0,01$). Inversely, subjects who were given a positive feed-back reported less effort in ego involvement than in task involvement ($p< 0,04$). Finally when receiving incompetence feed-back, subjects reported less effort in the absence of goals (control condition) than in ego involvement ($p<0,0001$) and task involvement ($p<0,02$). Concerning the heart rate, there is a significant rise during a real movement as well as an imagined one and this is even more evident when the subjects go from the conditions of implication in a task and implication of ego.

The electromyographic measures for the imagined contraction show there was no trace of electromyographic activity when the individuals did not perform a mechanical action. Interestingly, during actual contraction, the electromyographic potential differences between the task and ego involvement conditions were observed. EMG value was significantly higher with ego involvement goals than with task involvement goals, whether the feed-back was suggested incompetence ($p<0,02$) or competence ($p< 0,001$). In the same way, for task involvement situation, EMG signals were higher when subjects were given positive ($p<0,002$) or negative feed-back ($p<0,003$).

	IE		IT		GPC	
	fb-	fb+	fb-	fb+	fb-	fb+
with strength	0,3015	0,3058	0,2856	0,2504	0,2362	0,2251
without strength	0	0	0	0	0	0
N	5	3	1	1	1	0

Table : Amplitude of signal EMG (µv) crest with and without appearance of strength, and individuals number (N) used strength as a function of type of involvement (task : IT, ego : IE, lack of goals : GPC) and type of feedback (positive vs negative).

These results tell us that in the mental imagery phase, each time there was significant electromyographical activity it was due to a mechanical action. By controlling the absence of isometric contraction using a force sensor and an oscilloscope, it was then established that the muscle did not produce any electromyographic activity even when subtended by mental repetition. Consequently, when muscular activity has been observed during mental repetition in certain experiments (Hale,1982; Harris & Robinson, 1986; Jowdy et Harris, 1990), it is probably because the subjects were producing a mechanical action that could not be directly observed. The significant increase in heart rate between the the no-goal condition and the task -involvement or ego-involvement can be explained by the goal theory proposed by Locke and colleagues (Locke & Lathan, 1990; Locke, Shaw, Saari, & Lathan, 1981) and by theories on sociocognitive goals in an achievement context (Dweck & Elliot, 1983; Dweck & Leggett, 1988; Nicholls,1984, 1989). Firstly, according to the Locke et al. Theory (1981), effort is simultaneously mobilized towards and in proportion to goal and task demands. It is possible in our case that when goal was lacking, subjects " did their best " (Locke & al.,1981) because the emphasis was only placed on the formation of a mental image during maximal contraction. Secondly, we know that subjects set goals that are moderately realistic in task-involvement conditions and very difficult or very easy in ego-involvement conditions (Dweck & Elliot, 1983; Dweck & Leggett, 1988; Nicholls, 1984, 1989). It is equally probable that they anticipate important metabolic expenditures to attain such goals.
At the same time, the subjects stated that they made less effort when they were given a positive feed-back and made higher levels of effort when they received a negative feed-back in an implication of ego situation. We know that in self-threating condition, subjects subsequently reduce their effort in view of explaining their future failure as a handicap (Jagacinski & Nicholls,1990; Pysczzcynski & Greenberg,1983; Thill,1993). In the same way, being given incompetence feedback in a ego-involvement condition is experienced as a threat against self-esteem.

CONCLUSION

In the mental imagery phase, all significant muscular activity is due to a mechanical action. In the absence of force production, even with the creation of an image, the muscle produces no activity. The potential of a subliminal muscular activity would be the real action in weak proportions but mechanically not significant for the chosen movement. These results are in agreement with a second experiment carried out in 1995 in which a force platform was used in order to observe the subject center of pressure displacement during the real and imaginery phases. The benefits of the mental repetition are here considered according to a symbolic perspective, and emphasize the cognitive components of the mental repetition, in other words, the individual imagined the activity to be accomplished. This is a matter of purely cognitive process. If a muscular activity is visible, the individual has gone from the stage of an intention of movement to his effective achievement, this change would come from the representation of the activity that the subject creates himself.
We may conclude that measurements made with biomecanichal devices can be very useful to check psychological hypotheses in sport.

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