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INFLUENCE OF AN ADDED PERCEPTUAL MOTOR TASK ON PERCEIVED EXERTION: A TEST OF THE DISSOCIATION EFFECT [1]

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Summary.—This experiment showed that adding a perceptual motor task to an effort session on a cycloergometer for 4 men and 4 women led to an increase in perceived exertion. This effect is opposite to the dissociative effect classically reported in the literature. These contrasting results are analyzed according to the rate of processing imposed by the added task.

Most of the research on perceived exertion has studied simple tasks demanding high energy input such as walking, running, and pedalling (e.g., Borg, Van den Burg, Hassmen, Kaijser, & Tanaka, 1987). Nevertheless, in many sports subjects must simultaneously provide an intense effort and process information to adjust their behavior to the demands of the situation. The goal of this experiment was to study the influence of information processing on perceived exertion.

In a previous study using treadmill running tasks (Delignières, Legros, & Famose, 1991), we showed that, at the same work intensity, subjects perceived lower exertion in self-paced running than in a task in which they had to follow targets irregularly placed on the treadmill. This seemed to indicate that added information processing led to an increase in perceived exertion. This result was surprising as much research showed that the realization of a strictly mental task (mental calculation, counting) during a physical exercise led to a decrease in perceived exertion (Rejeski, 1985). Similar results have been obtained by playing music to subjects or by showing them a movie during exercise. It is generally considered that this so-called dissociation effect is due to the fact that the subject's attention is diverted from signals and other information relevant to effort.

Nevertheless, this first result does not permit us to come to a definite conclusion as the increase in perceived exertion could be attributed in this experiment to a deterioration of the running pattern efficiency and to the increase of local effort factors. To go beyond this experimental bias, we carried out an experiment dissociating the cognitive task from the energy-input task. We supposed that the performance of a choice reaction-time task would lead to an increase in perceived exertion on a simultaneously performed pedalling task. Nevertheless, we noticed (Brisswalter, 1992) that performance on a choice reaction-time task led to an increase in heart rate whether this task

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was performed alone or in association with an energy-input task. Our goal was also to see if this increase in heart rate could explain the increase in perceived exertion.

METHOD

Subjects

Four men and four women whose mean age was 17.8 yr. (± 0.7) were involved in the experiment. Maximal oxygen uptake was individually determined in a preliminary graded VO_{2max} protocol conducted on a cycloergometer at 60 rpm to volitional exhaustion: after a warm-up of 10 minutes at 75 watts mechanical power was increased by adjusting the resistance load (25 watts) every 1 min. until exhaustion. This exhaustion was determined when a plateau in VO_2 was reached with a maximal heart rate, a respiratory ratio above 1.1, and a blood lactate above 8 $mmol/l^{-1}$ (Lacour & Flandrois, 1977). The men and women were homogeneous in their maximum oxygen uptake (men: 60.2 $ml/kg^{-1} \cdot min.^{-1}$, $SD = 3.9$; women: 42.2 $ml/kg^{-1} \cdot min.^{-1}$, $SD = 3.9$).

Experimental Device

The pedalling task was performed on a cycloergometer *Ergomeca*. Work load was increased by increments both in pedalling frequency and in resistance. To provide subjects feedback regarding pedalling rate, a screen displaying the number of revolutions per minute was positioned in front of them. The experimental device could be adapted to the morphology of each subject with the aim of maximal standardization of the test.

The reaction-time task was performed on a computer connected with two joysticks held ahead of the ergometer handlebar. The subject placed his forearms on special supports held ahead of the handlebar. Subjects had to respond to signals appearing on the screen by tilting the appropriate joystick in the appropriate direction. Four empty squares were horizontally aligned on the screen, drawn in yellow on blue. The subjects had to respond when one of the squares became filled with red. The subjects responded to the two left signals by tilting the left joystick to the left or the right and conversely for the two right signals and the right joystick. The four signals were randomly presented and each signal appeared 1200 msec. after the preceding response.

Procedure

Subjects successively performed four exercise stages of four minutes. The work load of each stage was a percentage of individual maximal aerobic power, respectively, 20, 40, 60, and 80%. For each work load, pedalling frequency was chosen as the optimal energetic frequency determined for one work load and one level of physical fitness (Gregor & Broker, 1991). The duration of the pause between successive exercise stages was determined on the basis of the subject's heart rate so that a new stage was started when the resting level was reached. In the last minute of each stage after stabilization of heart rate, subjects performed 30 successive trials on the reaction-time task. Heart rate was recorded continuously. Perceived exertion was assessed according to the scale, Rating of Perceived Exertion (Borg, 1970), before and just at the end of the reaction-time task. Subjects were asked to rate exclusively their physical exertion without consideration of the added task. They did not have to provide any subjective rating concerning this additional task of RT.

Analyses

Two-factor analyses of variance (effort × task) with repeated measurements on both factors were performed using ratings of perceived exertion and heart rate as dependent variables. With the aim of eliminating the effect of the activation induced by the reaction-time task, a third analysis was performed using as the dependent variable the residuals of the global regression of perceived effort by heart rate.

Results and Discussion

Means are reported in Table 1. The analysis of variance showed an effect of the intensity of effort ($F_{3,21} = 58.33$, $p < .001$) and an effect of the added task ($F_{1,7} = 58.50$, $p < .001$) on perceived exertion. There was no interaction ($F_{3,21} = 2.95$). Similar results were obtained when using heart rate as dependent variable (effort: $F_{3,21} = 194.29$, $p < .001$; task: $F_{1,7} = 140.48$, $p < .001$; interaction: $F_{3,21} = .79$). When using as the dependent variable the residuals of the global regression of perceived effort by heart rate, the effect of effort disappeared ($F_{3,21} = .26$). Nevertheless it remained a significant effect of the added task ($F_{1,7} = 6.85$, $p < .05$).

TABLE 1
Perceived Exertion and Heart Rate According to Intensity of Pedalling Task and Experimental Conditions

Measure	Percentage of Maximal Aerobic Power							
	20%		40%		60%		80%	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Perceived Exertion								
Effort Alone	7.50	1.41	11.00	1.85	14.00	1.60	16.13	1.81
Effort + RT	8.75	1.98	12.75	1.28	15.88	2.17	19.00	1.41
Heart Rate								
Effort Alone	106.75	4.95	127.62	4.03	149.63	6.48	164.38	5.90
Effort + RT	114.75	6.65	133.75	4.13	157.13	6.49	171.50	3.51

These results show that the realization of an added cognitive task led to an increase in perceived exertion on a simultaneous high-energy task. This increase cannot be totally explained by the increase in physiological activation related to the realization of the cognitive task. These results confirm those obtained in our previous work (Delignières, *et al.*, 1991). Further, the effect of the added task is independent of the objective level of exertion provided so we suppose that it could consist of a general disposition to be more sensitive to effort.

As previously mentioned, most studies showed that added information processing led to a decrease in perceived exertion. Adding a perceptual motor task does not seem to lead to this dissociation effect but to the inverse. We suppose that these contrasting results could be explained not by the nature of the information processes required but by the rate of processing imposed. Generally, dissociative tasks were self-paced, e.g., mental calculation, or did not require unavoidable processing, e.g., hearing music. On the contrary, our protocols induced externally paced processing or high requirements of speediness. We can suppose that these specific demands generate an informational stress which makes subjects more sensitive to effort. Further work is necessary to validate this hypothesis.

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