

Mental fatigue can affect physical endurance

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When participants performed a mentally fatiguing task prior to a difficult exercise test, they reached exhaustion more quickly than when they did the same exercise when mentally rested, a new study finds.

The study also found that mental fatigue did not cause the heart or muscles to perform any differently. Instead, our "perceived effort" determines when we reach exhaustion. The researchers said the next step is to look at the brain to find out exactly why people with mental fatigue perceive exercise to be more difficult.

Samuele M. Marcora, Walter Staiano and Victoria Manning of Bangor University, Wales, the United Kingdom, did the study, "Mental fatigue impairs physical performance in humans." The study will appear in the March print edition of the *Journal of Applied Physiology*. The American Physiological Society published the study.

The study

The 16 participants rode a stationary bicycle to exhaustion under two conditions: once when they were mentally fatigued and once when they were mentally rested. The trials took place in the laboratory on different days. The participants got the same amount of sleep, drank the same amount and had the same meal before each of the sessions.

The mental fatigue sessions began with a challenging 90-minute mental task that required close attention, memory, quick reaction and an ability to inhibit a response. After undergoing this session, participants reported

being tired and lacking energy. The control session consisted of watching neutral documentaries for 90 minutes and was not mentally fatiguing.

After each of the 90-minute sessions - mentally fatiguing or non-fatiguing - the participants did an intense bout of exercise on a stationary bicycle. They rode until exhaustion, defined as the point when they could not maintain a cadence of at least 60 revolutions per minute for more than five seconds.

Throughout both exercise sessions, the researchers tracked a variety of physiological measures, such as oxygen consumption, heart rate, cardiac output, blood pressure, ventilation, and blood lactate levels. The participants completed surveys to measure their motivation and perceived effort. The researchers offered monetary prizes for the best performance on the exercise and mental tasks as a way to keep motivation high.

Results

- The participants stopped exercising 15% earlier, on average, when they were mentally fatigued.
- The participants stopped at the same perceived effort level in both the fatigued and non-fatigued trial. However, mentally fatigued participants started at a higher level of perceived effort and reached the endpoint sooner.
- The cardio-respiratory and musculo-energetic measurements did not vary between the two trials when compared at specific points in time. However, because the non-fatigued trials went longer, heart rate and blood lactate levels were higher at the end of those trials.
- Motivation was the same in both trials and was not a factor.

The researchers speculate that the perception of effort occurs in the brain. Dr. Marcora said his team is considering two possibilities:

- mental fatigue lowers the brain's inhibition against quitting, or
- mentally fatigue affects dopamine, a brain chemical that plays a role in motivation and effort

One interesting note is that demanding mental tasks activate the anterior cingulate cortex of the brain. Previous research has shown that rats with a lesion in the anterior cingulate cortex would not work as hard for a reward compared to rats with no lesion. This area of the brain may be where perception of effort originates, Dr. Marcora said.

Applying the results

This research could provide a way to study chronic fatigue syndrome, Dr. Marcora said. People with chronic fatigue report they lack energy and experience "brain fog," just like the mentally fatigued participants in this study. In addition, as in this study, people with chronic fatigue perceive exercise to be more difficult despite physiological responses considered normal during exercise.

The research model may also be helpful for military personnel. They do physically demanding tasks after long period of vigilance. Vigilance produces mental fatigue.

Finally, the study suggests that people doing high intensity training, such as competitive athletes, should do their training while mentally rested. However, people who exercise after work should continue doing so, even if mentally fatigued. Most people work out at a moderate intensity, which still gives plenty of physiological and psychological benefit, including relief from stress and improved mental performance.

Source: American Physiological Society

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