



Does mental fatigue affect physical performance?

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Will an athlete perform at their highest level if they have experienced mental fatigue beforehand? Until recently, research seemed to conclude otherwise. However, recent studies challenge the idea that mental fatigue affects subsequent physical performance. Alongside the poor replicability of one of the most cited studies in the field, two review and meta-analytical studies indicate the lack of statistical power in previous studies along with significant publication bias. Therefore, as of today, the evidence does not allow us to conclude that mental fatigue negatively affects physical performance.

Imagine two professional cyclists, both of whom are also pursuing university studies. One of them considers it important not to be mentally fatigued to complete a demanding training session, so she avoids them after an exam. The other one does not pay attention to this factor, so she goes out to train after completing an exam. Who will perform better in the subsequent training? It is very likely that the reader would lean towards the first cyclist, assuming that an exam generates mental fatigue, negatively impacting physical performance. This is the predominant hypothesis in the field of sports science. However, what does the empirical evidence tell us?



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Many studies have addressed this question, with the work of Marcora and his colleagues (2009) being one of the most cited. Marcora and colleagues subjected 16 participants to two different situations. In one, they completed 90 minutes of a highly demanding task in terms of working memory and inhibitory control. Immediately afterwards, they had to pedal to exhaustion at an intensity corresponding to 80% of their maximum performance. In the other situation, they watched a documentary for 90 minutes before performing the same physical test. Participants reached physical exhaustion sooner and perceived greater physical effort after the demanding task than after the documentary. These results have been subsequently corroborated both in empirical studies (e.g., Pageaux & Lepers, 2016) and meta-analyses (e.g., Giboin & Wolff, 2019).

The idea that mental fatigue prior to physical exertion leads to worse performance seemed well-established in the field until the publication of several studies from our lab in the last three years. Holgado et al. (2021), in a pre-registered study with a significantly larger sample size (30 participants), attempted to replicate the study by Marcora et al. (2009). Subjective data showed that participants reported being more mentally fatigued after the demanding task than after watching the documentary. However, this did not translate into worse physical performance. Interestingly, participants spent more time cycling, on average, after the demanding task than after the documentary, contrary to the original study. A subsequent study (Holgado et al., 2023a), in which the difficulty level of the cognitive task was adjusted to each participant's capacity, also showed null results. Finally, two meta-analytic works (Holgado et al., 2020; Holgado et al., 2023b) have pointed out two problems in the literature: the low statistical power of the studies and publication bias (the tendency to publish only significant results, not studies with null results). When corrected for publication bias, the effects on physical performance and perception of effort were reduced to the point of no longer being statistically detectable. Does this demonstrate that being mentally fatigued does not influence physical performance? No. But it demonstrates that, with the current evidence, it cannot be concluded that it does.

There are several relevant issues when evaluating the previous literature. First, the effect may be real but smaller than thought, so previous studies may not have had enough statistical power to capture it, which, along with publication bias, has led to the current landscape in the literature. If this is the case, one might wonder if such a small effect would have practical relevance (Román-Caballero et al., 2023). Second, the tasks used in these studies may not produce enough mental fatigue to affect physical performance. It is possible that, rather than causing fatigue, laboratory tasks generate boredom and fatigue. Third, and in line with the above, it is plausible that switching from a cognitive task to a physical task increases a person's motivation, counteracting the potential negative effects of previous cognitive performance.

Addressing these issues in properly designed and well-powered studies, and avoiding publication bias, will help resolve the question of whether it is better to avoid situations that generate mental fatigue before engaging in demanding training or competition when one aims to perform optimally.

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