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The interactions of exercise intensity, modality, and duration on concurrent executive function performance among highly trained athletes

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INTRODUCTION:
High-intensity exercise is often associated with decreases in concurrent executive functioning (EF) performance, but it's less clear if this also applies to athletes whose sport requires EF under intense physical loads. Furthermore, little is known about EF during high-intensity interval exercise or about how exercise duration may interact with intensity. This study aimed to assess the effects of exercise intensity and modality on EF, and to explore temporal patterns of EF during exercise. We predicted that athletes would maintain performance across conditions, and that within conditions, performance would decrease over time.
METHODS:
Six female (22.91±4.68 y) and 12 male (20.10±1.55 y) water polo players performed a 4-colour Stroop task during three cycling exercise conditions: constant-load moderate intensity (60% of maximal aerobic power [MAP]; CL60), constant-load high intensity (80% of MAP; CL80), and high-intensity interval (alternating 110% and 50% of MAP; HIIE). Conditions were work-matched, with exercise durations of 8 min 16 s (CL60) or 6 min 12 s (CL80 and HIIE). The Stroop task consisted of colour-naming trials; incongruent trials, which required participants to press the button of the same colour as the font; and switch trials, where participants instead had to identify the colour spelled by the word. Friedman tests for each trial type compared accuracy between conditions, and a linear mixed model was used to compare reaction time (RT) based on Condition and Trial type. To explore the effects of exercise duration on EF, in each condition, Stroop performance was divided into early, middle, and late thirds, and a second linear mixed model including Condition, Trial type, and Thirds as fixed effects was conducted for RT.
RESULTS:
While there was no difference in accuracy between the conditions, RT was faster in CL60 compared to HIIE (diff=38.27 ms, $p<0.01$). There was no difference between the CL80 and HIIE conditions. RT for switch trials was slower than for both incongruent (diff=67.7 ms, $p<0.0001$) and naming (diff=249.5 ms, $p<0.0001$) trials, and incongruent trials were slower than naming trials (diff=181.8 ms, $p<0.0001$). The model considering exercise duration revealed interactions of Third with Condition ($p<0.001$) and Trial type ($p=0.02$). Stroop performance decreased in CL80 and HIIE – but not CL60 – after the first third. Consequently, though RT was similar across conditions in the first third, it was worse during CL80 and HIIE compared to CL60 during the middle and/or late thirds. Moreover, in all conditions, switch trial RT was slower during the late compared to the early third (diff=50.23 ms, $p=0.005$).
CONCLUSION:
Our study suggests that high-level athletes also experience impairments to EF during high-intensity exercise, be it constant load or in intervals. Critically, it seemed that performance was initially similar across conditions, degrading at high intensity as a function of exercise duration, as well as depending on the complexity of the task.

Topic: **Training and Testing**

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