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Active Voice: Aerobic Exercise Targets Specific Higher-order Brain Functions

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Viewpoints presented in SMB commentaries reflect opinions of the authors and do not necessarily reflect positions or policies of ACSM.

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Timothy B. Weng, B.S., is a Ph.D. student in the Department of Psychological and Brain Sciences at the University of Iowa. His research investigates acute changes in brain and cognitive function following a single session of exercise. He applies this methodology to gain mechanistic insight into the beneficial effects of physical activity and aerobic exercise on brain health.

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This commentary presents Mr. Wengs and Dr. Voss views on the topic of a research project that they and their colleagues recently completed. Their research report appears in the July 2015 issue of Medicine & Science in Sports & Exercise (MSSE).

The benefits of physical activity and habitual aerobic exercise on cognitive function and brain health are becoming increasingly appreciated both by the scientific community and the general public. These findings stem from a growing body of epidemiological, cross-sectional and long-term intervention studies. Despite the abundance of encouraging scientific evidence, guidelines for establishing public health recommendations remain unclear due to a lack of knowledge regarding the exact mechanisms through which exercise benefits brain function. Furthermore, a concern arising from these studies is the difficulty of discerning the unique brain benefits of physical exercise, as distinguished from those associated with changes in other lifestyle factors, such as dietary and sleep habits.

In our study, reported in the July 2015 issue of *MSSE*, we sought to contribute to knowledge on these issues by investigating the acute effects of aerobic exercise on cognitive performance. We reasoned that such acute effects might reflect transient changes that, over time, contribute to more stable adaptations that result from long-term exercise training. Previous research indicates that executive functions are more sensitive to acute moderate-intensity aerobic exercise than are other cognitive processes. However, executive functions are comprised of multiple processes, and advancing mechanistic knowledge requires clarifying whether these are differentially affected by an aerobic exercise bout. Therefore, we tested the specificity of the acute effects of moderate intensity aerobic exercise on two tasks that engage theoretically distinct components of executive function. In our sample of healthy young adults, we found that 30 minutes of stationary aerobic cycling improved their ability to mentally store and update multiple features of information (i.e., working memory). Although we found that their working memory accuracy improved by ~6.4 percent, there were no significant changes in their ability to exert control over irrelevant information (i.e., inhibitory control). Furthermore, no changes in either task occurred when the same participants completed a passive exercise control condition in which their legs were moved by motorized pedals on the same bike and at the same cadence as in the aerobic condition.

We interpret these findings as evidence that, in healthy young adults, moderate-intensity aerobic exercise affects some specific brain systems more than others. Based on our findings, we suggest that actively engaging the musculoskeletal and cardiovascular systems at a moderate intensity, rather than moving passively, affects brain systems involved in working memory processes. In our study, we observed this specificity in the acute phase after one exercise session. Future investigations that combine acute and chronic exercise paradigms within the same individuals may provide insight into how the specificity of acute effects contributes to long-term adaptations that accumulate with subsequent training. We hope that our findings also encourage others to consider a within-

subjects acute exercise paradigm that controls for muscle movement as a method to systematically evaluate which exercise parameters maximize outcomes on a variety of brain and cognitive measures. Ultimately, we anticipate that advancing such knowledge will accelerate the establishment of evidence-based exercise recommendations for improving cognitive and brain health.