

太极拳对大学生执行功能及脑功能网络可塑性的影响：来自图论分析的证据

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摘要：目的：执行功能是对其他认知过程进行控制和调节的高级认知过程，是个体认知和社会功能的核心，对个体的身心脑健康发展至关重要，包含抑制、刷新、转换三个子功能。研究发现，执行功能在个体的整个生命周期都是可塑的，探索能够提升执行功能的有效手段已经成为多学科领域研究者关注的前沿热点。太极拳是东方正念运动的代表，已有研究发现太极拳可以改善记忆等认知功能，然而以往的太极拳套路存在门槛过高，动作结构复杂等问题，不便于推广普及，为了使更多人受益，国家体育总局委托研究团队创编了更简单易学的太极（八法五步）套路。那么，太极（八法五步）是否能提升执行功能，且效果是否优于其他运动，其机制如何，均值得深入探讨。**方法：**本团队以大学生为对象，综合运用了体育测量、心理测量、多模态成像技术（sMRI、rs-fMRI、task-fMRI、DTI、EEG、ERP），从行为学和脑科学层面，分析、比较了8周太极（八法五步）与健步走运动干预前后执行功能、脑结构、脑功能及相关心理学指标（如情绪、睡眠等）的变化及差异，旨在揭示太极（八法五步）对大学生执行功能各子功能的影响及机制，为采用太极（八法五步）提升大学生身心脑提供理论和实践基础。**结论：**本研究从图论分析的角度，探究太极（八法五步）对大学生执行功能的影响及其脑网络机制，发现：（1）8周太极（八法五步）能够提升大学生的执行功能各子功能，且效果优于健步走；（2）太极（八法五步）能够促进脑网络功能分离水平的提升，增强脑功能网络局部信息传输效率；（3）太极（八法五步）改善执行功能的脑机制可能是功能网络的重组优化。

关键词：太极（八法五步）；执行功能；功能网络；功能性磁共振；大学生

The effect of Tai Chi Chuan exercise on executive function and brain functional network plasticity in college students: A graph theory based study

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Abstract: Executive function (EF), as a higher cognitive process controlling and regulating other cognitive processes, is the core of individual cognitive and social functions. It consists of three foundational components: inhibition, updating, and shifting. Studies found that EF could be changed throughout the life cycle. Therefore,

exploring effective ways to improve EF has become a focus of researchers in multiple disciplines. Tai Chi Chuan (TCC, also known as Taiji, Taijiquan, and Tai Ji Quan) is a popular mind-body exercise and a form of traditional Chinese exercise. The benefits of TCC have been widely reported for cognitive function, emotional regulation, motor function, and fall prevention. Bafa Wubu of Tai Chi (BWTC) is based on the existing 24-form TCC, refined and organized systematically from the Bafa Wubu techniques, which are the essence of various types of TCC. It is a new set of TCC that is easy to learn and practice and is now being popularized in China by the General Administration of Sport of China (GASC). Therefore, whether BWTC intervention can improve the EF of college students, and whether the effect is better than other general exercise, and how its mechanism is worth to explore. **Methods:** Our team used physical, psychological and multimodal imaging measurement (such as sMRI、rs-fMRI、task-fMRI、DTI、EEG、ERP) to explore the 8-week BWTC intervention on the EF, brain structure and functional plasticity, and other psychological indicators. Revealing the mechanism of BWTC to enhancement on EF in college students, which can provide theoretical and practical basis for the use of more effective exercise to promote the development of college students' EF. **Conclusion:** This study based on graph theory, revealing the brain mechanism of BWTC to enhancement on EF in college students, found that: (1) 8-week BWTC could improve the EF of college students, and the effect is better than brisk walking. (2) 8-week BWTC could promote the level of brain functional segregation, and enhance the efficiency of local information transmission of functional network. (3) The neural mechanism of BWTC to improve executive function may be the remodeling of the recombination and optimization of brain functional network.

Keywords: Bafa Wubu of Tai Chi, Executive function, Functional networks, fMRI, College students