

## Short-Term Meditation Intervention Improves Self-Regulation and Academic Performance

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### Abstract

**Background:** Research has found that improved higher effortful control, a measure of self-regulation, improves performance of middle school students. Integrative body-mind training (IBMT) has been shown to improve attentional networks related to self-regulation. We hypothesize that an IBMT intervention will improve academic performance of adolescents.

**Methods:** Students age 13-18 were recruited from middle and high school in Beijing, China and randomly assigned to either IBMT or a relaxation training control (RT). Students were given 6 weeks of IBMT intervention with 30 min per day at school. The improved performance in attention and aspects of academic performance were measured.

**Results:** Compared to RT, IBMT intervention showed significantly greater improvement in attention and in academic performance (scores of literacy, math, and second language).

**Conclusions:** Brief mindfulness meditation is an effective technique for improving cognitive function, including academic performance.

### Introduction

Improved self-regulation and attention appear to have a beneficial effect on learning of school subjects such as literacy and numeracy [1, 2]. In one study higher self-regulation in self-reported temperament scales was associated with better school performance in many participants, while better performance on the executive attention network was related to improved mathematics performance in particular [2]. A 5 days of meditation intervention - the integrative body-mind training (IBMT) improved executive attention which in turn is correlated with self-control. However, there is no present evidence that brief meditation training improves academic performance in school.

### Methods

Two hundreds and eight students ( $15.5 \pm 0.58$  years old) participated this study and were randomly assigned into IBMT and RT groups (104 each group). They received a 6 weeks of IBMT or RT intervention (20 min per day from Monday to Friday, total is 10 hours) during school lunch break prior to their yearly final examinations. The IBMT intervention involves body relaxation, mental imagery, and mindfulness training. The IBMT method stresses making no effort, or less effort, to control one's thoughts and promotes a state of restful alertness that allows a high degree of awareness of one's body, breathing, mind, and of external instructions. RT involves the relaxing

of different muscle groups over the face, head, shoulders, arms, legs, chest, back, and abdomen. With eyes closed and in a sequential pattern, one is forced to concentrate on the sensation of relaxation, such as the feelings of warmth and heaviness [4,5].

Self-regulation involves the important components of attention control and emotion regulation. We measured the efficiency of three attentional components using Attention Network Test (ANT); the mood state using the Profile of Mood States (POMS); the intelligence scores using the Raven's standard progressive matrix, and the self-reported stress using perceived stress scale (PSS). All of these are frequently used measures of performance or subjective experience [4,5,7]. The school provided information of the official grades obtained at the end of the academic year by each student. Academic performance grades were obtained for Literacy (Chinese), Mathematics and Second language (English). The study was approved by a local Institutional Review Board, and informed consent was obtained from each participant.

### Results

Before training, two groups of IBMT and RT did not show any significant difference in all the assays and grade scores (all  $P > 0.05$ ). After training, we conducted t-tests to examine the main effect of ANT, Raven's Matrices, POMS, PSS in behavioral and grade data between IBMT and RT groups. We found 10 hours of IBMT significantly

improved both executive and alerting attention ( $P < 0.01$ ), indicating the greater self-control and sustained attention ability. However, orienting attention was only marginally significant following IBMT ( $P = 0.078$ ). The same amount of RT also improved all attention efficiency but did not show significances ( $P > 0.05$ ). We also tested whether intelligence improved after training. Paired *t* tests before and after training showed a significant improvement in Raven scores ( $P < 0.001$ ) indicating that short-term IBMT can improve the Raven's score. No significant improvement followed RT was detected.

Because the efficiency of executive attention improved, we expected better self-regulation of emotion. After training, there were significant differences in the IBMT group (but not the RT group) in the POMS scales: anger–hostility (A), depression–dejection (D), and F (fatigue–inertia), tension–anxiety (T), and vigor–activity (V) (all  $P < 0.01$ ). The result indicated that short-term IBMT can enhance positive moods and reduce negative ones. Meanwhile, Perceived Stress Scale (PSS) also favored IBMT group (not RT group) after training ( $P < 0.01$ ). The academic achievement indexed by the final mean of grades of Literacy, Mathematics and Second language (English) was also significantly improved following IBMT intervention ( $P < 0.05$ ). After training, we also conducted *t*-test to examine the behavioral and grade changes between two groups, and found significance in IBMT group compared to RT group (all  $P < 0.05$ ).

## Discussion

Attention control and emotion regulation are important components of self-regulation. In our previous work, 5 days of IBMT (~2 hours) significantly improved the executive attention of ANT, emotion in POMS and marginally significantly improved Raven scores [4]. In the present study, we used diverse assays including ANT, POMS, Raven's Matrix and PSS to measure self-regulation ability and found that 10 hours of IBMT intervention can improve attention, emotion and Raven scores. Meanwhile, we also the improvement in the academic performance in scores of literacy, math and second language learning.

Studies have shown that attention is crucial for the storage and retrieval of memories, and individual differences in self-regulation make a major difference in school and in life outcomes [1,6]. Multiple studies have shown that explicit learning (e.g., memorizing for recall) has the goal of learning material so that it can be brought to mind consciously, and being attentive at the time of learning is crucial for many aspects of school learning [1]. Learning literacy, math and second language requires attention heavily to memorize the subject contents and reasoning relationship, and also needs self-regulation to maintain better positive emotion and less stress for optimal learning environment. The improved attention and emotion following IBMT intervention may support the effective learning at school and thus lead to better academic achievement in the subject test scores [1,2,5].

Further, improving self-regulation also has a broad impact on learning difficulty and mental disorders. For example, self-regulation deficits are often related to attention deficit hyperactivity disorder, mood diseases, school failure, addiction and antisocial behavior [6,7]. In this study we found improved IQ following IBMT after 10 hours of training, in our previous work we had not found significant IQ changes for young adults after ~2 hours of training. Whether this difference is due to the length of training or the age of the participants remains for future study.

The current results with the ANT indicated that 10 hours of IBMT improves functioning of both executive and alerting attention network whereas ~2 hours IBMT only improved executive attention, indicating the time-course of IBMT practice [4,5]. Although our study did not examine brain activity, previous work suggests that executive attention is an important mechanism for self-regulation of cognition and emotion [1,4,5]. Studies designed to improve executive attention have found an important node of the executive attention network in the anterior cingulate gyrus [2,7,8]. We speculate that the activation or/and connectivity of this self-regulation network following IBMT is an important neural mechanism supporting these behavioral and grade changes. Future research should explore the relationship between training length and improvement of learning school subjects, the lasting effects of training and generalization of school subjects.

It should be noted that although the current study observed improvement in attention and self-regulation as well as better academic performance, we could not conclude that academic performance has been improved via an improvement in attention and self-regulation. Further casual modeling methods should be conducted to demonstrate this relationship.

## Conclusions

Our results suggest that brief mindfulness meditation is an effective intervention for improving attention, emotion and academic performance.

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